

Problems of Higher and Secondary School Interaction

G. M. Rozantsev and E. N. Shved

Donetsk National University, ul. Universitetskaya 24, Donetsk, 83001 Russia
e-mail: shved_e@yahoo.com

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Abstract—Conventional methods and techniques of effective interaction between higher and secondary school have been analyzed. This effective interaction has developed successfully until present and has ensured teaching continuity from school to university. It has been shown that introduction of the External Independent Evaluation (EIE) in 2007 led to revolutionary-evolutionary losses of the connection between secondary and higher school. Therefore, a possibility to teach high quality professionals capable of solving non-standard problems and accumulating new ideas has deteriorated significantly. Ways to restore the relationship between higher and secondary school have been proposed in order to save the high scientific potential of the country. These options included introduction of a general chemistry course in higher educational institutions, preservation of chemistry as a natural science subject in secondary schools, and renewal of universities' work with applicants based on their positive experience in the past.

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For many years of development of general education activities different techniques, methods, and ways of interaction between secondary and higher school have been established and have become traditional. Let us highlight the most successful of them, including lessons given by higher school teachers in the system of post-graduate education and in advance training courses; joint conferences, symposiums, and meetings dedicated to problems of secondary school; joint academic supervision of course works, graduation works, and master's theses of a scientific and methodological nature; students' teaching practice in secondary school (in Donetsk National University specialists take teaching practice in secondary school and masters give lessons in higher school); and lecturing by university specialists, primarily, in graduating classes of affiliated schools (this work is not as mercantile as it may seem at first glance, it is also professionally oriented).

For many years interrelation between secondary and higher school has been also supported by a system of entrance examinations to higher educational institutions. Within the framework of this interaction higher school, from the one hand, played a role of a controlling body performing independent evaluation of the quality of the applicants' level of training and defining their ability (or disability) to continue

education. From the other hand, there was certain interaction putting wishes and suggestions for improvement of quality of school graduates' knowledge into practice. It should be noted that higher school has always been ready to cooperate, helping to overcome difficulties accompanying the process of secondary school education; moreover, it helps to train, primarily, gifted young people whenever possible through a system of preparatory courses, Young Chemist schools, competitions held by the Junior Academy of Sciences, and so on.

School chemistry curricula, programs for applicants to higher educational institutions, and curricula for specialized schools or classes in no small measure took into account the requirements to quality of training of school graduates planning to continue their education at a higher level. In turn, higher educational institutions organized courses for applicants, issued promotional brochures, and published collections of problems and study guides, orienting school graduates to the demands of a particular institution of higher education with regard to the level of knowledge required from its future students. In no way should this point be treated lightly. Thus, to master a course of inorganic or organic chemistry in a classical university students require basic school knowledge at an immeasurably higher level than is needed to study

chemistry in a non-chemistry higher educational institution.

The Faculty of Chemistry of Donetsk National University sent university graduates to teach chemistry at secondary schools in order to solve the problem of school training compliance with the required level of knowledge of university applicants and students. In particular, this practice was introduced in basic schools of the region cities (schools of Artemovsk, Gorlovka, Enakievo, Kramatorsk, Makeevka, and Mariupol') and in lyceums of the city of Donetsk (Donetsk National University lyceum, Erudit lyceum, and Intellect lyceum), where university graduates, who are well aware of the requirements to school graduates' level of training, have been and are still teaching. It is clear that alongside with the necessary level of chemistry knowledge there are sufficiently high requirements to the level of knowledge in other disciplines of the natural science cycle (physics, mathematics, and biology).

This form of higher and secondary school collaboration had been developing and strengthening, though in a slow manner, till the moment when the Ministry of Education and Science of Ukraine (presently, the Ministry of Education and Science, Youth and Sport of Ukraine) gave birth to something called the External Independent Evaluation (EIE). Having emerged, as it would seem, under noble slogans of equality of school children's rights and opportunities, as well as a means to fight corruption, mythical for natural science faculties, the EIE testing almost broke the connections between secondary and higher schools, which have been described above. Part of these links was eliminated in a revolutionary way,

Table 1. Results of the survey among DonNU first-year students on reading materials they used when preparing to apply to the university

Answer options	Percentage of respondents selecting the corresponding option	
	2007	2010
Higher educational institutions	15	0
Textbooks	78	11
Training aids for applicants to higher educational institutions school textbooks only	7	42

as there was no longer any point in publishing printed materials allowing applicants to adapt to the requirements of a certain institution of higher education or in involving university teachers in giving classes in basic schools, lyceums, or colleges. Another part of these connections disappeared in an evolutionary manner, as school children's interest in additional reading materials was lost because shallow knowledge of the materials presented in school textbooks was enough to answer the EIE test questions. There has been a gradual loss of skills in solving medium complexity problems, the number and types of which are presently very limited; a possibility of including test questions of a problematic character into the EIE testing looks absolutely improbable, whereas it is tasks of this kind that make it possible to assess school children's creative potential. As a result of these revolutionary-evolutionary breaks in the connection between secondary and higher school

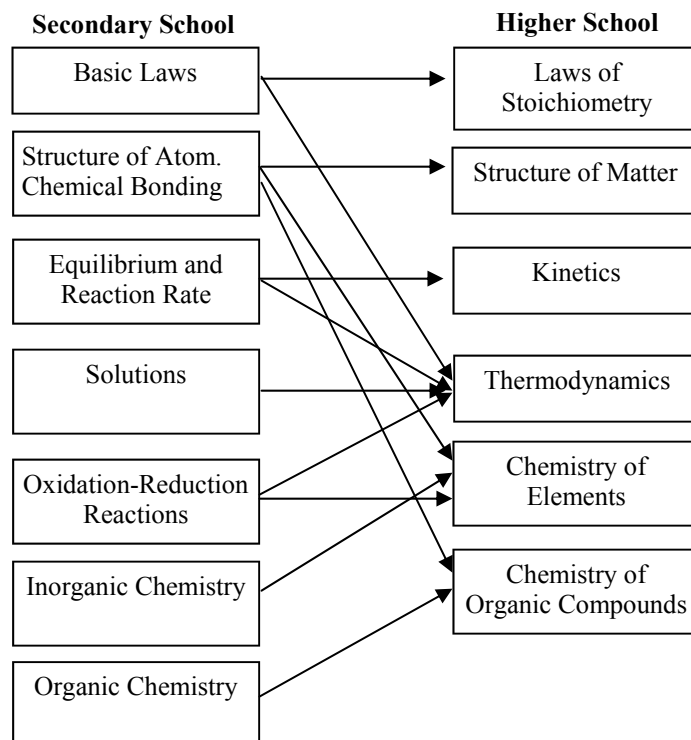
Table 2. Analysis of topics of 2008–2011 EIE test questions

Test topics	% content in the test				
	2008	2009	2010	2011	average
Basic chemistry laws	13.3	6.7	8.3	6.7	8.3
Structure of atom and chemical bonding	10.0	16.7	18.3	23.3	17.0
Equilibrium and reaction rate	1.7	0	6	1.7	2.4
Solutions	1.7	3.3	13.3	5.0	5.8
Oxidation-reduction reactions	6.7	3.3	11.7	5.0	6.7
Inorganic chemistry	26.7	25.0	16.7	18.3	21.7
Organic chemistry	26.7	25.0	23.3	25.0	25.0
Undefined	13.2	20	2.4	15	12.6

students gradually turn from thinking individuals into individuals reproducing the learnt material, which is equally unbeneficial both for secondary and higher school and for the society as a whole.

First-year students of Donetsk National University (DonNU) were asked about what study materials they had used when preparing for application to the University. The offered answer options included chemistry textbooks for higher educational institutions, various training aids for applicants to higher educational institutions, and school textbooks and methodological materials. Food for thought is given by the data obtained as a result of comparison of the answers given by first-year students of the DonNU Faculty of Chemistry in different years (EIE was introduced in Ukraine in 2008), given in Table 1. Naturally, it raises a question about what materials

were used by the remaining 47% of the respondents in 2010 in order to successfully pass the External Independent Evaluation testing. It turned out that these materials were represented by an enormous amount of counterfeit products under a conventional name of “Typical EIE Test Questions”, which took over our book market and the content of which is no one’s responsibility. Thus, to prepare for application to higher educational institutions and to pass the EIE testing successfully today’s school graduates do not need deep systematic knowledge, which are so necessary for further successful training in higher school. At the same time, the analysis of the current school chemistry curriculum demonstrates that with regard to the majority of positions such a curriculum makes it possible to provide quality training for further education in higher educational institutions. The inter-connection between these positions is shown in scheme.



Although the school curriculum is not sufficiently covered by school textbooks, the material presented in these textbooks is quite sufficient to answer the EIE test questions.

It raises a question whether the EIE testing really makes it possible to identify those school graduates who are ready for further training in higher school. This primarily concerns the comprehensiveness of

coverage of the positions, ensuring correspondence between the secondary and higher school curricula shown in Scheme, by test topics. The analysis of test topics (Table 2), including samples from four years, at first glance testifies to the fact that for all positions with the exception of number four (Solutions) the number of test questions is sufficient to control and evaluate knowledge within the framework of the corresponding section. The only topic that raises

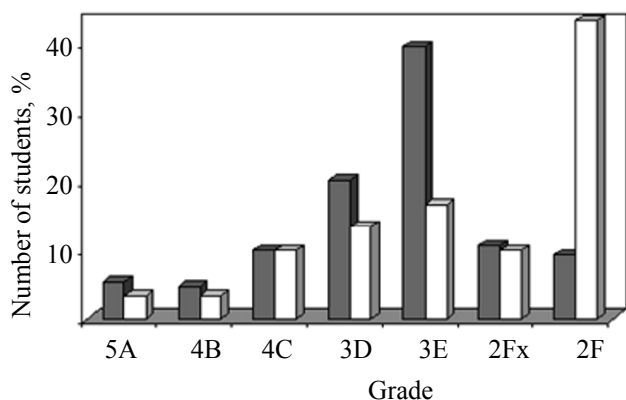


Fig. 1. Results of students' knowledge zero control: (2, 3, 4, 5) DonNU grades; (A, B, C, D, E, Fx, F) ECTS grades; white columns 2010 results, grey columns 2007 results.

certain concerns is "Equilibrium and Reaction Rate", as its school conceptual framework has to ensure adequate understanding of one of the main sections of chemistry, namely, kinetics. However, a more detailed analysis makes it possible to find out that whereas there are no major complaints about the number of test questions, there are well-grounded complaints about their content.

The content of approximately 14% of test questions cannot be considered directly related to chemistry but looks more like related to natural history, which is so much promoted by state officials responsible for education as a surrogate substitute for chemistry, physics, and biology. Every year the EIE test contains about 7–8% of similar tasks, which in fact check knowledge of one and the same training section. About 5–7% of test questions do not require any direct knowledge, as to answer them it is sufficient simply to reject some of the answer options using the exclusion method. In this situation, there is an impression that the testing is aimed not to check the level of knowledge but only to give as high results as possible.

Is it possible for the results of independent testing, which has replaced entrance examinations, to adequately reflect school graduates' knowledge, skills, and abilities, their potential and preparedness to continue education in higher school? To answer this question it is interesting to compare the results of zero control of knowledge among students who passed entrance examinations (2007) and students who were admitted according to their EIE results (2010) (Figs. 1 and 2). It should be noted that the entrance examina-

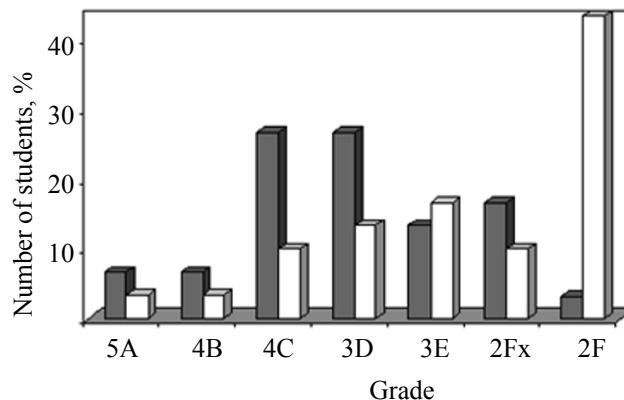


Fig. 2. Results of students' knowledge control: (2, 3, 4, 5) DonNU grades; (A, B, C, D, E, Fx, F) ECTS grades; white columns zero control results (2010), grey columns knowledge control results after a course in general chemistry (2010).

tion and the EIE test grades that students of both groups received were rather similar.

The analysis of the diagram, given in Fig. 1, demonstrates that the level of knowledge among students who passed entrance examinations (2007) corresponds to a distribution of grades that is close to normal, which testifies to the fact that secondary and higher school curricula are in line with each other and that the university applicants have sufficient basic knowledge to continue education at university. In turn, it is possible to see the objective that is to be pursued by higher school teachers, namely, to ensure sufficient basic training, which is to be illustrated by a shift of the diagram peak from 3E towards 3D – 4C, which is quite attainable. The situation with students who were admitted on the basis of their EIE results is much more complex. The distribution of grades on the diagram (2010) is very far from normal. In this case higher schools teachers have to eliminate obvious gaps in the students' basic knowledge, which is done at the expense of the university main chemistry course. In order to increase the students' basic knowledge in chemistry Donetsk National University introduced an additional course in general chemistry. After this course the university students had much better zero control results (see Fig. 2), although they were still below the results of 2007 students.

It should be noted that only in the second or third year, after some students have dropped out of university and as a result of herculean efforts, it is possible to bring the level of knowledge of students admitted to DonNU on the basis of their EIE results to the level of

students who passed entrance examinations. Thus, the average grade for the first module of the course in organic chemistry among 2010 students is 3.7–3.9 points (3D), which is only approaching the grade of 2007 students (4.0–4.2 points – 4C).

Difficulties emerging while studying at higher school can be successfully overcome only in case the

interconnection between secondary and higher school is restored. The first step on the way to such a restoration could be to provide higher educational institutions with a right to select themselves their future students capable of continuing education and to preserve the school chemistry discipline as a full-scale natural science subject (not a half humanities subject) in the school curriculum.