How to attract young people to science? (based on materials of sociological research)

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Abstract. Involvement of young people into science at the present time is relevant not only in Russia but as well in countries with big experience in this process. The article states that profession of scientist is considered prestigious in the United States and positioned at 4th place in the rating, wheras in Russia it is only at 19th place in the similar rating. The conclusion is based on the sociological studies conducted in the United States and Russia. The authors speculate that changes in public policy in Russia, aimed at recovering of scientific potential, had an impact on young people's ideas and motivation for scientific work. The article provides an analysis of the sociological study conducted by the National Research Tomsk Polytechnic University (TPU), which aims to determine the willingness and possibility to engage in scientific work. The authors note that TPU entered the federal program "5-100-2020" at 4th place in the ranking of the best universities in Russia and has extensive experience, research base, international training programs, exchanges, and internships with best universities in the United States and Europe. The main conclusions of the study is that master students are ready to engage in scientific work; conditions created at the university are the backbone for the development of scientific career of the students; the highest motivation for students is the satisfaction in their scientific advisors.

1. Introduction

Almost 20 years ago, a prominent populariser of science, astrophysics, astronomer, famous scientist Carl Sagan wrote: "In opinion poll after opinion poll science is rated among the most admired and trusted occupations, despite the misgivings" [1]. Obviously, the question of how to attract students to science remains relevant today. It is relevant not only in Russia but also in countries with extensive experience in the involvement of young people in science. We can see it in G8 countries: UK, Germany, Italy, Canada, USA, France, Japan. Despite the fact that these countries have a strong scientific and industrial base, science parks, exchange programs, support programs for talented youth, development of


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government-supported private partnership of major companies with universities, the search for new ways to involve young talented researchers in science not only continues, but is also "gaining momentum". It is worth emphasizing that in Germany, France, Belgium and most of European countries studying in undergraduate, graduate, and postgraduate programs is free and the base for fundamental scientific research is strong. On the other hand studying in the United States requires payments while granting access to high quality of educations and tools. Still the school system of the United States remains behind the University standards making the States an attractive place for talented youth from all over the world. The basis for fundamental and applied research in the US is as strong as in Europe. By the number of research centres the United States overtake any of the European countries. The climate for the development of scientific and innovative ideas in the United States is maybe the most favourable in the world. The active work for integration of young people in different research projects in the United States comes through:

1. Governmental organizations such as: USAID (United States Agency for International Development);
2. Non-profit, non-governmental organizations such as ACIE (American Councils for International Education), CIEE (Council on International Educational Exchange).

The main objective of these organizations is educational and research programs of academic exchange, programs on international scientific collaboration, programs for research projects support, investments search supports and consulting. But what should be particularly emphasized is that these programs are focused to attract foreign research staff as one of the most important directions of their activities. Here is the list of the most important programs of that kind:

- Hubert H. Humphrey [2];
- Fulbright Program [3];
- Global UGRAD Program (The Global Undergraduate Exchange Program of the Department of State) [4];
- Edmund S. Muskie Graduate Fellowship [5].

2. How sociologist sees the profession of scientist

A vivid picture of the prestige/ non-prestige of the profession of a scientist can be drawn on the basis of the sociological data. For example, according to the US research firm Harris Interactive for 2014, in the top ten most prestigious professions in the US the profession of scientist ranks fourth (76%). Moreover, in the age group 18-37 years, this figure is even slightly higher - 78%. Additionally, in the list of 23 occupations that parents would choose in the future for their child, the profession of scientist holds the third place - 91%, after the engineering profession - 93%, and the medical doctor - 91% [6]. As of 2002, the profession of the scientist took first place in the ranking of the most prestigious professions, 51% of respondents put it in the first place. The medical profession was the second place - 50%, and the profession of engineer - seventh place (34%). There is no doubt that the position occupied by the profession of the scientist in the today's US is much higher than in Russia. For example, according to the Russian Public Opinion Research Center, in 2012 the profession of scientist was ranked at 19 position (2%) among the most prestigious professions [7]. Center for Social Forecasting in Russia in 2006 published a digest "Science in Russia: the sociological analysis". The authors of the evaluation of the students at Russian university concluded that "the academic profession is of public importance right after the medical profession. However, it is only the 8th among the prestigious professions, and profitability-wise shares 7-8th places with the military" [8]. In the same book the indicators of potential of scientific specialists among university students shows that 60% of students do not show interest in scientific work and only 6-8% have a tendency towards scientific work, 30.8% participate in scientific research (university/ faculty) and only 14% plan to apply to graduate school. In addition, the utility as a motivator to participate in the scientific work is evaluated by the students of Russian universities in the following way: helps to expand professional knowledge - 18.8%; develops research skills - 11.1%; provides professional practice and will help to quicker adapt to the workplace - 10.0%; helps to understand whether it makes sense to do science in the course of the working live or not - 7.3% [8].

Referring to the Russian reality, the problem of aging of scientific specialists in Russia had started to be pronounced since the early 90s, after the liquidation of the Soviet Union. Whole generation of young talented researchers "dropped out" from science. By the beginning of "zeros" Russian science has been recognized as the oldest in the world, 40% of graduate students due to a low income had left science. "The average age of the candidate of sciences has reached 50 years, every sixth scientists is a pensioner, half of the researchers are older then 50. Only 15% of the college students continue into science after graduation. Ratio of scientists younger then 40 decreased to 12%" [9].

According to sociologists, the reasons for the reluctance of students to engage in scientific work in Russia are due to conditions that dominated in the early 90s and until the mid-2000s: low wages; the absence of a material base for research and development; bureaucratization of the organization of scientific work; low prestige of scientific work [8]. And speaking about the interest in scientific work, it is first necessary to understand that in any creative profession, "and science is a creative profession, and forced creativity is impossible. - As emphasized by sociologists - one in ten students [in Russia] is involved in research work in 'voluntarily-forced' manner" [8].

Since the mid-2000s, the restoration of Russian scientific specialists was among the government priorities. Today, young scientists receive financial support through both domestic and foreign programs through grants, foundations, and governmental organizations.

At the state level the target program "Scientific and scientific-pedagogical specialists of innovative Russia" was designed 2014 - 2020 years and is currently operational. The purpose of the program is the "development of an effective system of reproducibility of highly potential specialists of scientific and educational spheres and increase of their competitiveness on a global scale" [10].

Among the non-state funds to support research the best known are: Alferov Foundation, Vladimir Potanin Charity Foundation, Bortnik Foundation, Prokhorov Foundation, Non-Governmental Ecological Foundation of V. I. Vernadsky, National Specialists Training Foundation, Charitable Foundation to promote domestic science etc.

The Russian Bureau of International Educational Programs "Straight talk" regularly presents new services in the field of education, training, exchange, *etc*, which are provided by the most well-known universities, primarily from the countries of G8. In addition, scholarship programs developed by the President and the Ministry of Education for the period 2014-2017 provide grants of € 32 000 for tuition fees (master or doctoral programs in the best universities of the world). "One of the main conditions of the grant will be signing by the involved student an agreement that he will return to Russia at the end of the program and will work in a state-owned company or organization for 3 years" [11].

3. Results of sociological research at TPU

An example of the effective involvement of young talented youth in science is the Tomsk Polytechnic University, who entered the program '5-100' - a project of Ministry of Education aimed to improve the competitiveness of the leading Russian universities among the world's leading research and education centres. Tomsk Polytechnic University has great experience, research base, international training programs, exchanges, internships with the best universities in the US and Europe. In 2014, according to Vladimir Potanin Foundation, TPU received 4th place in the ranking of Russian universities. Among the 14 universities of Russia in the ranking of QS (for 2014) TPU occupies the 10th position and 45th place in the top 50 (QS) rankings of universities in developing countries of Europe and Central Asia, showing the best result among Russian technical universities located outside Moscow and St. Petersburg.

In 2014 TPU carried out a sociological study to examine the readiness of students and the available opportunities for the students to engage in scientific work. The main method of obtaining empirical results was conducting a survey in the form of a questionnaire. The selected for questionnaire were the students of 1st and 2nd year in master program. The number of graduate students at the time of survey was 1 686 people. The sampling quota was managed according to the profile of training in the master program. 80 students were surveyed. The questionnaire included 100 items, grouped in the following blocks: personal information; objectives, results and plans; daily routine, leisure time; scientific work.

The questions were of different types: multiple choice (no more than 3 options), closed questions, the assessment on a scale from 1 to 5. For further analysis, we can identify the following types of indicators:

- Quantitative. For example: "How much of free time do you have per day?";
- Ordinal. For example: "How do you assess, on a scale of 5, the most important results that you expect from your master degree?";
- Nominal. For example: "Do you consider as your possible future work in the next 5 years, the following options?", with the options indicated.

The hypothesis of the study: TPU has highly professional scientific atmosphere, there are the necessary resources to carry out research (laboratory space, office space, equipment, material resources and qualified supervisors, opportunity to participate in scientific conferences and other events held in the TPU, Russia, and abroad), availability/ opportunity to engage in scientific work depends only on the level of personal self-organization of the student.

Analyzing the data obtained during the study, we concluded that the majority of students (75%) at master program are former undergraduate students from TPU, it indicates that the outflow of students to other schools is minimal and the university is actively informing, advising, carrying agitation work to attract students in the master's programs. But at the same time, a fairly low rate of participation are in research projects of TPU, only 25%; the number of students who combine the work in the TPU projects and according to their specialization is only 8%, while almost half of the students combine school and work (48%). Consequently, the last category of the students has the time to participate in research projects. Distribution of answers to questions by category is shown in Figure 1.

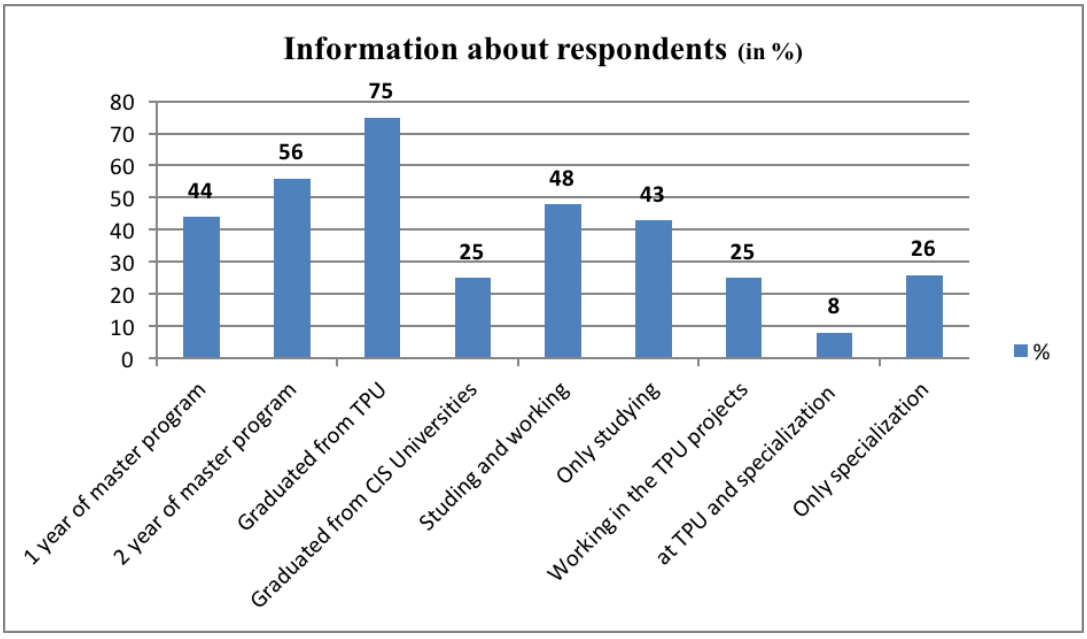

Fig. 1. Diagram of distribution of responses on the block "information about respondents".

It may be noted that the application of students for the master program is a sensible decision. Perhaps this decision was done at school or while studying for bachelor degree, as "acquiring of knowledge and a diploma" among the possible answers (no more than 3) is the choice of 74% of respondents. Relatively fewer responses selected from the category of "on demand" and "no alternative", which presents options haven't found a job - 8%, forced necessity (Army, influenced by parents) - 18% (Figure 2).

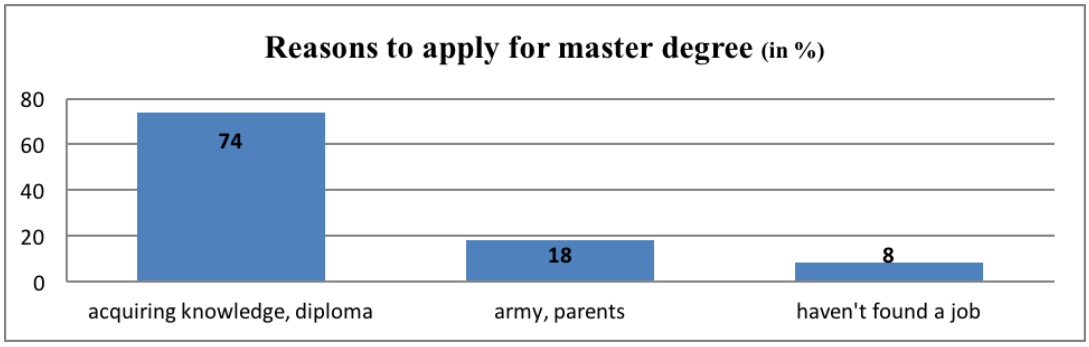

Fig. 2. Diagram of distribution of responses on the block “reasons”.

As results of the acquiring master degree students have chosen the answers that can be attributed to the group of non-material incentives. This is primarily a prestige (63%). To get practical skills, a high level of knowledge and interesting work is the aim of more than a half of the respondents, whereas a financial incentive, such as a high-paid job, and a diploma, is present in one third of all respondents. Quite interesting is that (although a small number of 19%) respondents have chosen as the end result of learning “the ability to acquire knowledge" (Figure 3).

This allows us to hope that in the future these students plan to relate their further education to the TPU’s graduate school. Perhaps this group is the future scientific potential. And how well suited the university teachers to motivate this group depends on how many of them will be not just staying in Russia, but in science in general. At least for the moment, plan to continue the education in graduate school in Russia is the choice of 39% of respondents, stay and work in Russia plans 76%. The number of students who are planning to work abroad is only 35%, going to graduate school abroad is the choice of an even smaller number of respondents, only 20% (Figure 4). We can assume that this is due to “language barrier”. We believe that in the near future this figure will change for the better, because TPU deployed multiple language training programs for different levels of language proficiency.

A special place in the study was given to the study of the student’s self-organization and the allocation of their time between studying, scientific work and the leisure time during a week. About a third of the students spend on their studies and research work only 8-10 hours a week, while on entertainment, sports and hobbies they spend 16-28 hours a week. To make time for studies of 10 and more hours is the answer of 40% of students, 5-10 hours and more for the scientific work is the answer of 1% to 10% of the master students. To monitor personal free time and to estimate that it is of enough quality is the skill and answer of less than half (42%), while 58% do not know how to dispose their free time and are feeling constant shortage of free time. Moreover, 42% are spending 6-7 hours on sleep, the remaining 58% are spending 8-12 hours of sleep. 60% of respondents try to stick to the agenda, for 40% of the others there is no agenda.

Interest in scientific work is expressed by more than half of master students (78%) and 89% believe that in the TPU there is highly professional scientific atmosphere. According to respondents, TPU has the necessary resources for the organization of scientific work (from 74% to 89% of the students choose this answer). Here the resources considered are: financial and material. 66% of the students participate in scientific events at TPU, 80% in Russia, and 35% abroad.

Among the key problems hindering scientific work are the following: laziness prevents - 75%, the lack of free time is experienced by 78%, family obligations prevent 60% to engage in scientific activities, and the need for jobs is the reason of 54% of the students. We can say that in general, students do not know how to build a schedule, to control the distribution of their free time, to overcome laziness. But you should pay attention to the fact that the involvement of students in research work that pays well, will reduce the number of those who are forced to look for jobs on the side to provide themselves and their families with the necessary level of prosperity.

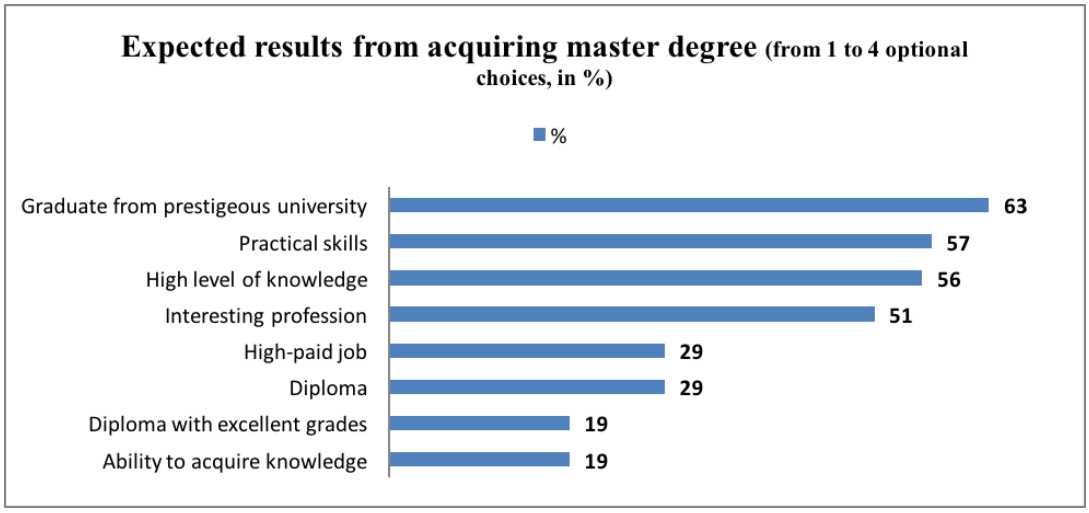

Fig. 3. Diagram of distribution of responses on the block "Expected results".

According to the analysis the satisfaction with scientific supervisor is among the essential incentives of students to involve in research. Most students agree with these statements: supervisor has good leadership skills - 96%; supervisor is interested in my participation in scientific activity - 94%; supervisor shows me respect - 92%; supervisor gives me time to such an extent that I need - 94%; I'm interested in the proposed by supervisor themes - 84%. It should be emphasized that the majority of students is ready to work in a team (71%).

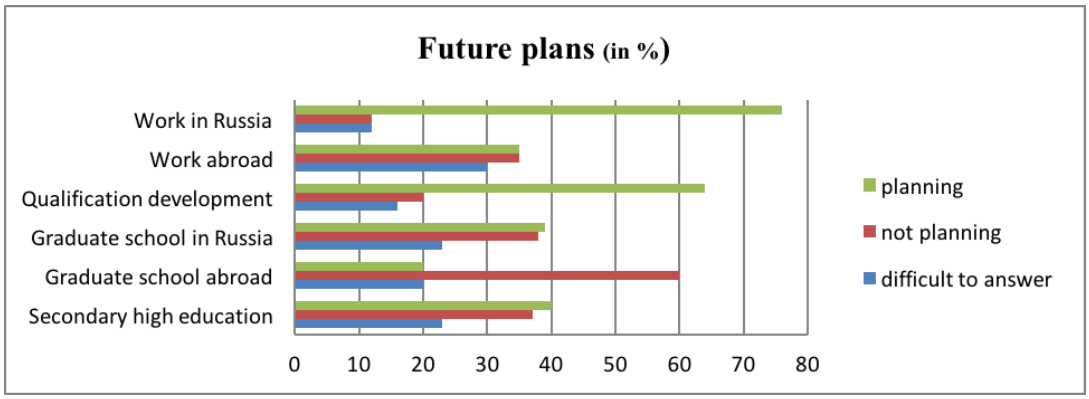

Fig. 4. Diagram of distribution of responses on the block "Future plans".

4. Conclusions

The conducted study shows that the master students of Tomsk Polytechnic University are willing to do research. In general, the study confirmed the hypothesis. Non-material incentives such as personal interest, prestige, knowledge prevail over material incentives. The biggest problem hindering the organization of scientific work of the students is the lack of skills and the ability to self-organization: the daily schedule, the self-control over personal free time, laziness. The study has revealed a problem that requires deeper analysis and attention. This is a lack of awareness of students about opportunities to participate in research projects, grants, conferences, internships, and other events.

Available at TPU base for research activities, including financial, material resources, highly qualified scientific executives allows to make optimistic forecasts. First of all, about the fact that 'voluntarily-forced' form of organization of scientific work in the TPU is not the case. The conditions created by the leadership of the university, are the backbone for the development of scientific career of students. Secondly, the highest incentive motivation is the satisfaction of students with their scientific supervisor.

In our opinion, the scientific career of famous scientists always shows an example how a good scientific supervisor pushed young scientists towards their future careers. In his memoirs Carl Sagan writes on his experience at the University of Chicago: "The status of the teachers in the Hutchins curriculum had almost nothing to do with their research; perversely – unlike the American university standard of today – teachers were valued for their teaching, their ability to inform and inspire the next generation" [1].

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