Formation of environmental research competencies of foreign pre-masters’ students for sustainable region development

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Abstract. The article considers the development of pre-master's programs for foreign citizens in Russian universities. The main content of the article concerns the formation of environmental consciousness of future research engineers. The article analyzes the content of university websites, as well as the publication activity of researchers in the field of training foreign pre-master's students. The authors highlight universities in which the environmental component of modern engineering master's programs for foreign citizens is the strongest aspect of the curriculum. The article shows that in these universities pre-master's training aims primarily at developing environmental research competencies among engineering students. At the same time, the authors pay special attention to activities and tools that contribute to the formation of these competencies, focused on the sustainable development of the regions of Asia, Africa and Latin America. The authors demonstrate their own statistical data on the development of publications of participants in pre-master's training at Peter the Great St. Petersburg Polytechnic University.

1 Introduction

The term "pre-master training" (PMT) was introduced into scientific circulation by specialists of the Tomsk Polytechnic University (TPU) in 2012-13. Since then, this problem has aroused keen interest in a relatively narrow segment of the scientific and pedagogical community dealing with the preparation of foreign applicants for study at Russian universities. In addition to TPU, PMT in one form or another has been introduced into the educational process of pre-university training of foreigners at Peter the Great St. Petersburg Polytechnic University (SPbPU), Volgograd State Technical University (VSTU), Peoples' Friendship University of Russia (RUDN), Kazan Federal University, Moscow State University, Bauman Moscow State Technical University (BMSTU), Moscow Automobile and Road Construction State Technical University (MADI), Pushkin State Russian Language University (PSRLU) and other universities.

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The issues of the formation of engineering research competencies are relevant in the light of the implementation of STEM education based on CDIO-FCDI-FFCD Standards [1; 2; 3]. It is obvious that the global tasks facing the Russian master's degree at the present time can be resolved only on the basis of preparing students for the last two years of study at the bachelor's degree. Foreign students who have received a bachelor's degree abroad have both different levels of training and also different cognitive focus, due to the national educational paradigms of their countries. Thus, there is a certain contradiction between the high requirements for the preparation of future master level students and standardized programs for the preparation of foreign citizens for learning university level educational programs in Russian. However, these problems have not received sufficient research coverage. The authors try to find approaches to the solution in this article. Another important problem is the formation of an ecological culture of master's degree graduates, since it is they who will make decisions on the sustainable development of their states in the future. This issue has been well studied [4; 5; 6; 7]. The authors consider it in the aspect of the formation of research competencies of pre-master students.

2 Object of research and methodology

The formation of engineering and environmental research competencies in the PMT process implements in two main areas – academic and non-academic work. Accordingly, this study has two interrelated goals. Firstly, it is necessary to determine the optimal structure and content of PMT for various engineering areas of training. This means that the nomenclature and hourly workload of the basic PMT courses should be highlighted. In addition, you should carefully consider the content of the above courses, bearing in mind that the training is conducted in Russian language that is non-native for pre-masters’ students. We should not forget about the methodological support of the basic courses of the PMT. Secondly, it is necessary to identify the essence and nature of non-academic events that contribute to the formation of engineering research competencies of pre-masters’ students. Such events include independent student research work, participation in student scientific and practical conferences, publication of scientific articles. Despite the fact that many similar events in Russia are held using English, pre-masters’ students should be ready to present the achieved scientific results and professional scientific communication mostly in Russian. Thirdly, it is necessary to present statistical results showing the effectiveness of the transformations carried out in the structure and content of PMT, as well as in attracting pre-masters’ students to research activities.

The main research method is to study the experience of the best universities that implement the PMT. First of all, the authors investigated the official websites of universities, then the websites of aggregators of educational services for foreign citizens in the Russian higher education market. This made it possible to identify a group of universities that only declare the PMT, and another group of universities that implement the PMT programs. Also, news sites and media materials were attracted, which made it possible to reveal the activity of universities in promoting the PMT. In addition, the authors have personally participated in numerous professional events dedicated to the preparation of foreign students in Russian universities. In-depth interviews with representatives of the administration and teachers involved in the implementation of the PMT allowed us to reveal a fairly objective picture of the development of the PMT programs in Russian universities. Another source of PMT analysis was the study of scientific publications in scientific journals, materials of specialized conferences and collections of scientific papers. The data from these publications made it possible to clarify the geography and nomenclature of the PMT programs. Also, the categories of universities were identified, which can be considered the most adapted to the introduction of PMT. Also, a statistical study of the results of the implementation of the PMT...
in SPbPU was carried out. The paper provides data on the academic success of pre-graduate students, as well as on their further professionalization.

3 Result and discussion

Because of the analysis of media content, the authors found that the programs for the preparation of foreign citizens for the magistracy are declared on the websites of more than 40 Russian universities. At the same time, on the website of the aggregator “Study in Russia”, only 4 universities applied for pre-master training programs. This indicates a lack of understanding of the problem by wide circles of the scientific community. Only 12 universities present detailed information on the PMT programs on the websites. It reflects the real picture of the development of pre-master training in Russian higher education. The authors also studied the available information about manuals developed to provide pre-master training programs, and scientific events with the participation of pre-master students or dedicated to the problems of pre-master training. Among the scientific events the authors mark seminars dedicated to pre-master training, which became part of the congresses of teachers and heads of preparatory faculties held by RUDN and PSRLU (2020-2021). The authors found section "Pre-master training" of the annual conference "Science Week of SPbPU" (2015-2020) and conference "Topical issues of pre-master training of foreign citizens", organized by SPbPU (2019). Also SPbPU with the participation of VSTU, RUDN and TPU organize videoconferences "Pre-master training in Russian universities" (2019-2021). There are pre-masters’ sections of TPU scientific conference "Scientific initiative of foreign students and postgraduates of Russian universities" (2012-2021), as well as pre-masters’ sections of student conferences MSTU. Authors select 15 Russian universities and present the results of the best practices research in comparable form (table 1).

Table 1. Activity of universities in the field of pre-master training.

<table>
<thead>
<tr>
<th>University</th>
<th>WEB information (sites +/-)</th>
<th>Number of scientific publications</th>
<th>Scientific events (+/-)</th>
<th>Number of manuals issued</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peter the Great St. Petersburg Polytechnic University</td>
<td>+</td>
<td>21</td>
<td>+</td>
<td>1</td>
</tr>
<tr>
<td>Tomsk Polytechnic University</td>
<td>+</td>
<td>17</td>
<td>+</td>
<td>1</td>
</tr>
<tr>
<td>Moscow Automobile and Road Construction State Technical University (MADI)</td>
<td>+</td>
<td>12</td>
<td>-</td>
<td>0</td>
</tr>
<tr>
<td>Bauman Moscow State Technical University</td>
<td>+</td>
<td>2</td>
<td>+</td>
<td>0</td>
</tr>
<tr>
<td>Peoples’ Friendship University of Russia</td>
<td>-</td>
<td>4</td>
<td>+</td>
<td>0</td>
</tr>
<tr>
<td>Moscow State University</td>
<td>+</td>
<td>7</td>
<td>-</td>
<td>0</td>
</tr>
<tr>
<td>Moscow Power Engineering Institute</td>
<td>+</td>
<td>1</td>
<td>-</td>
<td>0</td>
</tr>
<tr>
<td>Volgograd State Technical University</td>
<td>-</td>
<td>3</td>
<td>+</td>
<td>0</td>
</tr>
<tr>
<td>Kazan Federal University</td>
<td>+</td>
<td>2</td>
<td>-</td>
<td>0</td>
</tr>
<tr>
<td>Pushkin State Russian Language University</td>
<td>+</td>
<td>2</td>
<td>+</td>
<td>0</td>
</tr>
<tr>
<td>Moscow State University of Technology STANKIN</td>
<td>-</td>
<td>1</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>Higher School of Economics (HSE University)</td>
<td>+</td>
<td>0</td>
<td>-</td>
<td>0</td>
</tr>
<tr>
<td>Tomsk State University</td>
<td>+</td>
<td>0</td>
<td>-</td>
<td>0</td>
</tr>
</tbody>
</table>
It is clear that some universities only declare the implementation of pre-master's programs. These declarations are not backed up by either publication activity or participation in scientific events. A common drawback for all universities is the practical absence of textbooks for undergraduates. This is due to the inertia of the educational system, which does not have time to respond to new phenomena. A more detailed analysis of publications shows that many of them only indicate the existence of the problems of pre-master's training, and a few give specific recommendations in the field of training engineers and environmentalists [8; 9; 10; 11].

The choice of suitable quantitative indicators of the quality of pre-master's programs led the authors to the need to analyze the publication activity of students and graduates of these programs. 16 undergraduates per year studied at SPbPU in 2015-2016, more than 30 ones in 2017-18, the maximum of 98 people was reached in 2019, and in the pandemic years the number of undergraduates decreased to about 50 students per year. Of course, only a small number of undergraduates can be attracted to research and, accordingly, to participation in publications due to their insufficient knowledge of the Russian language. The numbers of participants in publications by year are given in table 2.

| Table 2. Scientific publications of students and graduates of pre-master programs. |
|---------------------------------|----------|----------|----------|----------|----------|
| Number of publications          | 2015-2018| 2019     | 2020     | 2021     | 2022     |
| Total                           | 8        | 9        | 24       | 21       | 23       |
| Pre-master program students     | 3        | 7        | 11       | 4        | 4        |
| Pre-master program graduates    | 5        | 2        | 13       | 17       | 19       |

The given data demonstrate the success of teachers of pre-master's programs in the formation of students' research activity. Approximately half of the published works are related to the field of physics and electronics, and the second half - equally to the field of computer science and environmental science. This distribution is determined by the given directions of future master's programs of students. The authors give the names of the most active participants in publications. Bassel Zaity and Zein Shaheen from Syria [12; 13] and Ara Abdulsatar Assim from Iraq [14; 15; 16; 17] have proven themselves to be specialists in the field of information technology. Linda Boudjemila from Algeria [18; 19; 20; 21], and Faridoddin Shariaty from Iran [22; 23; 24; 25; 26] joined scientific groups of physicists and electronics engineers at the stage of pre-master's training. All the researchers mentioned began publishing as pre-master’s students and continued to publish had studying in master’s and postgraduate programs. They were also the ones who demonstrated the best academic success in their years of pre-master’s study.

Of particular note are the publications of pre-masters on environmental topics. Forming the environmental consciousness of future engineers is one of the main tasks of higher education in the field both of fundamental science and technology [27; 28]. In the last decade, universities have been paying increasing attention to shaping the environmental consciousness of students in connection with global climate change [29]. Because only specialists with the appropriate competencies will be able to ensure the sustainable development of their countries and regions. Pre-master students from many countries around the world study at Peter the Great St. Petersburg Polytechnic University. Their research contributes to the development of environmental science in Asia [30; 31], Africa [32] and Latin America [33; 34; 35]. In the future, the authors plan to include the number of
publications of pre-master students in the indicators of university activity in terms of pre-master training of foreign citizens at different universities.

4 Conclusion

The authors conducted a study of the activity of Russian universities in the field of pre-master's training of foreign students. The authors used 4 criteria: information on the university website, publication activity of teachers on pre-master's issues, holding specialized events and publishing textbooks. The authors found that there are two indisputable leaders in the development and implementation of pre-master's programs in Russian higher education. These are Peter the Great St. Petersburg Polytechnic University and Tomsk Polytechnic University. These universities have non-zero indicators in all criteria and are significantly ahead of others. At the same time, it is necessary to develop cooperation between universities in the field of pre-master students training. The best option may be to organize a network pre-magistracy for foreign citizens.

The authors analyzed the mechanisms of formation of research engineering and environmental competencies of foreign pre-masters. The authors collected data on scientific publications of students and graduates of pre-master's programs of Peter the Great St. Petersburg Polytechnic University from different regions of the world. The authors cited the names of the participants in the program, who made themselves known to the greatest extent by publications in indexed sources, paying special attention to works on environmental topics for the sustainable development of their states.

References


