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Modern Russian Higher Education and the Role of Federal Subject Olympiads for Schoolchildren

O. N. Ryzhova and N. E. Kuz'menko

Lomonosov State Moscow University, Leninskie Gory, Moscow, 119991 Russia
e-mail: ron@phys.chem.msu.ru; nek@educ.chem.msu.ru

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Abstract—A discussion and comparison was presented for the current trajectories of gaining admission to a higher educational institution: the traditional entrance examinations combined with USE, high-level subject Olympiads for schoolchildren, and subject Olympiads for applicants, organized and conducted by universities. It was noted that, despite recent changes in the forms and methods of attracting students to higher education, the "geography" of students enrolled in the first year at the Chemistry Department, Lomonosov Moscow State University, does not significantly vary and remains fairly wide. The academic quality of the students admitted has been declining steadily. It was shown that the strategy of attracting students to the university through Olympiads is well justified. Under conditions of the ongoing modernization of the entire national education system, the combination of the three methods of selection of applicants allows the leading Russian universities to admit new students more effectively.

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The two subsystems which independently operate in parallel in the Russian system of higher professional education were discussed by us earlier [1, 2]. One of the subsystems is the so-called mass higher education which is accessible to any secondary school graduate (figuratively speaking, even to an "underachiever"). The other subsystem is the fundamental higher education which was vividly described by Academician V.A. Sadovnichii, Rector of the Lomonosov Moscow State University (MSU), as follows: "Meant by fundamentality of higher education is a combination of scientific knowledge with education process, which provides us with understanding of the fact that we all are living in accordance with the laws of nature and society and that ignoring these laws by an illiterate or unintelligent person is dangerous to others" [3].

By contrast to mass education, fundamental education is not accessible to every school graduate and can be provided by selected higher educational institutions solely. Among them, there are many Russian classical universities whose scientific capacity and human resources are still sufficiently high for providing high-quality fundamental education.

The degree program of the Chemistry Department, MSU, is designed for six years of study and includes disciplines which can be grouped into several "cycles:" chemical, physical, mathematical, and humanitarian. There are ten mandatory chemical disciplines (apart from special courses) against fourteen "physical" and twelve "mathematical" disciplines (see, e.g., [4]) in this degree program, which cannot be mastered by mediocre students. Hence, admission of a corpse of well-trained first-year students having high academic quality is an essential prerequisite to providing fundamental higher education.

The fulfillment of this task is complicated by a number of adverse factors: (1) steadily declining interest in fundamental natural-sciences education, which since recently has been recognized as a worldwide trend; (2) unfavorable demographic situation in Russia; and (3) changes introduced constanly (sometimes on the eve of the admission campaign) to the admission rules and to the list of entrance examinations at higher educational institutions. As a result, the forms and methods of attraction and selection of applicants by Russian higher education institutions have undergone radical changes over the past several years [2]. For example, in 2007, the applicants to the Chemistry Department, MSU, had to pass four traditional written exams, while in 2008 it

Table 1. "Geography" of the students enrolled at the Chemistry Department, MSU

Enrollment year	Total enrollment	Number of students from indicated region (per cent of the cohort size)			
		Moscow	Moscow oblast	other regions of Russia	CIS member-states and Bulgaria
2003	216	70 (32.4)	29 (13.4)	96 (44.4)	21 (9.7)
2004	215	74 (34.4)	26 (12.1)	96 (44.6)	19 (8.8)
2005	217	73 (33.6)	27 (12.4)	95 (43.8)	22 (10.2)
2006	216	71 (32.9)	28 (13.0)	102 (47.2)	15 (6.9)
2007	217	66 (30.4)	30 (13.8)	106 (48.8)	15 (6.9)
2008	237	71 (30.0)	32 (13.5)	121 (51.1)	14 (6.0)
2009	245	64 (26.1)	37 (15.1)	135 (55.1)	9 (3.4)
2010	243	61 (25.1)	42 (17.3)	129 (53.1)	11 (4.5)
2011	231	75 (32.5)	24 (10.4)	125 (54.1)	7 (3.0)

was necessary to present two Unified State Examination (USE) certificates (in mathematics and Russian language) and to pass three written exams in mathematics, chemistry, and physics. In 2009, applicants had to submit four USE certificates only, and in 2010 and 2011, to submit four USE certificates and to pass an additional written exam in chemistry.

It was declared that, though the above-described modification of the students' enrollment rules, the higher education programs offered by the most prestigious domestic universities will become more easily accessible to gifted and motivated school graduates from distant regions of Russia. In this connection, it seems important to track the recent trends in students' enrollment "geography" in a specific higher education institution, e.g., at the Chemistry Department, MSU (Table 1), and draw conclusions about the academic quality of the students admitted.

Despite the difficulties indicated[1], the regional composition of the Chemistry Department students traditionally remains very wide, and the first-year students' "geography," virtually unchanged over the recent years. Since 2008, the enrollment has increased by 20 students because of establishment of a new specialized group comprised mostly of students from "non-Moscow" regions of Russia. In 2011, among the Chemistry Department applicants there were representatives from 59 subjects of the Russian Federation, and among the students admitted, those from 51 subjects. It should be noted that the recent trend has been toward decrease in the number of applicants and students from CIS member-states whose young people are evidently changing to different priorities in which the focus is placed on entering major universities of the world.

The above-said suggests that the changes introduced into the admission mechanism and rules for higher education institutions did not affect the "geography" of the Chemistry Department students. Much credit for this wide "geography" goes to the ongoing systematic efforts towards this end, undertaken by the MSU. This concerns, in particular, schoolchildren contests (Olympiads) in various subjects, which invaluably contribute to the formation of a corps of high-quality applicants. These are All-Russian Schoolchildren Olympiad in chemistry and the International Mendeleev Chemistry Olympiad, as well as the "Conquer Sparrow Hills" and "Lomonosov" university Olympiads having a federal status. Along with promotion of chemical knowledge, these intellectual competitions aim at supporting talented young people not only from Moscow but also from other regions, and getting them involved into studying chemistry, and promoting chemistry as their career choice.

The Olympiad-based strategy of attracting students is working well in practice, as suggested by the first end-of-term evaluation exam scores gained in the

[1] It should also be noted that the admission of a large number (over 230) of first-year students by the Chemistry Department, MSU, constitutes another essential difficulty under current conditions.

Table 2. Academic progress indicators for the first-year students of the Chemistry Department, MSU, in the 2011/12 academic year

Student category	Number of students	Number (percentage) of excellent students in indicated category	Average point score for exam in indicated subject	
			inorganic chemistry	mathematical analysis
Winners and prize-winners of the All-Russia Schoolchildren Olympiad[a]	25	17 (68.0%)	4.83	4.7
Winners and prize-winners of the International Mendeleev Olympiad[a]	7	4 (57.1%)	4.67	4.5
Winners and prize-winners of other chemistry Olympiads included in the Registry[b]	56	15 (26.8%)	4.16	4.13
Students enrolled by the standard procedure	136	13 (9.5%)	3.68	3.92
First-year students' cohort as a whole	224	49 (21.9%)	3.95	4.07

[a] Winners and prize-winners were enrolled without passing entrance tests, out of competition. [b] Winners and prize-winners were granted different privileges in enrollment, depending on the Olympiad's rating in the Registry.

2011/12 academic year by the first-year students of the Chemistry Department, MSU, enrolled by different trajectories (Table 2). The fist end-of-term exams (in winter) were those in inorganic chemistry and mathematical analysis (by the start time of these exams, there were 224 first-year students at the Chemistry Department, MSU). Table 2 shows that the students enrolled by the Olympiad trajectory (Olympians) demonstrated the academic performance exceeding the average level for the cohort, being noticeably higher than that for their fellow-students enrolled by the traditional trajectory. These data are fully consistent with the results of the study undertaken by the Russian Rectors' Union [5, 6].

Though useful, important, and conforming with the ideas for modern education, a purely Olympiad-based trajectory of selection by no means represents the most common mechanism. The major mechanism of competitive selection to attract best-trained school graduates to MSU is still that based on additional entrance exam in chemistry, combined with USE scores, and on privileges granted to federal Olympiad winners and prize-winners.

Reduction in the number of academic hours assigned to natural sciences in secondary school curricula and universal application of the USE system is responsible for steadily declining academic background of school graduates [7], as clearly seen in the example of the first-year students admitted to the Chemistry Department. The difficulties in achieving mastery of mathematical analysis, analytical geometry, and physics courses, experienced by the first-year students, tend to increase from year to year. The number of the first-year students expelled from the Chemistry Department is substantial; it attained its maximum in the 2009/2010 academic year, when over 30 students (16%) were expelled for failure. In the previous years, when the enrollment to the Chemistry Department followed the traditional trajectory, as many students were expelled during the entire five-year study period. As already mentioned, 2009 was the only year in the Chemistry Department's history when the selection was based on the USE scores exclusively and no additional (internal) exam was conducted. In the subsequent 2010/2011 academic year, 12.6% first-year students were expelled. In the 2011/2012 academic year, 6.5% of the initial students' cohort was expelled for failure at the first end-of-term exams.

One way to get out of the current situation is via promotion of such mass events as schoolchildren Olympiads in different subjects, which beneficially affect the formation of high-quality students' corps, as noted above. This concerns primarily the All-Russia Schoolchildren Olympiad in Chemistry, the major mass competitive event of this kind with its intrinsic structural pattern and traditions [8]. In this connection, it makes sense to go back to the issue of granting privileges to winners and prize-winners of the regional stage of the All-Russia Olympiad.

Of much significance in this context are also Olympiads organized by higher education institutions, which were included in the Registry (to be approved

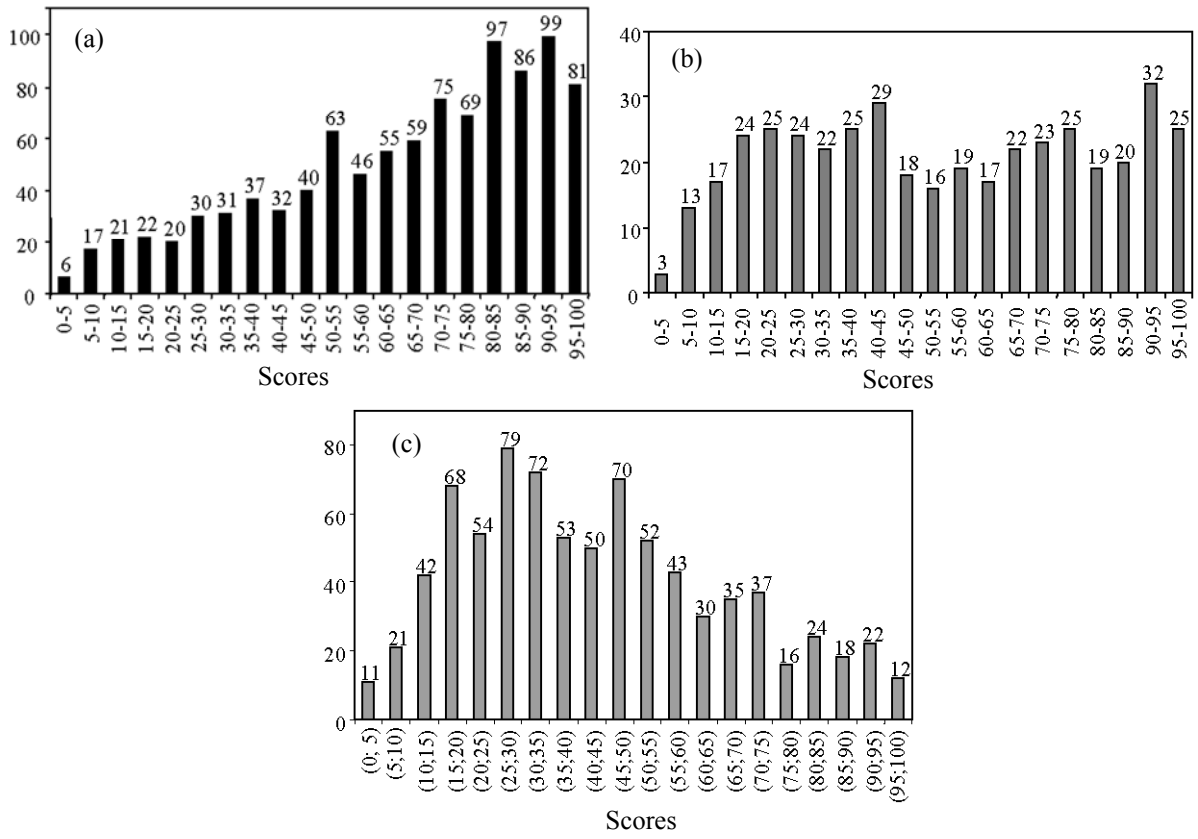

Fig. 1. Distribution pattern of the scores gained by the participants of the "Lomonosov" Olympiad in chemistry: (a) correspondence round, 2011, (b) on-site round, 2011, and (c) on-site round, 2010.

every year by the RF Ministry of Education and Science) and, thereby, acquired a Federal status two years ago. This means, in particular, that the "Lomonosov" Olympiad winner's and prize-winner's certificates are recognized by other higher educational institutions in Russia. However, higher status of any Olympiad inevitably entails greater formalization and regularization of the procedure and, consequently, the emergence of some negative aspects, as illustrated below by the example of the "Lomonosov" Olympiad in chemistry.

During the first five years of its history the "Lomonosov" Olympiad consisted of one, on-site, round; since 2011, this has been a two-stage intellectual competition (like other federal Olympiads) in which the winners and prize-winners of the first (selection) correspondence round are admitted to the second, on-site, round. In the last two years, about one thousand schoolchildren in their senior grades took part in the correspondence round of the Olympiad in chemistry. According to the appropriate regulations, no greater than 35% of the correspondence round participants can be invited to take part in the on-site round. Let us analyze the implications of this scheme.

Figures 1a and 1b show that, in 2011, the scores gained by the participants of the correspondence and on-site rounds of the "Lomonosov" Olympiad in chemistry exhibit clearly different distribution patterns. In the correspondence round, the maximum lies in the area of high and very high scores. This is an expected result, since the correspondence form of the Olympiad permits the use of school textbooks and reference books, Internet resources, and consultations with friends, teachers, and tutors.

Those schoolchildren whose score in the correspondence round was 82 and above were invited to participate in the on-site round. The distribution pattern of the scores in this round undoubtedly suggests that a significant proportion of the participants demonstrated poorer performance compared to the correspondence round: The number of low scores (below 40) is very large, and the proportion of participants who gained high and very high scores declined markedly. Among the on-site round partici-

pants, there were many schoolchildren who resorted to outside assistance in completing the correspondence round assignment, whereas participants who completed those assignments by themselves and got 70–80 scores could not take part in the on-site round, although they were potentially able to show good results. Our experience of organizing the "Lomonosov" Olympiad in chemistry and checking over its assignments suggests that the scheme in which selection via the correspondence round is combined with setting rigid quotas for admission to the on-site round does not contribute to finding well-trained and highly motivated schoolchildren. The correspondence round is largely turned into a tutors' or school teachers' contest. It is no secret that, for teachers, the participation and winning or prize-winning an Olympiad or a creative contest by their pupils are of much social and professional significance.

The requirement of deciding the winners and prize-winners of the correspondence round among the schoolchildren admitted to the on-site round (the infamous 35%!), posed by the appropriate regulations, seems to be absolutely incomprehensible and meaningless: Both categories enjoy equal rights to be admitted to the on-site round and receive no further bonuses.

For comparison, Fig. 1c presents the distribution pattern of the scores gained by the "Lomonosov" Olympiad participants in 2010, when the Olympiad consisted of one on-site round. It is seen that this distribution pattern is much closer to the optimum (the distribution maximum is shifted toward moderately low scores).

Thus, we can conclude that, at least at the MSU, three trajectories of gaining admission to university were formed, each having its unique features. These are national/international schoolchildren Olympiads, traditional entrance examinations combined with the USE scores, and schoolchildren Olympiads in different subjects, organized by higher educational institution. These trajectories are compared and analyzed below, with Olympiad in chemistry taken as an example.

High-Level Subject Olympiad for Schoolchildren (e.g., All-Russia Schoolchildren Olympiad in Chemistry or International Mendeleev Olympiad [8, 9]). This Olympiad pursues the goal of finding gifted schoolchildren, attracting schoolchildren to studying chemistry, promoting chemistry as their career choice, and popularizing chemical knowledge.

The Olympiad participants are schoolchildren in their respective year of the study (the All-Russia Schoolchildren Olympiad participants are offered different assignments depending on the year of study) or pupils in the year preceding graduation (Mendeleev Olympiad whose participants, regardless of age, get the same package of assignments). Both competitions are open to junior schoolchildren.

The Olympiad consists of several rounds, including an experimental round.

All participants are offered a single package of assignments (this concerns international Olympiads; at the All-Russia Olympiad there are different packages for pupils in different years of study).

The official score is individual; the absolute position in the overall final ranking is essential.

Ungraded participants are not identified, i.e., the minimal score below which participants are rated "unsatisfactory" is not determined; any Olympiad participant can get a score ranging from zero to a maximum.

Participants are offered creative assignments of advanced, "Olympiads," level, which goes beyond the scope of the chemistry course taught by ordinary schools and the program for university applicants. Often, the level of assignments corresponds to that of the university courses of chemical disciplines.

High-School Admission Test (written exam in chemistry, see, e.g., [2, 10]). This test pursues a very utilitarian goal of competitive selection of best-trained and easily trainable high-school entrants.

The contestants are school graduates of the current and previous years; pupils in the year preceding the graduation year and junior schoolchildren are now allowed to participate.

There is one on-site round; no experimental round is conducted.

The participants are offered several (four in the case of the MSU Olympiad in chemistry) equivalent versions of assignments (to prevent cheating), this being admissible for All-Russia and world-level Olympiads (likewise, competition at different distances is inadmissible for skiing race participants).

The assignments fit exactly the school course and the program for applicants of a specific higher educational institution.

Participants rated "unsatisfactory" are identified (e.g., those whose score was under 40 out of 100 at the additional summer exam in chemistry in 2011 at the MSU dropped out of the competition).

High-School Subject Olympiad for Schoolchildren (by the example of "Lomonosov" and "Conquer Sparrow Hills" Federal Olympiads; see [10, 11]).

The declared goal of this contest is to find most gifted schoolchildren and attract learners to studying chemistry, and the real goal, to select best-trained schoolchildren for a higher educational institution (thus, such Olympiads represent another "progressive" trajectory, supplementary to USE, which constitutes an alternative to USE in many respects).

The Olympiad participants include the graduation-year pupils of general education secondary schools; junior schoolchildren are also allowed to participate.

There are two, a correspondence and an on-site, rounds; no experimental round is conducted.

The correspondence round participants are offered a single variant of assignment, and the on-site round participants, depending on their number, may be offered several equivalent variants, like at an exam (two variants were offered at the "Lomonosov" Olympiads in 2011 and 2012), which scheme is inadmissible in principle for the All-Russia Schoolchildren Olympiad or Mendeleev Olympiad.

No individual official score is provided for participants; only the "winner" (no greater than 10% of participants) or "prize-winner" (no greater than 25% of participants) categories are essential.

Participants rated "unsatisfactory" are not identified; possible scores can range from zero to one hundred points.

The correspondence round participants are offered assignments of both the school course level and of advanced, "Olympiads," level. The on-site round assignments are based on the secondary school course of chemistry and the program for applicants to the higher educational institution organizing the Olympiad, but they contain one or two creative problems.

The comparative analysis performed in this study shows that high-school subject Olympiads for schoolchildren, which have been conducted since recently by various higher educational institutions, are the result of a synthesis of several genres. This is a kind of a positive centaur in which the features of traditional subject schoolchildren Olympiads are combined with those of traditional entrance examinations. Thereby, Russian higher educational institutions can more effectively admit new students under conditions of the ongoing modernization of the entire national education system.

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