Improving the quality of pre-master training of foreign students in the field of environment

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Abstract. The Paper discusses the main characteristics of educational programs for pre-master training of foreign students in engineering and natural sciences. The most important feature of these programs is the individualized approach together with the orientation of the program on the student's master study area. We give the brief description of pre-master program content. In addition, we emphasize on the requirements to Russian language training of the students. We show the importance of preparing and public demonstration of presentations related to the bachelor final works of the students. Based on the analysis we give the recommendations for improving the quality of pre-master training.

1 Introduction

Nowadays they consider the full implementation of a multilevel system of training both in the world and in Russia as an implementation of the humanistic paradigm of higher education. Indeed, the variability of individual educational trajectories is a consequence of the principle of free choice in education [1]. The entrants often choose the first stage of higher education (bachelor degree program) under the influence of parents, or friends, or from heuristic considerations of accessibility or representativeness. In contrary graduates are more conscious for graduate studies and they make a largely independent choice. They can interrupt higher education at all, they can adjust the profile, or they can change the area of training. Such changes inevitably lead to the problem of forming or of improving the competencies necessary for training in the newly chosen area/profile of training. They can solve the problems of preparation for master degree program either independently or through taking pre-master training programs. Currently, pre-master training around the world has become widespread.

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Another major trend in the development of higher education in the last 30 years is its internationalization [1-4]. Among the variety of forms of internationalization, the most obvious is education abroad, either through academic mobility programs, or in the format of academic migration, i.e. with the receipt of a document on the termination of a foreign university [3-5]. This category includes studying in master degree programs abroad. However, the freedom to choose a university for master's training in most cases turns out to be significant problems of student’s responsibility for the perfect choice. This is most true when cultural distance between countries of origin and education is significant. The best way to overcome intercultural difficulties may be participation in pre-master training programs.

2 The Objectives and fundamentals of pre-master training

The purposes of pre-master training of foreign students in leading foreign universities are:
- Improvement of the language competencies of future undergraduates, including those in the scientific and professional sphere;
- Activation of general cultural, and general professional and, possibly, professional competencies, formed at the level of bachelor's training;
- Academic adaptation to study in a foreign university.

The need for general cultural and general professional training at the pre-master stage is associated with possible differences in the requirements for the level of bachelor's training existing at universities of different countries. In particular, this is true for graduates of bachelor's degree of universities in developing countries those seek to take master degree study at the universities in developed countries.

To provide the quality of education in the field of technology we should have the graduates with the ability to combine research, and design and entrepreneurial activities, focused on the creation of highly efficient manufacturing structures, which in turn stimulate the growth and development of various fields of activity. The preparing a foreign graduate at a leading technical university is a complex problem because we need to combine deep mastering of fundamental knowledge with studying engineering and mastering engineering creativity, as well as forming a professional culture of a graduate based on the second certification level of Russian language proficiency.

Peter the Great St. Petersburg Polytechnic University (SPbPU) introduces and develops its own approach to the educational process. The fundamental scientific basis of this developed polytechnic approach means multidisciplinary research for various kinds of large-scale targeted research programs. These studies include solving large-scale scientific and technical problems. We use complex inter-branch and industry-specific technologies, as well as the effective interaction of specialists from various fields of knowledge. Intra-industry technologies allow effective interaction between the specialists from different countries, and various companies and industries. These technologies contribute to the rapid spread and penetration of new inter- and multidisciplinary knowledge into new areas, and to the inter-sector transfer of advanced "invariant" technologies, which is in demand at present in our country [4-11]. This process requires the training of relevant personnel, mainly in the natural sciences and engineering disciplines, regardless of where the student came from. Therefore, the developed pre-master training programs for foreign citizens should lead to this level of competence of foreign students. Although our university has been working with foreign students for more than 70 years, work with those enrolled in the master degree programs requires the introduction of an innovative approach to pre-master training.
You can find a detailed review of the goals, objectives, as well as the content of pre-master programs for foreign students in [5-6]. The authors of this work emphasize that pre-master programs "assume an individual personality-oriented approach to each listener", which is the main characteristic of such programs [5].

Despite the fact that the term "pre-master training for foreign citizens" was introduced by the authors of [5], the priority in the development of such programs belongs to SpbPU. It was reflected in the article [7-16], which touched upon the problems of preparing pre-master’s students in mathematics. The implementation of such a program was possible because a group of bachelor graduates from one of the Chinese universities came to join to the master degree program in economic areas.

We returned to the idea of selecting of pre-masters training as a special program in SPbPU in year 2014. We organized training programs for the pre-master's program for students of engineering and natural science areas, and we holding these programs every year [15-18].

3 Content and main terms of pre-master training

The uniform program for the engineering area of pre-master training includes such disciplines as Russian language, mathematics, physics and computer science. For students of the natural-science profile we replace computer science by chemistry, as well as biology at the level of terminology. In addition, we had to introduce the specialization-level differences. We present the typical study plan for Environmental Engineering specialization in table 1.

Table 1. Pre-master training Study Plan / Profile: Engineering / Specialization: Environmental Engineering

| Course status                        | Course title                                      | Contact hours | ECTS |
|--------------------------------------|--------------------------------------------------|---------------|------|
| General compulsory courses          | Russian Language                                 | 840           | 34   |
| Individual training                 |                                                  | 40            | 3    |
| **Subtotal**                         |                                                  | **840**       | **37**|
| Engineering profile compulsory courses | Mathematics                                     | 160           | 8    |
|                                      | Physics                                          | 80            | 4    |
| **Subtotal**                         |                                                  | **240**       | **12**|
| Environmental Engineering specialization compulsory courses | Chemistry, Biology, Environmental Science | 40            | 2    |
|                                      | Basic Environmental Engineering                   | 40            | 3    |
| **Subtotal**                         |                                                  | **80**        | **5** |
| **TOTAL**                            |                                                  | **1160**      | **54**|

The improvement of language skills is very important part of pre-master training. Indeed, a significant part of master’s programs in Russia is in Russian. For example, SPbPU is one of the leaders in the internationalization of higher education in the country. Nevertheless, only 16 out of the 168 master degree programs offered are in English. In addition, SPbPU offers 16 double degree master programs with partner universities. In most of them, study in Russia is in Russian, study abroad - in a foreign language. It means that the bachelor graduates have a limited choice of master degree programs in English. Thus, we should ensure the teaching of the Russian language deeper than at pre-university training for bachelor's level.
For a number of years the content of the disciplines of pre-master programs has been adjusted [16-20]. Therefore, in the course of mathematics, the pre-master students repeat mathematical analysis, including differential equations, as well as linear algebra. Students learn discrete mathematics, probability theory and mathematical statistics in more details. The last section terminologically differs significantly from foreign analogs. The learning of probability theory gives to the students the tools for understanding the scientific style texts in Russian. This is the most text-rich section of mathematics.

We pay the main attention on the terminology in information theory, and automation control theory, and computer networks theory in the course of computer science. We designed laboratory work to demonstrate to pre-master students methods of working with modern equipment of leading world companies. Perhaps these companies will turn out to be employers of graduates in the future. In addition, the professors prepare students to interdisciplinary exams in computer sciences.

Taking into account the experience of the first years of teaching, we revise substantially the requirements for teaching the physics course. We developed a flexible modern physics course, combining lectures and practical and laboratory exercises. We conducted lectures at the first stage of teaching with special attention to terms and definitions. Then the elements of the solution of tasks and calculation and graphic tasks are included. SPbPU has a powerful fleet of physical laboratory works for all levels of complexity in all areas of the physics course. There are 32 classical works, and 29 virtual ones with full computer simulation, and 11 real works using a computer as a measuring instrument in the arsenal of the physical laboratory. The laboratory is partially equipped with modern laboratory facilities of the world famous company PHYWE.

We pay special attention to the methodological aspects related to the training of pre-master students in a physical laboratory. Via work in laboratory classes students get the experience and develop skills in obtaining, and processing and analyzing experimental results and in writing reasoned conclusions. It is especially important for students in engineering and natural sciences, as well as for future project activities [12-17]. We modify the structure of conducting laboratory sessions and the reporting documentation especially for the students of pre-master training.

All the students must pass an interdisciplinary exam for enrollment to master degree program. Candidates for admission sit interdisciplinary examinations in Russian. Professors control the possession of general cultural, and general professional and professional competences with the exam questions. Relevant training units post all questions for the interdisciplinary exam on their websites. The system of enrollment guidance of foreign students works in SPbPU. Responsible institutions for the training of foreign students conduct enrollment guidance activities for preparatory course students in the second semester. In the case of pre-master training, student’s enrollment guidance should start earlier. This was necessary to refine the area of the master's program. We can provide an early start of enrollment guidance because of good level of preparation of pre-master students in English.

We introduced an individualized approach to pre-master training to help students in the development of professional competencies in the Russian language. Each future master's student should prepare a small presentation in Russian, for example, in the PowerPoint system. We recommend choosing the theme of the presentation in relation with the bachelor's final work of the student, protected at the university abroad. Professor analyzes carefully and agree the theme of the presentation. Student demonstrates the presentation publicly with the participation of representatives of international services and training institutions [18-21].
4 Conclusions

We proclaim an individual approach to the students as the base of pre-master training of foreign citizens. We pay particular attention to the personnel policy in the choice of pre-master training teachers, as well as of the content and of quality of the courses teaching. It is especially important to conduct an enrollment guidance campaign throughout the pre-master training period. One of the important forms of the academic activity is the preparation and demonstration of the presentations of the main results of the protected bachelor's work of pre-master students.

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