

Natural Science University Education in Czech Republic and in Russia

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Abstract—In this article the author's experience of university studies in the field of natural science in Russia and Czech Republic is summarized and analyzed.

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As a rule, comparison of Russian and foreign universities in relation to the quality of education in the field of natural and exact sciences is not in favor of Russian education, as there is an evident drop in its quality, which requires no special justification. There is an opinion that graduates of Russian higher educational institutions are far behind their foreign counterparts; however, according to another viewpoint, the reduction in the level of the students' knowledge and competence is a worldwide trend, which is more evident in Russia against the background of the formerly high level of the Russian higher educational institutions graduates.

Discussions on this topic are still going on and each of the parties provides numerous examples justifying its position, including cases from personal experience (as a rule, research or teaching work). At the same time, there are few assessments for comparison of the students' learning results. With no claims for completeness and systematic character, I will, however, try to close this gap. It will not be a comprehensive analysis, but more like a collection of observations and impressions.

As for the most part further presentation will be based on my personal experience, I will give a brief description of my biography as a student. I graduated from the Chemical Faculty of Moscow State University, took postgraduate courses at its Department of High-Molecular Compounds, and later enrolled in a program of postgraduate studies at the Faculty of Mathematics and Physics of Charles University in Prague. Thus, my experience allows me to make a direct comparison between postgraduate programs at these two univer-

sities; moreover, I have first-hand experience with bachelor and master program of Charles University. I will not provide detailed description of all aspects of education but will only focus on the differences.

Studying at university is preceded by the entrance examination procedure. Both in Moscow State University and Charles University the system of entrance examinations has been recently changing (in particular, I avoided the tough fate of students who have to pass the Russian Unified State Examination (USE); alongside with traditional examinations a knowledge assessment mechanism similar to the Russian USE has recently appeared in Czech Republic). Despite certain parallels, it is not possible to say that the entrance examination evolution in Russian and in Czech Republic goes similar ways. Firstly, in Czech Republic the majority of written examinations had been performed in the form of testing before the introduction of the unified school examination; secondly, school testing in Czech Republic does not replace entrance examinations but complements them; only in certain cases the results of the testing can count as entrance examinations. Disappointing results of the first experimental tests and a guardedly negative attitude of the society towards them make it possible to suggest that in case school graduation testing does replace entrance examinations, it will not happen soon and only after radical revision.

Putting aside the examination form, it is possible to say that in many respects the systems of entrance examinations in Russia and in Czech Republic are similar, though there are certain differences.

In Charles University a set of entrance examinations includes from two to five subjects depending on the faculty and specialty. In this case to enter the university it is necessary to pass only two of them at the applicant's choice. It is possible to take more examinations than two; however, only the best two results will be counted in the total score. Often there is no such choice; for example, when choosing the specialty of physical chemistry (Faculty of Natural Science) it is necessary to pass entrance examinations in physics and chemistry. In case of choosing the specialty of biophysics and chemical physics (Faculty of Mathematics and Physics), applicants have to pass two examinations in the field of mathematics, physics, and information science at their choice. The language proficiency examination is taken by foreign applicants only.

It is possible to apply for admission to any number of faculties and specialties; in this case repeated subjects are only passed once (though, there is a fee to be paid for each application in the amount of about 20 Euros).

Entrance examinations are evaluated on the basis of a 50-point system, the minimum amount required in order to continue further participation in the competition is 40 points for two examinations.

In my opinion, Charles University admission system (namely, an opportunity to choose examinations) is organized with a little more flexibility (although, this opinion can be argued). Let us consider the above-mentioned specialties related to physical chemistry as an example. The applicant can pass only three (chemistry, physics, and mathematics) out of five examinations and continue participation in the competition for both specialties. Moreover, even failing one examination that is common for these specialties, namely, physics, the applicant still has chances to enter one of the selected specialties on the basis of the examination results in mathematics and information science.

Under certain conditions both Moscow State University and Charles University can accept applicants without entrance examinations. Thus, winners of the national and international competitions among schoolchildren in the corresponding subject are exempt from examinations (each case is considered individually by the Admissions Committee; however, almost always the entrant's application is satisfied and usually the applicant is only exempt from the corresponding examination). Apart from that, with the rector's agree-

ment school graduates having the average score of 1.50 and lower (in Czech Republic 1 is the best grade and 5 is the worst) for the last two years of school studies can be completely exempt from entrance examinations.

Despite the fact that in Charles University the admission competition for many specialties is traditionally high (for example, the competition at medical faculties reaches about 10 applicants per place), the interest of Czech school graduates to many other specialties is falling steadily. In this connection, the management of some universities has ventured an interesting experiment completely cancelling entrance examinations for admission to bachelor programs. Instead of this, the academic office reserves the right to dismiss the weakest students after completion of the first academic year, even in case they meet the minimum requirements of the curriculum. In 2009 the total of 15 faculties of various Czech universities supported this initiative, including one of the Charles University faculties, namely, the Faculty of Mathematics and Physics.

In any case, after passing through the sieve of entrance examinations the applicants become students, full participants of the educational process. Charles University provides free education (in case of education in the Czech language) regardless of the student's citizenship. The University has no mandatory educational program as such even within the framework of one specialty. From the first year of study students themselves choose subjects they want to learn (the total number of subjects at the Faculty of Mathematics and Physics alone reaches several hundred). Significance of each subject depends on the number of classes and form of reporting. The task of the student is to attend lectures, seminars, and workshops and pass examinations in order to score the required number of points during the academic year. Among other things such independence is regulated by certain requirements existing in many courses. For example, it is impossible to take a course in electronics of polymer materials without passing examinations in general and quantum physics before that, which in turn requires a positive grade in mathematical analysis. Apart from that, the total score that should be reached during the whole period of education is so high that it is simply impossible to successfully meet the requirements without attending the core courses. There is also a set of compulsory subjects; however, it is not large and leaves enough space for students to form their

individual curricula by themselves. It is important that from the very beginning of university studies students have an opportunity to choose interesting subjects or courses that they consider important for their future work within the framework of the selected specialty. In my opinion, the fact that for many years this system has been successfully functioning in the self-regulation mode proves that it is correct and viable.

It should be noted that students can attend courses taught at other faculties, which will be counted in their curricula. Moreover, well-established links with other Czech and European universities make it possible (with the agreement of the academic office) to take certain courses outside Charles University; and these subjects will be also counted in the student's individual curriculum. Thus, almost every Charles University graduate can have records on taking a unique set of courses in his or her graduation certificate, at the same time, not leaving the framework of the selected specialty from the formal point of view.

It should be also noted that there is a fantastic (by Russian standards) level of computerization of formal activities in the educational process. The general remote control system allows the student to choose a curriculum for the current term, register for examinations on the selected date and time, apply for changing a dorm room, change the account to which the scholarship is accrued, receive a statement on accrued items etc... Apropos, in the same manner a future student can apply for admission to university and present all required documents directly at the examination or during the enrollment process. In the extreme case, the student's personal communication with the academic office can be limited to two visits a year, when it is necessary to have the student's record book stamped to mark successful completion of another academic term. Alongside with that the student can obtain an official paper on the mode of study, entitling him or her to a reduced price student ticket. Probably, that is the reason why I have never seen a line of more than five people at the academic office, although, the total number of students at my faculty is about three thousand.

However, such approach encouraging the student's self-sufficiency and personal responsibility has a downside. It is easy enough to unknowingly miss the information on some mandatory occasion; moreover, in this case the "I did not know" argument will look extremely helpless, as all the information is constantly updated and is publicly available. To control the

performance of tasks is the responsibility of students themselves and such inattention can have the most serious consequences, even including expulsion. However, such cases are very rare. Students appreciate the opportunity of still free education and very thoroughly explore all opportunities provided by the Internet portal of the University.

On a subjective and emotional level it seems that teachers at Charles University are more attentive and even helpful to students as compared to Moscow State University. Distribution of lecture and seminar presentations and learning materials required for preparation to examinations, asking students (before the start of the course) concerning the most convenient time to hold the classes – such were the teachers' initiatives in all the courses I attended and the students took that for granted. Probably, the desire to captivate students with the subject and to make the educational process and preparation to examinations as comfortable as possible can be also associated with the optional character of the majority of courses and the University staff interest in the teaching load.

Bachelor and master programs are completed with the state examination and the thesis defense. Topics for the theses proposed for the current academic year are also published in the information system of the University. If they want to, students can also perform research work in the first years of studies; however, the system of term-papers, which is common for Moscow State University, is not applied at Charles University.

The next stage of education at Charles University is a postgraduate program (doctoral program). Before taking a postgraduate course it is necessary to choose the topic of the future scientific paper, which is again to be taken from the list of academic advisors and topics that is presented on the Web-site and regularly updated. The entrance examination is not very difficult; it is more an interview than an examination aimed to check the motivation of future postgraduate students and their interest to the selected research areas. There are no time limits for postgraduate education; however, scholarships are only given during the first four years.

The curriculum of the postgraduate student is not fully formed by the student himself or herself, but in cooperation with the scientific advisor taking into account both the student's preferences and the objective requirements to the topic of the research work. Generally speaking, there is also a set of

compulsory subjects (as a rule, the set consists of two to four courses depending on the specialty); however, postgraduate students have even more room for maneuver than students. The compulsory course can be given by various teachers from different faculties. The course programs and durations vary significantly; and students can choose the option that suits them best. For example, it was recommended to include a course in polymer chemistry into my curriculum and I had to choose one out of three options. A two-term course in the Institute of Chemical Technology in Prague was mostly dedicated to polymer synthesis methods; a similar course at the Faculty of Natural Science focused on polymer modification methods; whereas the topic of the corresponding course at the Faculty of Mathematics and Physics was production and properties of special structure polymers, i.e. network and branched polymers. The only compulsory subject for postgraduate students is the English language, the examination in which is to be taken only at the faculty of studies. However, upon the recommendation of the academic advisor this examination can be passed as an external subject through handing in an article in the English language prepared for publication.

Scholarships for postgraduate students are indexed every year taking into account the number of full completed years of education. There are increments for a positive grade in English and passing of the state examination. After three-four years of studying the scholarship is almost doubled as compared to the initial amount.

It is interesting that many courses are attended by postgraduate students and senior university students together, which, in my opinion, puts a little too high demands on the students, at the same time, making the position of postgraduate students a little more carefree. In the context of time expenses, Czech students' studies leave them a little more free time as compared to Moscow State University education (due to absence of humanities, which are compulsory at Russian universities, the average classroom load of Charles University students is 6 h per day 5 days a week), whereas postgraduate students, on the contrary, study much more intensively than their Russian counterparts. It should be noted for comparison that at Moscow State University I passed one candidate examination in my specialty, whereas at Charles University I had to pass seven of them, including the final doctoral examination consisting of questions from all the courses taken during my postgraduate studies.

Let us summarize the above. What are the main differences between university education in Russia and in Czech Republic (demonstrated by the example of Moscow State University and Charles University)?

After all, the first place is taken by flexibility of the educational system at Charles University. From the moment of admission to the University to the moment of defense of the qualification paper the applicant/student/postgraduate student has opportunities to choose and implement his or her individual curriculum, which is limited only by common sense and the number of hours in a day. Undoubtedly, school graduates cannot know beforehand what will be interesting for them in 5–8 years. Despite a wide range of overall opportunities, the alternatives for Czech students to choose from are separated in time: first, selection of the specialty, (possibly) entrance examinations and form of study (bachelor/master, full-time/combined); then, the order of attending compulsory subjects and the list of optional courses; and, finally, the topic for the graduation thesis.

The second difference is the emphasis on the student's self-sufficiency. If analyzed, it is an absolutely irrational feeling. Moreover, it is self-sufficiency and personal responsibility which are always emphasized as distinctive features of Moscow State University students as compared to yesterday's school students and school graduates. However, for some reason it was Charles University where I fully felt my responsibility for my choices.

It should be noted that Charles University is characterized by perfect organization and well-developed information system. Although it is not directly related to the educational process, such nice little things saving the students' time and nerves are worth a lot.

I understand that what I have written is a number of exclusively positive moments distinguishing Charles University from Moscow State University. But still, which of the two universities gives better education and makes it possible to perform successful research work in the future?

Of course, I would really like to say that Charles University is wonderful, but Russian students are the best despite all the difficulties. Unfortunately, it is not the case. Probably, the level of competence of the strongest, most talented graduates of Moscow State University and Charles University specializing in natural science is comparable. However, in my subjective opinion, the average level of Czech students

is higher as compared to Moscow State University. Here I should specify that my circle of contacts at Charles University mostly consisted of master students attending classes together with postgraduate students, i.e. the most motivated part of the Czech student community. At the same time, when I was a Moscow State University student, lack of experience did not allow me to evaluate the level of knowledge of my fellow students during my education there; and later I gave a course in high-molecular compounds to students who did not specialize in this subject. However, even taking these facts into account, I must admit that Czech students significantly exceed their Russian counterparts, at least, with regard to orientation in the material of related and previously taken courses. The reason for that is not only the differences between the Russian and Czech educational systems described above but also purely material aspects (size of scholarships, quality of living conditions in student dormitories, modern laboratory and lecture equipment etc.).

In conclusion I would like to note that natural science education in Czech Republic is far from being trouble-free right now. Not long ago the Institute of

Macromolecular Chemistry, Czech Republic Academy of Sciences, held a round table on problems in the sphere of education, at which it was noted that in recent years there had been a drop in the students' level of competence. However, participants of the discussion specified that they did not refer to the average level but spoke of students taking postgraduate courses and planning to continue their scientific work. The majority of strong Czech students prefer to continue their education taking master and doctoral programs in the neighboring countries with a higher quality of life (Germany and Switzerland). At the same time, it was recognized that the young graduates' ability for independent work, their initiative and motivation were constantly improving. From my point of view, there is nothing surprising in that, as it is a natural consequence of those characteristic features of the educational organization that catch the eye at detailed acquaintance with Charles University. The main conclusion of this round table discussion was that, although, not everything was perfect in the sphere of education in Czech Republic, they were moving in the right direction, though, probably it was not by the optimal trajectory. Which path and way does education in Russia follow? This question is rhetorical.