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Reflections on University Education: Soviet and French Organization of Education

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Abstract—Comparative analysis of university education is performed by the author on the basis of his own teaching experience at Moscow State University and at a provincial French University in the north of France.

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INTRODUCTION

Within the framework of the subject specified in the title of the article I would like to present my reflections on university education based on my experience of teaching at Moscow State University of the Soviet time and at a provincial French university in the north of France. It happened that after more than twenty years of work (1970–1991) at the Chemical Faculty of Moscow State University, preceded by five years of studies at the same faculty, I found myself in France, where in 1993 I was permanently employed in the position of Professor at a newly formed university (Université du Littoral) in the city of Dunkerque. By now the length of my employment in France has become almost equal to my record of work in Moscow State University. I never held any teaching positions at the Chemical Faculty of Moscow State University; at the same time, during this twenty-year period I worked my way up from a junior researcher to a leading researcher. Nevertheless, I regularly conducted classes mostly for students of a group specializing in physicochemical theory, teaching both compulsory and special courses for diploma students and postgraduate students. In France I am employed in a teaching position of Professor and give lectures on basic general subjects for junior students.

Before comparing the level of education and methods of teaching in the Soviet Union and in France, I should note a significant difference between the educational institutions in question and the composition of the student communities I dealt with in Moscow and in Dunkerque. Moscow University in general and its Faculty of Chemistry in particular was and still is one of the leading higher educational institutions in the country. In the Soviet period the selection of students in Moscow State University was performed on a competitive basis; moreover, applicants took entrance examinations on earlier dates than in the majority of other higher educational institutions.

In France, on the contrary, universities are, in a certain sense, second-rate educational institutions, whereas elite institutions are represented by higher schools such as, for example, Polytechnic School (Ecole Polytechnique) or Superior Normal School (Ecole Normale Superieure), at least, in the sphere of natural science education. After graduating from lyceum (lycee) and obtaining a diploma of secondary education, applicants have to spend two more years attending special preparatory courses (classes preparatoires) in order to enter these higher schools. Admission to these preparatory courses is associated with serious selection, and after two years of studies the applicants still have to pass difficult entrance examinations to enter higher schools. On the contrary, no examinations are required to be admitted to university; it is sufficient to have a diploma confirming successful graduation from lyceum. University education is almost free. Students from low-income families can receive scholarships; though, they are much smaller than student scholarships in, for example, Polytechnic School.

Formally, after two years of university studies students can enter higher schools after passing the examinations; however, there are few who succeed in

it. As practice shows, another way – in a certain sense, a reverse way – is much more realistic. Many of those who attended preparatory courses for two years and failed to pass competitive selection to higher schools become third-year university students. There are a lot of such examples. As a rule, such third-year students who went to university after attending preparatory courses turned out to be among the strongest.

Enrollment into French Universities

The absence of entrance examinations in French higher educational institutions causes a somewhat paradoxical situation from the point of view of a Soviet university graduate. When enrolling to university, it is not the entrant's desire or choice and not even the entrant's grades that are important but the place of final school examinations (lyceum) and obtainment of the education certificate. Applicants can enter the first year of university studies according to their place of residence. In this case it is implied that the first two years of university education can be obtained in any French university that has a department corresponding to the selected specialty. If in your city of residence, where you went to school and passed your final examinations, there is a university with a department of mathematics, physics and chemistry, or any other area corresponding to the specialty you have selected, it is this local university you have to enter, even in case there are no departments in the specialties that attract you most in senior years of study. After the second or, maybe, fourth year you will be able to transfer to another university, which is more in compliance with your particular choice. It should be noted for the Russian reader that such transfers from one university to another are quite typical for France. Moreover, they are originally incorporated into the established educational system. Many small universities have quite a wide range of departments in the first years of study; however, to continue education and receive a five-year education diploma is possible only in some specializations. Thus, in 1993 Université du Littoral acquired the status of an independent university; before that for a number of years it had functioned as a branch of the University of Lille. Courses were taught mostly to students in the first two years of university by teachers coming from Lille.

In the 1990s the French government decided to bring universities closer to places of young people's residence in order to facilitate access to higher education directly on site without the necessity to move to university centers, which in principle significantly reduces financial difficulties. University education is almost free; however, to move to another city and rent a flat there is a serious financial burden, especially for low-income families living in industrial outskirts of France. Several years after the university in Dunkerque became independent with its own teaching staff and student community, education in physics, nevertheless, could be obtained only in the first two years of study. Later, it was continued to include two more years. However, a drastic reduction in the total number of students all over France (and not only in France) together with a loss of interest to natural sciences in general and physics in particular as compared to other subjects resulted in a repeated reduction in the period of university education in physics to the first two years of study just four years after a four-year course was introduced. During the period of four-year education in physics in order to complete a full five-year educational cycle and receive a university diploma students had to enroll to another university for the fifth year of study. The most important issues for students enrolling to study at another university include a set of attended courses, grades for the previous years, and recommendations from the previous university teachers.

Despite a seemingly huge difference between various universities, as practice shows, successful students remain successful even when changing an educational institution. Thus, one of my students, who had the best grades among his fellow students during all four years of studies in Dunkerque, after the fourth year of education moved to Université Paris 6, a university in Paris, to complete his education in the specialty of molecular spectroscopy; after completion of the fifth year once again he had the best grades. Unfortunately, this example is unique and it does not at all show that the average level of students in Dunkerque is the same as in Paris.

A permanent reform of education is common for many countries, including France. Thus, whereas in the 1990s the prevailing trend was to establish new independent universities in peripheral cities, at present there is a new objective, which is to create big, strong centers of university education incorporating small independent universities. Thus, in the north of France it is expected to form one university which is to incorporate almost all small universities and a number of other educational institutions.

Evaluation of Students' Knowledge in the Process of Education

Perhaps, one of the most striking differences between education in French and Russian universities is the process of flunking out students during the process of education. At French universities the number of the first and fifth year students can differ by an order of magnitude, which is primarily related to the fact that students are accepted into the first year without meeting any barriers, for example, entrance examinations. As I have already mentioned before, to enter a university it is sufficient to have a relevant Baccalaureat[1] diploma. In this connection it should be mentioned that in France at the end of secondary school[2] in order to receive a diploma students have to pass examinations in one of the following areas: natural sciences, economics and social sciences, and literature. The type of the diploma imposes restrictions on the selection of a higher education institution; although, these constrains are not very tight. In the presence of the required diploma and positive grades all applicants can be admitted to university despite physical limitations related to the size of university rooms and the number of teachers. I do not remember any problems connected with overcrowded lecture rooms in Dunkerque; however, at the Department of Medicine of the University of Lille, for example, it is a standard situation.

The absence of entrance examinations is compensated by a tough competition among students for continuing education in the second year. The number of places in the second year, for example, at the Faculty of Medicine is limited and in order to enter the second year of study the student not only should have positive grades but also should be ranked among the best according to these grades. Sometimes it happens that only about 250 out of approximately 1500 students at the beginning of the first year continue into the second year.

In French universities the attitude to grade repetition is much more liberal than it used to be in the Soviet Union. In France completion of a full university course can stretch for a long time based on a principle of completing one year in two. Apropos, similar attitude to grade repetition in colleges and lyceums leads to a fact that the age of students in the final grade can significantly vary. Thus, my daughter graduated from lyceum at 17, whereas the oldest of her fellow students was 22.

The criteria for successful completion of an academic year in French universities also require a special comment. As a rule, the student's knowledge of the subject is evaluated on the basis of a 20-point scale. Final grades in all subjects are summed up taking into account the significance of the subject and the number of hours allocated to studies of the subject during the term. Such weighted total score is also reduced to a 20-point scale. Students who have 10 and more points after this averaging of grades are considered as having completed the term or the academic year successfully and automatically qualify for the next year of study (of course, unless the university has pre-defined restrictions on admission of students to the next course in this specialty).

Is it a progressive system as compared to the Soviet system, according to which it is necessary to have positive grades or, at least, to pass all tests in all subjects, both in majors and minors, in order to continue education? For strong students who very well realize their future professional interests already in the first years of university studies such a system undoubtedly makes it possible to focus on subjects that are the most important from their personal point of view. At the same time, other subjects of the compulsory curriculum that are considered by the student as unimportant can be taken and passed with minimum effort. However, it should not be forgotten that the total score is important for everyone, as it is taken into account in all kinds of competitions, when transferring to another department, or when obtaining a student scholarship.

French universities give almost no freedom in the choice of compulsory subjects; however, there are optional courses to choose from. These courses make it possible for students, especially students in the first years of study, to get acquainted with subjects outside the framework of standard programs. Compulsory subjects vary only in case of transfer from the department of mathematics to the department of physics and chemistry, information science, geography etc. The greatest disadvantage of the compensation system of grades manifests itself, for example, when

[1] Baccalaureat = BAC – French diploma obtained at successful completion of lyceum. Lyceum corresponds to three senior grades of secondary school.

[2] Secondary school in France consists of primary school, college, and lyceum.

students specializing in physics or chemistry continue into enter the next year with low grades in mathematics compensating them with sufficiently high grades in other disciplines. Such gaps are very difficult to close in the following years of study because mathematical tools used in physicochemical and other applied disciplines require sufficient knowledge of mathematics. Such situation is quite typical; it leads to a fact that some students attending classes in thermodynamics or quantum theory find it difficult to calculate derivatives of simple functions and even to take logarithms.

When summarizing the results of the academic year, it is possible for a student to successfully complete a course in one term and fail to pass it in the other. Moreover, some of the courses can be passed in the current year, whereas other subjects will be left for the student to deal with in the next year. It is this system allowing students to pass not all but a part of their subjects that results in students taking their time at university, sometimes completing one academic year during a two-year period.

Emphasis in Education

Historically (at least, in XX), French education made an emphasis on mathematics. It was traditionally believed that the best school education and the strongest students were always to be found at the department of natural sciences. This situation was explained to me with a rather unexpected example. Let us assume that a lyceum student chooses educational specialization for the last two years of study when there is such a choice. In this situation the student has almost defined his or her further interests already, which are in the area of geography. At lyceum advanced study of geography is performed within the framework of the department of economics and social sciences. The student intends to continue education in this very area after graduating from lyceum. However, in this case for graduating from lyceum and receiving a diploma, the student should choose the department specializing in mathematics (department of natural sciences). This choice is recommended not because there is a greater focus on geography at the department of natural sciences. If the student is interested in geography, he or she will continue studies in this area without the help of lyceum, whereas the knowledge obtained in the course of studying at the department of natural sciences and the corresponding diploma are necessary for the student to enter a prestigious higher educational institution.

There is another interesting observation I made at the beginning of my residence in France. I was surprised to find that among my French colleagues I communicated with at University there was a high percentage of people who knew or, rather, studied Russian at school. When I tried to find out the percentage of lyceum students currently studying Russian as a foreign language, it turned out that even to find a lyceum with classes in the Russian language was far from easy. For example, in Dunkerque there are no such lyceums. It should be noted that at present the number of French schools where it is possible to study Russian is lower than it was in the 1960s, when the people of my age were students. In France it is considered very difficult to study Russian. Therefore, if a lyceum does have a course in the Russian language, as a rule, it is taught only in a few grades with the most gifted students selected according to their personal abilities, primarily, in mathematics. That is exactly why almost all most prominent representatives of French mathematics studied the Russian language.

Having started to talk about the mathematical emphasis in French education, I should comment on this aspect from my point of view. By education I am a theoretical chemist who studied in a group of theoretical chemistry at the Faculty of Chemistry, Moscow University. My scientific interests are related to construction of mathematical models describing the dynamics, spectra, and properties of isolated simple molecular systems. Therefore, during my residence in France I have had rather extensive contacts with mathematically oriented members of the scientific community. At the same time, with regard to my teaching activities I belong to the category of physicists (according to the French classification it is section 30 – continuous media, optics), like the majority of theoretical spectroscopists. Therefore, I have mostly communicated with students of physics and a little with students of chemistry, primarily, from the second and third courses. Speaking of professional mathematicians, I can express my main impression of the majority of them using a classical phrase, “How far they are from the people!” They consider working with specific problems, arising in applied forms, neither interesting nor prestigious.

I fully share the view expressed in a joke on French and Russian approaches to formulation of mathematical problems attributed to V.I. Arnol’d. The French approach is based on the initial tendency to generalize the problem as much as possible so that the

answer to the original question is a very special case of the generalized problem. The Russian approach is based on simplifying the problem as much as possible and reformulating it so that to exclude all secondary factors found in the original formulation, of course, avoiding "throwing the baby out with the bathwater."

Probably, a lot of people know "Math Problems for Kids from 5 to 15," a small brochure written by V.I. Arnol'd [1][3]. This book includes a number of sufficiently simple problems, the solution of which requires non-formal thinking. I have used many of these problems in the course of teaching various courses to students of I–III years of study. Strange as it may seem, the level of these math problems was quite suitable for students and contributed to detailed understanding of the problem before starting to solve it. It is exactly what the majority of French students lack.

Commitment of professional mathematicians to abstract formal mathematics is reflected in the students' knowledge of mathematics. The entirely abstract way of thinking characteristic of the French school of mathematics, in my opinion, has led to strong polarization in the level of understanding and applying mathematics. Whereas France has a great number of highly professional mathematicians of international scale (the French are justifiably proud of the fact that France is among the top three countries with the greatest number of winners of the prestigious Fields Medal, together with Russia and the United States), the average students' level of mathematical knowledge, in particular, in Dunkerque university is quite low. In the eyes of an outside observer, excessive abstraction and formalism in teaching the foundations of mathematics at lyceum and in the first years of study in higher educational institutions prevent average students from the department of natural sciences from seeing the connection between abstract mathematical concepts and theorems, on the one hand, and specific applications of mathematics in solving special physicochemical problems, on the other hand.

Another contribution to this break in the connection between mathematical thinking and making use of it for solving applied scientific problems is made by progress in the use of computers. Dependence on calculators in solving the simplest problems, in which mathematical calculations are represented by nothing more than arithmetic operations with integers or fractions often leads to a situation when the student solving such a problem at the blackboard (where I do not allow students to use calculators) simply cannot perform basic arithmetic calculations correctly, making gross errors in reducing fractions, to say nothing of taking logarithms. The most dramatic is that such situations can occur among the third and fourth-year students of the physical and chemical departments, who formally have fully completed a course in mathematics for this specialty. I do not want to say that French lyceums do not teach their students that $\ln (a + b) \neq \ln a + \ln b$; however, such operation is one of the several elementary mistakes that I have repeatedly encountered for many years in students' tests on thermodynamics (years II and III) or quantum mechanics (year III). It is obvious that students making such mistakes are really weak; however, the most amazing is that with this level of knowledge they can reach as far as the third and fourth years of study.

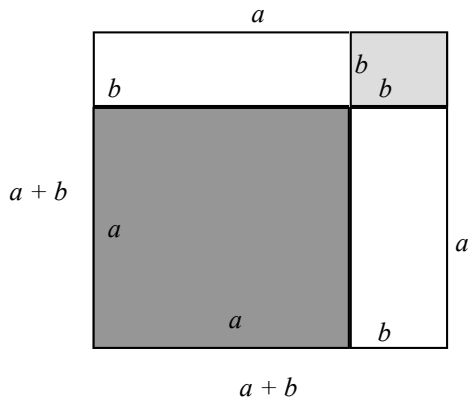
Such situation can be attributed to the problem of residual knowledge after taking and passing every separate discipline. It is necessary to admit that there is a very poor connection between different courses taught at French universities. It is not customary to use knowledge obtained from allied disciplines, as well as to apply skills mastered within the framework of this course in other subjects. According to my understanding of the objectives of teaching, which was formed back then when I was at Moscow University, one of the most important goals of education is the formation of students' understanding of deep connections between different disciplines and finding what they have in common, especially in the context of mathematical models.

Construction and application of graphs can be used as an example of the simplest universal mathematical method causing obvious difficulties for French students. In mathematics the attitude to construction of graphs is ambiguous. In introduction to his treatise Analytical Mechanics (Mécanique Analytique) [4] Lagrange wrote, "No figures will be found in this work. The methods I present require neither constructions nor geometrical or mechanical arguments, but solely algebraic operations subject to a regular and uniform procedure. Those who appreciate mathematical analysis will see with pleasure mechanics becoming a new branch of it and hence, will recognize that I have enlarged its domain." It is evident that he

[3] This collection of problems for kids should not be confused with more serious problems from Trivium [2] and Arnold's Problems [3].

was very proud of using no graphical illustrations. Moreover, of course, no one doubts that it was not at all difficult for Lagrange to make graphical illustrations for different problems and laws of mechanics.

A diametrically opposite view on usefulness of graphical interpretation can be found in a work of another famous mind, in Confessions of Jean-Jacques Rousseau [5]. Recalling his studies of mathematics, Rousseau writes that he never managed to understand the meaning of the simplest algebraic formula: $(a + b)^2 = a^2 + 2ab + b^2$. The clarification came only after he geometrically interpreted the formula for himself as representing the area of the square with a side of $(a + b)$ as a sum of areas the square can be divided into (see figure).



Geometric representation of algebraic formula $(a + b)^2 = a^2 + 2ab + b^2$ as a sum of areas.

This example vividly demonstrates how different the perception of mathematical concepts by people with different mentality can be. Mentioning the story about Rousseau during my classes with physicists and chemists I have seen again and again that for many students the geometrical interpretation of the algebraic formula in terms of areas is quite unexpected and, at the same time, quite evident, clarifying the meaning of mathematical manipulations. Application of graphical representations even in their simplest version, in the form of graphical representations of functions, turns out absolutely unusual for students. Strange as it may seem, for many of them even to construct a graph of a certain rather simple function, for example, a function containing polynomial and exponential factors, is a very difficult task if they cannot use calculators with a graphic display and a program for construction of functions. Moreover, as a rule, the very idea to construct a graph of the function, which is suggested for analysis in the task, does not occur to students unless it is explicitly required to construct the corresponding graph. I have repeatedly observed such behavior, for example, among students of the third year solving quantum mechanics problems on movement of a particle in one-dimensional potential represented in the form of an analytical expression. The student can never think of constructing a graph of the potential (unless it is explicitly required to construct it) despite the fact that it is the graph of the potential that can reflect the characteristics of the discrete and continuous spectra regions most evidently.

There is another example, which is very characteristic of French mathematicians with respect to application of graphs. I am sure that a lot of people have read or, at least, have looked through "Symmetry," a wonderful book written by mathematician Hermann Weyl [6]. This book was published in English in 1952, after which it has been republished many times and translated into many languages, including Russian and French. The book is interesting because it introduces and illustrates mathematical ideas and mathematical thinking using a great number of prints of art works, natural objects, and simple graphical constructions. However, I have decided to mention this book in connection with the introduction to its French edition written by one of the patriarchs of using mathematical methods in humanities and social sciences, as well as in economics, administration, and production. In his introduction to Weyl's book he asks why one of the most prominent mathematicians at the end of his university career decided to publish such a funny album of pictures (images). Thinking about it, the author comes to a conclusion that illustrations are not the most important, the most important is the algebraic content hidden behind the illustrations. He confirms his idea with a metaphor taken from N. Bourbaki's work saying that with its ruthless clarity algebra forces geometry to lose its brilliance. What should readers do? In my opinion, they should abandon all associations with reality and perceive mathematics as something completely abstract.

In general, I have got the impression that many students, even those who are successful, have difficulties if the problem they have to solve does not fit into the standard framework and requires preliminary thinking on how to approach it. As for technical difficulties on the selected way of solving the problem, as a rule, they do not present serious obstacles for good students. In my opinion, it is a consequence of the fact that when students attend preparatory classes in order

to get ready for entrance examinations into higher schools, the main focus is made on training students to solve difficult, yet typical problems, which are solved by using more or less standard universal recipes. I have realized this fact working with students of the third year; almost every year there are several people who have completed such preparatory courses. Although, it is evident that they have not been among the best at the courses, at University it is primarily their level of mathematical training and their ability to solve standard problems sufficiently fast and accurate that set them apart.

Undeniable priority of mathematics in the selection of lyceum students with specialized diplomas (natural sciences, economics and social studies, and literature) in higher educational institutions of different specialization undoubtedly contributes to the formation of competent personnel. However, excessive abstraction in teaching mathematics causes serious damage with respect to competent use of mathematics for solving applied problems and creates a deep chasm between professional mathematicians, on the one hand, and physicists, chemists, and biologists applying mathematical models, on the other hand. In my opinion, attempts made by a number of first-rate mathematicians to declare themselves physicists and start describing the real world from the point of modern advanced (and, as a rule, the most abstract) mathematical ideas and concepts are doomed to failure, at least, till the moment when professionals and consumers of mathematics find a common language, equally accessible to all.

Testing of Knowledge

I would like to pay special attention to the problem of evaluating students' knowledge, as it involves a number of serious differences from the Russian and Soviet traditions. The main difference is written examinations, which are mandatory for almost all subjects in French educational institutions. Another special feature is anonymity of all examinations and even all mid-term tests. The degree of anonymity is striking already at the level of lyceum final examinations. French lyceum students take all final examinations neither at their lyceum nor with their teachers; moreover, it applies both to written and oral examinations. Furthermore, students from the same grade can take examinations in different places.

Of course, I knew very well how written entrance examinations to Moscow University were organized, when the names on students' works were coded and teachers who checked them did not know whose works they evaluated. In French universities not only all examinations at the end of each term are anonymous but even mid-term tests, the results of which are taken into account in the total score. Most often the final grade is formed on the basis of the following rule: the final grade is taken as the maximum of the two grades, namely, the examination grade and the average grade based on the test and examination results. Weight of written tests can vary depending on the teacher's desire, which has to be formulated at the beginning of the year and reported to students.

In order to ensure anonymity at examinations and written tests students are given special sheets of paper with a special field where to record their names and ID numbers. After putting down these data, students seal the corner of the paper closed so that the work becomes anonymous. In many cases the teacher is not even present at the examination; other teachers specially invited for the purpose keep order. Sometimes this pursuit of ostentatious anonymity clearly goes too far. In some years test papers checked by teachers were returned to the secretariat with unopened grades. To unseal corners and correlate grades with the students' names was not the responsibility of the teachers but of the secretaries, who had to do it in the presence of student representatives. However, it is clear that such extreme anonymity could not last long. At present, the situation is different: the teacher checks a paper not knowing the name of the student who has done it; then the teacher opens the sealed information about the student's name and gives the paper over to the secretariat.

Of course, there are courses attended by a very small number of students. In some years I gave lectures to three to five students. It is evident that I could say whose paper it was with almost absolute certainty; however, even in this case the general rule regarding anonymity of written tests and examinations was still valid.

In my personal opinion, to conduct examinations solely in written form does not seem a progressive approach, contributing to more adequate evaluation of knowledge. At oral examinations it is possible to ask additional questions, the answers to which will show whether students really understand the material or they have simply learnt a few useful formulas without understanding what they mean. During seminars I always call students to the blackboard to solve problems and explain their actions. As a rule, oral

conversation is very difficult for students. Even at the blackboard they prefer to write and not to talk. Nevertheless, it should be admitted that written examinations provide more objective evaluation of knowledge. In many cases they make it possible to avoid conflicts concerning grades between the student and the teacher. Apropos, all written tests of each student are kept at university during several years of the student's education.

I should give credit to French students for their ability to format written tests (or notes of lectures). The majority of students always have a set of colored pens (markers or pencils), a ruler, correction fluid or pen, scissors, glues etc., which they actively use. This neatness in writing and formatting of written tests takes roots as early as at school. However, it cannot but cause some funny consequences.

During a number of years at written tests on thermodynamics I asked students to solve versions of one and the same problem, in which it was required to picture a circular process for ideal gas consisting, for example, of an isobaric process at the first stage, resulting in a two-fold increase in the gas volume, and the following isochoric and isothermal processes, returning the gas to its initial parameters. Year and after year when checking the tests I found graphs of the isothermal process depending on volume and pressure, represented by lines clearly made with a ruler. Probably, if the isotherm was not drawn so neatly, the teacher checking the test might never come up with the idea that the dependence was represented by the student exactly in the form of a line, as there was just a small part of the hyperbola shown in the graph; moreover, it was accompanied by the correct formula ($pV = nRT$); however, the use of a ruler evidently showed that the student absolutely did not understand the subject.

Sometimes instead of traditional written examinations in some disciplines students are requested to prepare an oral presentation, a kind of small course work or, more correctly, individual work. Most often such a possibility is put into practice at optional courses. The range of subjects of such optional courses is extremely wide, from astronomy and Chinese culture to the game of bridge and basic concepts of LaTeX. For a number of years I taught an elective course titled "Symmetry in Nature," which was attended by students of the I–III courses from different departments: mathematics, physics, chemistry, biology, and geography. To pass examination students had to make a 10–15 min report, illustrating different concepts related to symmetry using an example, object, or phenomenon they chose themselves. Of course, I did not insist on making the report in the form of a computer presentation; however, for the majority of students it was the most natural way of making a report, which was self-evident. It is interesting that students of the I–III courses from different departments use computer graphics, repeating a situation that is typical for modern scientific conferences. If we compare mathematical, physical, chemical, and bioecological conferences, there is a clear transition from oral presentations with the use of chalk (or a marker) and the blackboard at mathematical conferences to sophisticated slideshows presented by chemists and biologists. The same trend could be also observed in my students' work. Partial non-compliance with the tradition was likely to result from the students' desire to imitate my style of lecturing. I regularly brought various paper models, tree cones, cabbage etc. to my classes. Therefore, alongside with computer pictures my students actively used auxiliary materials, i.e. they came to the examination with flowers in pots, sea shells, an electric piano etc. to discuss symmetry.

Teaching Load

When comparing organization of the teaching process at French and Russian universities, the teaching load problem can be of certain interest. In French universities the major part of the teaching load falls on permanently employed full-time teachers, who are divided into two categories: Maitres de conference and Professeurs, which roughly correspond to the Russian Assistant Professor/Associate Professor and Professor, respectively.

There are also different temporary teaching jobs with a fixed salary and jobs paid by the hour. Without dwelling on administrative possibilities of using visiting teachers, I should only note that France does not have a tradition typical for the Soviet Union to distribute the teaching load between the teaching and researching personnel: researchers perform teaching work, receiving no salary for this, thereby, reducing the teaching load of the teaching personnel, leaving them some free time for research work. Of course, it is admitted both in France and in Russia that a combination of educational and scientific work is useful for both full-time researchers and for teachers. However, in France if research staff members do conduct classes for

students (a small number of additional hours is allowed by law), this work is paid by the hour.

In terms of time, the teaching load in France is regulated strictly enough. Officially, the teacher's annual load amounts to 192 h (effective hours), which are distributed between classroom lecturing, and seminars or workshops. Effective hours are mentioned in this context because lectures, seminars, and workshops have different weight. One effective hour is equal to one hour of seminars. One effective hour of lectures accounts for 1.5 h; whereas 1.5 h of workshops corresponds to one effective hour. It should be noted that working hours used for calculation of the teaching load in France are standard hours consisting of 60 min, not academic hours used in Russia (45 min). Checking of written tests and examinations is not taken into account in calculation of the hourly load; although, it can take a lot of time, especially when lectures are given to a great number of students. Neither work with postgraduate students nor work with trainee teachers gives any hours accounted for in the teaching load. The presence of postgraduate students can have influence only on receiving a bonus, which is roughly equivalent to the thirteenth salary.

It can happen that the annual teaching load exceeds 192 effective hours. In this case overtime work is paid by the hour. If, however, the annual load is below 192 h, no financial sanctions are imposed. In connection with the fact that the number of students admitted to university is almost uncontrolled, as neither entrance examinations nor selection of applicants takes place, fluctuations in the number of students from year to year can be quite significant. Moreover, there can be variations not only in the number of first-year students but also in the number of students in senior courses, as there is significant student migration between different universities and other educational institutions. The number of student groups in the year is preliminarily estimated based on the figures of the previous year; however, it can change at the last moment. Recruitment of students continues for a month after the start of the official studies. Some departments might not operate at all in a given year due to full absence or a very small number of enrolled students.

A great number of additional hours recalculated to real hours per a staff teacher is a strong argument in favor of obtaining new staff positions. As a consequence, different university departments struggle to get more additional working hours. For example, with some exaggeration I could say that physicists take upon themselves a responsibility to give a course in mathematics for students of physics, chemists – a course in physics for students of chemistry etc. Unfortunately, in this case the problem of the teachers' qualifications and compliance of their knowledge with the subject is hardly discussed.

The teachers' attitude to their work load also has a number of special features characteristic of small provincial universities. Sometimes when distributing the teaching load, teachers, first of all, try to choose the most convenient working time, whereas which subjects are to be taught is a matter of secondary importance.

This feature manifests itself most clearly when teaching is related to moving from one town to another. For example, our Université du Littoral has branches in four towns: Dunkerque, Calais, Boulogne, and Saint-Omer. Driving from one town to another takes about an hour; however, the desire to group classes in other towns together is seen very clearly. If, for example, I have 1.5 h of lectures and 1.5 h of seminars in the same subject per week, in particular, in quantum mechanics, then when I conduct classes in Dunkerque, which is a town where I live and where my workplace is located, I never plan giving lectures and seminars on one and the same day, as I care not only about myself but also about my students. However, if similar classes are to be conducted in Calais, then I (not only I, but almost all teachers) perform all this work in one day, either in the morning or in the afternoon. For many teachers six hours (360 min) of lectures and seminars is a standard daily load.

Why do teachers tend to concentrate their teaching activities so much? Apart from working with students, many teachers carry out active research work. Here it should be noted that teachers receive no separate remuneration for scientific work, apart from a very moderate bonus. Of course, active research work is important in order to progress up the job ladder; however, without any doubt it provides fewer opportunities than administrative and teaching activities if we talk only about intra-university opportunities.

In my opinion, the opportunity to perform scientific work without having to care about searching for additional means of living was by itself a very important factor for a great number of Soviet/Russian researchers and teachers to move abroad in the 1990s. Probably, for many specialists, who need serious experimental equipment in order to carry out scientific

research, France is not the best choice for implementing their scientific ambitions. However, comparing my peaceful scientific work in France with the work of my Moscow colleagues, who spend a lot of time and effort looking for all kinds of contracts and grants, which are essential for them to implement the very possibility to carry out scientific research, I come to the conclusion that serious measures are necessary in order to change the situation with respect to both research and teaching work in Russian universities.

Personnel Policy

An important factor in organization of education is personnel policy aimed at combining teaching and scientific activities, as well as ensuring continuity of generations.

France differs from many countries in that the majority of teachers are state functionaries who have permanent staff positions and can hardly be fired till their own retirement. However, the retirement age is clearly defined. Several years ago the maximum age till which it was officially allowed to hold a university position was 65. Now the retirement age is shifted to 67.5 in connection with an increase in the period of length of service required to receive full pension to 41 years. It should be noted that in case of the maximum length of service, the pension is almost the same as the salary (deductions included). After retirement it is possible to remain a non-staff university employee and carry out research work without receiving a salary. I personally know some professors of mathematics who after retirement continue active scientific work now that they are free from teaching and administrative responsibilities.

The procedure of young teachers' recruitment causes a lot of criticism with respect to transparency and objectivity in the selection of candidates. Nevertheless, every year there is a national competition announced on the same day throughout France. All candidates have to pass national qualification before applying for the competition. The competition committee formed independently for each specialty should include both representatives of the university that has an open vacancy and not less than 50% of invited members. Of course, requirements to candidates highly depend on the specialty; however, there are some general criteria (especially, in case of employing young teachers). For example, recruitment of non-local candidates (i.e. candidates who have performed and defended their theses in another university) is encouraged. Apart from that, as a rule, the candidates are required to have experience of scientific work as a postdoc in some other country. I will not dwell on disadvantages of this system here because, as far as I know, compared to the Russian situation with the teaching personnel, France is now very far ahead in this sphere.

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