

## Formation of the future engineering chemical elite in lyceums for gifted adolescents at universities

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**Abstract.** It sets out innovations in formation of the future chemical engineering elite in the lyceums for gifted teenagers created at universities. Such as Small Chemical Institute, professorial lectures, professorial schools, professorial mentoring, regular trips to the enterprises of petrochemical complex of Tatarstan, the scientific community lyceum students. The results of additional education in chemistry are presented in the form of convincing victories lyceum students at the various olympiads and conferences.

Tatarstan is one of the leading regions of Russia for oil production and refining. At the same time, there is a shortage of qualified engineering personnel in the industry, capable of solving complex problems of renewable energy [1], recycling industrial waste [2], system analysis of the energy complex of enterprises [3] and others. At the same time in the Republic of Tatarstan there are a lot of gifted children, capable of innovations and new scientific discoveries. Selection, education and development of gifted students in the process of general education is no less important task than their further educational trajectory in the university.

The above indicated was a prerequisite for the opening of the IT-Lyceum and the Lyceum. N.I. Lobachevsky at the Kazan (Volga region) Federal University (KFU) and the boarding school for gifted children. academician P.A. Kirpichnikova with in-depth study of chemistry at the Kazan National Research Technological University (KNITU).

IT-lyceum with KFU was opened on September 1, 2012. Training is conducted from the 7th grade. Individual selection on a competitive basis in three phases: distance testing (on-line), intramural stage (control work on the Russian language, mathematics, logic and core subjects), interview, taking into account students' portfolio. Lyceum is a structural subdivision of KFU, it is a resonant, unique educational institution not only in Russia, but also in the world. Teachers work professionally in modern Singapore and European methods, attaching students to analyze the contradictions and formulation of problems, explanation of natural phenomena (details in [4], [5]).

Despite the fact that the basic discipline of high school students - informatics, the guys have shown great interest in both the robotics and chemistry, after school is visited Small Chemical Institute at the Chemical Institute. A.M. Butlerov KFU (for more details on the forms of work with gifted adolescents in [6]).



Small Chemical Institute - an innovative pilot project for gifted in the field of chemistry students, including four additional educational programs "Chemistry-8", "Chemistry-9", "Chemistry-10", "Chemistry-11" (each 72 hour program) was launched in Kazan (Volga region) Federal University in 2013. Enrollment is held on the advice of teachers of chemistry and the results of the entrance testing. Structurally, the Small Chemical Institute includes a club of young chemists, preparation for the passing of a unified state examination, olympiads, project activities of students at the departments of the Kh. A.M. Butlerov KFU (for details see [6]).

In the 2013/2014 school. 8 students of the IT-Lyceum attended the Small Chemical Institute, in 2014/2015 - 16, and in 2015/2016 school. 20 IT-lyceum students were involved in chemistry, in 2016/2017 - 26, and in 2017/2018 - 39 lyceum students. The number of students attending the Small Chemical Institute of Lyceum students correlates well with the positive dynamics of the number of prize-winners of various stages of the All-Russian Chemistry Olympiad (Table 1).

For example, at the regional stage of the All-Russian Olympiad in chemistry, respectively, in 2014. The winners were 2 people, in 2015 - already 4, 2016 9 IT-school students became the winners of the regional stage of the All-Russian Olympiad on chemistry, and in 2017 it was already 10 winners and one winner.

Table 1.

Correlation between attending the Small Institute of Chemistry students of IT-Lyceum and the number of winners / winners of various stages of the All-Russian Olympiad in Chemistry

Stages of the All-Russian Olympiad in Chemistry	Number of students awarded IT-Lyceum at KFU							
	2013/2014		2014/2015		2015/2016		2016/2017	
	Prize-Winners	Winners	Prize-Winners	Winners	Prize-Winners	Winners	Prize-Winners	Winners
Municipal	4	0	12	0	15	1	16	1
Regional	2	0	4	0	9	0	10	1
Final	0	0	1	0	3	1	2	1
The number of lyceum students attending the Small Chemical Institute at the Chemical Institute. A.M. Butlerova								
	2013/2014		2014/2015		2015/2016		2016/2017	
	8 students		16 students		20 students		26 students	

In general, for four years in the IT-Lyceum, a creative chemistry team has been created, consisting of prize-winners of the All-Russian Olympiad, the Volga Interregional Olympiad, the Interregional Subject Olympiads of the KFU, the All-Siberian Open Olympiad, the Nobel Prize-KNITU competition.

Considering the long-term perspective of the formation of the engineering chemical elite of the Republic of Tatarstan, an interest is the organization of engineering classes at the Lyceum named after. N.I. Lobachevsky at the KFU and the chemical lyceum-boarding school at the Kazan National Research Technological University (KNITU). More details on the Lyceum-boarding school. P.A. Kirpichnikov. Its main task is the preparation of talented students for various engineering directions of the KNITU, the formation of the fundamentals of engineering thinking among the lyceum students (for details see [7]). This will allow the republic as a whole and the chemical industry enterprises to receive in the future highly qualified industrial engineers.

The methodological basis for constructing the content of instruction in the Lyceum is a comprehensive and system-activity approach. The peculiarity of the additional education of the lyceum students is conditioned by such innovative forms of activity as the professorial lecture hall, professorial schools, professorial supervision, regular excursions to the enterprises of the oil and gas chemical complex of Tatarstan, the scientific community.

The teaching staff of the Technological University directly participates in educational activities. The first half of the day students are trained according to the program provided by the State Federal Educational Standard. After lunch, lessons continue in the format of professorial schools, lectures and research activities within the scientific community of lyceum students.

Professor's lecture halls are lectures by professors working in different directions. The classes cover and discuss with the lyceum students a variety of fields of science, the latest trends.

Professorial schools are a systematized (most often weekly) course of lectures given by a teacher with subjects with rigidly set ultimate goals. There are seven such schools in the Lyceum, within the framework of which the lyceum students are trained in the olympiads in chemistry, physics and biology. Since January 2015, a program has started, suggesting the attendance of professorial lectures by schoolchildren of other educational institutions in the city of Kazan and Zelenodolsk municipal district of Tatarstan.

Professorial supervision provides for the focal registration of a lyceum student (or a small group of lyceum students of 2-3 people) for a specific university professor to perform scientific work with subsequent protection at contests and conferences. The best lyceum students are given credit books, where professors evaluate their knowledge, which is an additional stimulus to successful educational activity.

Excursions to the enterprises of the oil and gas chemical complex of Tatarstan have a pronounced practice-oriented direction, where the lyceum students freely communicate with the leading experts in the engineering field of knowledge.

Preparation for olympiads on the natural-science profile (chemistry, biology, geography, physics) passes systematically throughout the year and there is a positive dynamics of winners and winners of the Olympiads.

For example, according to the results of the 2013/2014 academic year, there were 10 winners at the All-Russian Olympiad for schoolchildren in natural science subjects, 5 of them winners, in the 2014/2015 academic year there were 22 winners and 9 winners.

Thus, the use of innovative forms of supplementary education in chemistry, such as the Small Chemical Institute for the IT Lyceum at the Kazan (Volga region) Federal University, professorial lectures, schools, curatorship, regular excursions to the enterprises of the oil and gas chemical complex of Tatarstan, the scientific community of lyceum students in the Lyceum. P.A. Kirpichnikov at KNITU, effectively increasing the motivation to study chemistry, contribute to the achievement of high results by students in Olympiads and research conferences of students at various levels and, most importantly, the formation of a future engineering chemical elite.

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