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ARTICLE IN THE SPECIAL SECTION

# Youth Participation in Citizen Science: Problems and Opportunities of Engagement in Russian Context

*Gulnara F. Romashkina*
University of Tyumen, Tyumen, Russia

*Elena V. Andrianova*
University of Tyumen, Tyumen, Russian Federation; West-Siberian Branch of the Federal Research Sociological Center of the Russian Academy of Sciences, Tyumen, Russia

*Marina V. Khudyakova*
University of Tyumen, Tyumen, Russia

**ABSTRACT**
We present a study of social participation in Citizen Science. The aim is to identify the problems and opportunities for attracting young people to Citizen Science using an example of genetic research projects held in 2020–2023 in Russia. The paper briefly reviews the development of the understanding and use of Citizen Science, as well as shows its application in genetic research. Empirical data were obtained in the course of qualitative and mass quantitative sociological studies. Scientific, organizational, and social contexts of wide involvement of people in scientific activity are shown. The narratives and motives of interested parties are analyzed. The study revealed limited development of Citizen Science practices in Russia, as well as the underdevelopment of the infrastructure for expanding social participation in scientific research. Moreover, natural scientists show contradictory attitudes and doubts about the involving volunteers in scientific research. We conclude that critical and doubtful attitudes towards Citizen Science decrease as practical experience of interaction is gained. According to data from mass sociological studies, there are significant differences in young people's assessments of scientific activity and participation

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g.f.romashkina@utmn.ru, e.v.andrianova@utmn.ru, m.v.khudyakova@utmn.ru

in volunteer practices, especially at school age. The necessity to draw public attention to the potential of using Citizen Science in a broad sense has been demonstrated.

**KEYWORDS**
youth, volunteers, citizen science, motivation, social technologies

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## Introduction

The collaboration of science and private life is reflected in the active participation of ordinary people in the production of scientific knowledge. Thus, research carried out by amateur scientists is referred to as Citizen Science (Cooper, 2016). On the one hand, this involvement of ordinary people causes so-called massivization of science, thus changing the ground rules within the scientific environment. Given this, scientists by profession are forced to adapt to the changes (Popova et al., 2017). However, many of them oppose these changes, rejecting the practices of citizen science as quasi-scientific. On the other hand, Citizen Science practices that have existed for over a hundred years (and implicitly for over three hundred years) are global in scope, representing one of the most inherently horizontal forms of public participation in progressivist action. Such activities change localized communities by encouraging people to work for the common good and scientific progress. In this way, people learn about themselves, the world around them, and the possibilities of modern science. They can better accept the knowledge and innovations that new scientific data and results bring to private life.

Citizen Science, as well as volunteering in general, is social participation in a broad sense, since it is a horizontal interaction or a form of collective action. Embedded in certain institutional settings, it has different directions of interaction, including centers of engagement initiation (Pevnaya & Tarasova, 2022, p. 209). Social participation acts as a source of social ties in communities (Verba & Nie, 1987), increases trust in social institutions, including the state (Vishnevskii, 2021, p. 109). In this sense, Citizen Science expands opportunities for interaction between such important institutions

as science, education, the state, and ordinary people, increases public confidence in science, creates many additional channels of horizontal communication, changing society itself.

Our research focuses on voluntary participation in scientific research and projects, or scientific volunteering, or Citizen Science (CS). In many countries, the engagement of non-professionals (citizen scientists) in the implementation of scientific projects is a common practice; however, in Russia, such types of activities are either new, little known, or are not articulated as volunteering. An overview of publications by Russian authors on the issues under study reveals that the majority of works analyze the international experience of Citizen Science reflecting on its philosophical and sociocultural aspects (Shekera, 2022, p. 92). As a form of social participation for national practice, Citizen Science remains largely unexplored and faces even greater difficulties than cultural, social, and educational volunteering in Russia (Volkova, 2019, p. 42). In the Russian discourse, Citizen Science is often seen as a social project that is still in the process of forming its own identity (Muraveva & Oleynikova, 2021, p. 48). Gazoyan (2020), Muraveva & Oleynikova (2021) explore the limitations of citizen research, including mechanisms of interaction with professional science, barriers to its scaling.

In practice, the enthusiasm of volunteers, who are excited to be involved in scientific projects, is often counterbalanced by the skepticism of scientists themselves as to whether such projects might actually be of any scientific merit. Moreover, both scientists by profession and science administrators note the contradictory and ambiguous attitude to the work of related sciences and citizen researchers. In this regard, there remain open questions concerning the organization of citizen scientists' activities, the principles and standards of such work, along with other issues such as the concept of citizen science, its differences from other practices, and the involvement of non-professionals in solving research issues.

Pevnaya et al. (2020) note that modern formats of volunteer activity are determined by several aspects: the structure of the organization of activity (formal/informal); place of activity (online/offline), its intensity (episodic/regular); motivation of the volunteer (self-improvement/community creation); category of work (provision of services, mutual assistance, participation, agitation, and leisure). On that basis, we focus on the motivations for participation and types of volunteer activities in CS, as well as organizational schemes of work to engage citizen scientists in this paper.

## Characterization of the Basic Concept

Further, we rely on the definition of Citizen Science from the Oxford English Dictionary, that is, “scientific work undertaken by members of the general public, often in collaboration with or under the direction of scientist by profession and scientific institutions” (The University of Oxford, n.d.). Thus, the key criteria are the choice, desire, and motives to engage in such activities. The role of Citizen Science has been understood differently in the research of naturalists, representatives of the exact and technical sciences, humanities and social sciences. Historically, this is due to the

discussion between R. Bonney and A. Irwin who are considered the founders of the CS concept (Bonney et al., 2016; Irwin, 1995). On the one hand, scientists by profession are focused on the interests of science as "things in themselves," pay a lot of attention to data collection technologies, the development of scientific tools. With CS approach, the costs of large-scale works can be significantly reduced (Romashkina & Lisitsa, 2022). However, the free use of civilian researchers' labor is quite often criticized (Vohland et al., 2021). Likewise, the use of the term "science" in defining the activities of non-professionals is also under criticism. These are, however, characteristics that are essential for scientists and resonate with volunteers. Representatives of the humanities and social sciences draw attention to the fact that the inclusion of a wide range of non-professionals opens science to the public, while at the same time attracting research attention to the problems of citizens (Irwin, 1995). In this sense, SC contributes to the democratization of science, the development of civic engagement of society (Zhelezniak & Seredkina, 2016); like any other non-profit sector, it serves as "an arena of collective action around common interests, goals and values" (Clark, 1991). Also, the possible reduction of bureaucratization is noted. Certainly, the transition from amateurism to professionalism increases quality, and these arguments are relied upon by critics of CS. The complex relationship between academia and society is now increasingly criticized, accusing the former of excessive bureaucratization, focus on scientometric indicators rather than on "pure knowledge" and "common good," making arguments for absolutization of financial results.

Modern researchers suggest distinguishing between a broad and narrow understanding of CS. The active participation in scientific research of voluntary participants from among ordinary citizens gives an idea of the broad semantic content of Citizen Science. In a narrow sense, CS involves obtaining truly scientific results by non-professional scientists (Vohland et al., 2021). For a number of reasons, the international institutionalization of Citizen Science has bypassed Russian practices; therefore, the present priority is the development of Russian institutions for expanding the participation of citizens in scientific research and their support.

## Citizen Research Practices

A rather specific list of types of volunteer work is known that implies the inclusion of a wide range of non-professionals voluntarily participating in the scientific process (Federal crowdsourcing and citizen science catalog, n.d.). Some projects involve volunteers in the field and laboratory work, such as collecting natural material, archaeological digs, as well as medical, biological, ecological, and agricultural tests and studies. This allows scientists to process large data arrays for complex calculations, process modeling (Shekera, 2022, p. 96). In addition, some equipment of volunteers or their IT competencies can be used. Civilian researchers might be engaged in data ranking and classification, extraction of content from an image, annotating, and other issues that fundamental scientific research usually solve (Wiggins & Wilbanks, 2019).

Modern scientific-cognitive activity is being transformed into the one assuming different degrees of engagement among the subjects of scientific cognition. Therefore,

CS is considered as an organization form of scientific activity, as a unification of cognitive efforts on the basis of scientific methods and scientific worldview (Pirozhkova, 2018, pp. 77–78).

Meanwhile, scientific popularization is also being accomplished as well as the recruitment of volunteers who might eventually become scientists. The hierarchical interrelationships that are being built are partially transformed into a dialog between professional and non-professional scientists, and partially into a developing volunteer movement. This mechanism requires a greater level of trust from science to society, and science also needs to be open to the issues of society.

Trust, knowledge, cooperation, and mutual assistance stand out as the basic values of Citizen Science. The inquisitiveness inherent especially in young people, the desire to learn about the world around them, and the popularity of online interactions contribute to expanding the boundaries of citizen science (Volkova, 2019, p. 43).

Due to the real growth of volunteer research in the international community, the European Association for Citizen Science institutionalized its basic principles in 2015. Alongside the essential characteristics described above, which imply the productive citizens' engagement aimed at achieving new knowledge and bringing benefits to all research participants, organizational rules and legal aspects have been defined. The organizational rules established for such research provide for the citizen involvement at all stages of the research, control over their work, public availability of CS project data, and feedback from the organizers, in particular on the volunteer's personal scientific contribution, the quality of the data provided to the scientists, and the extent of the impact of the research results on society. The legal aspects of CS take into account ethics, copyright, and intellectual property issues[1].

Citizen Science is most engaged in biology, environmental protection, ecology, and geography (Kullenberg & Kasperowski, 2016). In addition, Citizen Science projects contribute to solving problems in the field of food supply, achieving the goals of sustainable development (Ryan et al., 2018). In different countries, farmer volunteers are involved in agricultural experiments (Gosset, 1936).

As to the organization of citizen research, the practice of independent projects on a non-profit basis or local research projects is more widespread. Another important factor for the organization of citizen research and the development of Citizen Science in general is the availability of appropriate infrastructure, primarily high-quality information platforms. For example, the Russian project *Liudi nauki* [People of Science][2] exemplifies the effective information ecosystem for citizen research. This platform enabled everyone to find a project according to their personal preferences and resources. Regrettably, the project was discontinued after the funding period expired.

To sum up, the development of scientific volunteering in Russia should be recognized as neither systemic nor widespread. According to the Institute for Statistical Studies and Economics of Knowledge of the National Research University Higher School of Economics, in 2019, only 3% of the adult population (aged 18–65 years with

[1] https://www.ecsa.ngo

[2] https://citizen-science.ru

a total sample of 7,584 people) noted the experience of participation in some type of scientific volunteering (Gokhberg et al., 2020).

Due to the integration of scientific volunteering into the initiatives of the Decade of Science and Technology in Russia (Ob ob'iavlenii v Rossiiskoi Federatsii, 2022), we can assume an increase in efforts to promote the practices of involving citizens in large-scale research projects in the near future. The government has created a demand for the involvement of scientific volunteers. In this regard, since 2021, six major scientific projects in the field of genetic technologies have been implemented in five Russian regions within the framework of the Federal Scientific and Technical Program for the Development of Genetic Technologies[3] (hereinafter referred to as Genetic Research). For each of the projects, a large-scale involvement of citizen scientists was intended in order to expand the geography of voluntary participants as much as possible. Of particular importance was to ensure the largest possible involvement of the studying youth. Researchers and organizers faced some difficulties: they had no experience in interacting with volunteers and did not understand the structure of organizing such work. In addition, the actual participants often denied the very possibility of a successful outcome.

## Data and Methods of Analysis

The processes of involvement of citizen researchers (scientific volunteers) in the genetic research projects were studied in 2022–2023 in the course of a sociological study. The study was designed following the scheme of work with citizen researchers in Genetic Research: scientist by profession—project (subproject) leader—organizer of work with volunteers from the project—mentors—scientific volunteers. We labeled the first group as "scientist by profession," the second and third as "organizers," and the fourth and fifth groups were actually "volunteers." In-depth interviews were conducted with representatives of the first three groups, as they were the most informed. The fourth and fifth groups were examined using mass questionnaire surveys. In this article, we analyzed 11 interviews with representatives of the first two groups, as well as sociological data of a formalized survey in the fifth group, which we defined as citizen researchers, and a mass formalized survey in a random sample of young people aged 18–35.

The survey was conducted according to a three-stage design. The samples were purposive, non-random; data collection was carried out by the snowball method. The sample V1 was formed directly in the process of Genetic Research from students-citizen scientists (citizen researchers' sample). A total of 530 citizen scientists were interviewed, of whom 477 (90%) were aged 18 years and 53 (10%) were aged 19–35 years; 33% female and 67% male. Since scientific projects are implemented in different territories, this sample is characterized by geographical diversity. Of the respondents, 23% live in rural areas, 28% of volunteers live in small towns and urban-type settlements, 33% live in large cities with a population of up to a million, and 16% live in cities with a population of over a million.

[3] https://fcntp.ru/programs-and-projects/gentech/detail/

Sample V2 (control, or random) was formed by mixed method, through questionnaire and online survey of respondents from young people under 35 years old. The sample was selected randomly, with a sample size of 3,159 people. The V2 (control) sample comprise 40% male and 60% female, 24% of respondents live in rural areas, 14% live in small towns and urban-type settlements, 22% live in large cities with a population of up to a million, and 40% live in cities with a population of over a million. Two age groups were identified in the V2 sample structure: under 19 years old are 2,114 people (67%) and 19–35 years old are 1,045 people (33%). Since the former are more likely to be still in secondary general education and the latter have already completed it, we refer to these subsamples as V2M and V2S, respectively. Subsamples of both V2M and V2S are 39% and 40% male, respectively. In the V2M sample, 95% of respondents are in high school and the rest are students; the V2S sample has 87% of students in the group up to 25 years old while in the group 26–35 years old, 5% are students, 86% are employed and 9% are neither working nor studying.

The research questions were aimed at identifying the characteristics of CS perceptions among those who had such experiences and those who could potentially be involved. The authors used qualitative analysis of textual data and the statistical software IBM SPSS for quantitative analysis.

***Organization of Citizen Science in Genetic Research***

The projects we reviewed required the widest geographical coverage and the involvement of a large number of schoolchildren and students. In the projects, the interaction with citizen scientists varied depending on the tools and goals. Some projects involved volunteers for collecting biomaterials in a particular way. At times, the scientists asked volunteers to lend their digital resources or to do some work in the laboratories. Citizen Science was understood here in a broad sense.

In our study, we distinguish cognitive-affective, status, and behavioral signs and contexts. Our assumption was that the status component reflects future orientation, the cognitive-affective component represents orientation directly to cognition and communication, and the behavioral component displays current actions and motives. Organizers mainly emphasize the behavioral context, but there are also cognitive-affective signs.

According to the interview results, at the planning stage and during the first experience scientist by profession and organizers had different opinions about the feasibility and efficiency of work with scientific volunteers. Scientist by profession were often reluctant to involve volunteers in science or distrustful of their work. They most often built their critical argumentation on the basis of status and behavioral contexts. The organizers' arguments were much more diverse. First of all, they relied on behavioral signs. They tested different ways of involving scientific volunteers and arranging their work, as well as built communications with all the participants of the projects.

In particular, scientist by profession expressed the following opinions: "I asked not to involve volunteers in my project", "people who are non-professionals can spoil not only our results, but also the image of science itself", "in my opinion, all these things [SC] are just empty words". As for organizers, they said: "Communication is not clear enough … it is quite difficult to understand how it should be arranged," "not

everyone knows each other, it is not clear yet who is doing what," "scientists do not always communicate with citizen researchers" (Trans. by Gulnara Romashkina, Elena Andrianova, & Marina Khudyakova — G. R., E. A., & M. K.).

In the course of the work, the assessments of scientist by profession shifted towards cautious optimism. Here are examples of statements by representatives of different groups of informants: "It really matters to me how it all works," "how everything will continue after the funding is cut off," "sometimes citizen researchers come to work in science, but in their hearts, they still can't give up volunteering," "I would like it to be not a single action," "if after involving 100 people we get three people in science, will it a lot or not enough?" (scientist by profession; Trans. by G. R., E. A., & M. K.).

> Almost every scientific project involves work, repetitive actions that do not require special skills and knowledge. … It is possible to teach a person some simple technical functions quite quickly and, probably, it would be even effective," "the skeptical attitude of scientists may be caused by their unwillingness to interact … but this is fixable. (Organizers; Trans. by G. R., E. A., & M. K.)

All organizers emphasize the difficulties in organizing citizen research, as well as the necessity to technologize some key works (behavioral and status context):

> To structure the target audience by age, keeping in mind that different ages have different needs, communication channels, means of engagement, and levels of expertise in social experience, so different tasks can be entrusted to them; "all the legal aspects should be figured out, i.e., the organizational framework should be developed. (Organizers; Trans. by G. R., E. A., & M. K.)

Also, organizers said:

> The first step is to define the goals for citizen reearchers, … to identify those functions or items of this research that can be entrusted to common people, … to think through the communication system ... and what the path of a citizen scientist in the project will look like, how they will learn about it, what they will do in the project, how they will get feedback. (Trans. by G. R., E. A., & M. K.)

The basic narrative of the organizers suggests that citizen science holds great promise or resource for science, which is, however, difficult to realize:

> It is especially relevant today. There are stereotypes in society about science and scientists that they are such "ivory towers," … they know something, do something, but there is no sense in their work. … Stereotypes arise from the fact that they are not familiar with this field. (Organizers; Trans. by G. R., E. A., & M. K.)

Moreover, "citizen scientists and volunteers, who not only collect data and do some field work, have economic potential in projects, because they can make the project cheaper, make it effective, but you have to work with them"; "Young people think: it's not

interesting there, they won't let me in, it takes too long to study there, it's too difficult and there is little pay … Meanwhile, there are now state tasks about technological independence"; "Citizen science is a chance to interest those who have doubts, to show them from the inside that in fact there is something to do in science, that it can be interesting, scientists are also young". (Organizers; Trans. by G. R., E. A., & M. K.)

Among the interviewed organizers there is a rather strong positive message with cognitive-affective content:

> Our mission is to teach children to make projects and model science … They use the same methodology to collect data in different parts of the country, and then discuss and analyze these data. It's a model for now, but our dream is to find a place where our kids can enter real science. (Organizers; Trans. by G. R., E. A., & M. K.)
>
> Any climate research, as well as phenological ones are built on citizen science and researchers, because there is no real possibility to collect reliable obvious facts of climate change or to fix all categories, plantations, measure trees by "greening". For me personally, citizen research was an occasion to conduct mass research with no budget, i.e., on a purely volunteer basis. This proved to have its own positive result. (Organizers; Trans. by G. R., E. A., & M. K.)

A general conclusion that emerged from the initiatives is that citizen researchers are not that difficult to involve as long as their motivation is known and their goal is properly formulated. It is also necessary to know where to find these motivated researchers and, most importantly, to equip them with instructions and tools. Whatever the citizen researchers do should be technologically comprehensible and not too time-consuming. From a scientific point of view, the results obtained by citizen researchers are relevant, valuable, and can be further used in large-scale research. The main request from young participants of the projects is the availability of feedback and appropriate communications, which at present have not been fine-tuned.

Based on the analysis of interviews, the following possible schemes of work between organizers and research volunteers can be identified:

- the research organizer directly interacts with a volunteer who is a highly motivated, interested participant of the project, independently applied, ready to work under instructions; does not require additional motivation and intensified control over the implementation of the work;
- the research organizer directly contacts the mentor who is a motivated participant of the project, independently applied or agreed to the invitation (from the management or the research organizer) to arrange the work of volunteers on the territory; is ready for mostly independent work under instructions; does not require additional motivation and control over the implementation of the work;
- the research organizer is in contact with a mentor organizer who has no motivation (or low level of motivation) to participate in the project, is not ready to work independently under instructions; in this regard, they need a motivation support at all stages of fieldwork, constant contacts with the research organizer and increased control over the implementation of the work.

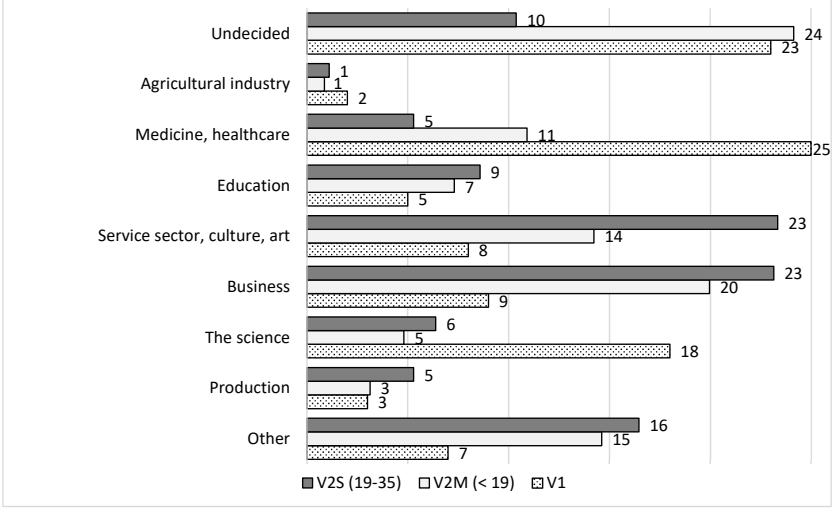
Thus, the formats of work with scientific volunteers depend on the degree of motivation of the participants and their willingness to participate in scientific projects. These formats determine the ways of organizing work with research volunteers, the degree of inclusion of the research organizer in their activities, as well as the planning of further interactions.

## Results and Discussion

In Genetic Research projects, the majority of volunteers (83%) are schoolchildren, the rest are students of technical schools and colleges. Such a sample is conditioned by the main aim of the project which is the necessity to engage young people in science. When answering the question "What professional sphere would you like to associate your future with?" 18% of volunteers mentioned science, 25% chose medicine and health care, 9% noted business, 8% would like to work in service sector, 2% in agricultural industry, all others were still being determined (Figure 1). These answers can be easily explained by the joint influence of the scientific field of the studied projects and the age of the respondents.

**Figure 1**

*The Structure of Responses to Closed Questions "If You are Studying, What Professional Sphere Would You Like to Associate Your Future With? If You Work or Have Worked, in What Professional Sphere?" (In % of the Sample of citizen researchers)*




Answers to the question about the preferred career field among the interviewed citizen researchers and young people in the random sample under 18 years of age are similar only in the groups of "Undecided" (23% and 24% respectively), "Production" (3%), "Education" (7% and 5% respectively). The proportion of those oriented towards medicine and healthcare is more than twice as high among scientific volunteers as in the random sample under 18 years of age (V2M). In the V2S random sample (19–35 years old), only

5% are medically oriented (see Figure 1). Science projects involve young people initially focused on scientific research in this particular field or those who are still in search of their vocation. The higher proportion of science, medicine and health choices by citizen researchers is explained by the fact that the projects themselves focus on the application of genetic technologies. The older the youth in the random sample, the higher the share of those who are oriented towards the service sector, culture and art, and business.

The gender specifics of the chosen field of activity are quite expected. In the V2M subsample, males' priority is given to business (43%), and females' to services and education (22% each). In the V2S subsample, the choice of males is business 27%, and females have the first places in the service sector 19%, business 15%, and medicine 14%.

Engagement in volunteering in general, and especially in scientific research, is by no means a randomly organized process. Young people need to be encouraged to take part in this activity. Thus, according to our data, when asked "How did you become involved in this project?" 58% of the volunteers answered that they were recruited by mentors (teacher, lecturer, supervisor), 18% were recruited to participate in projects as part of a training course at their place of study, 17% became interested in the project on the basis of information from open sources, 7% came with friends or acquaintances. As a result of participation, only a small proportion of respondents reported negative experiences: 2% indicated that their participation was not voluntary; 3% were not interested in the project; 3% did not acquire anything new. Sometimes the interviewed citizen researchers noted difficulties and ambiguities in the work (14%); expressed dissatisfaction with the fact that it took too much time (8%); did not receive information about the results of the work (4%). Evaluative and behavioral responses have no gender specifics.

More than half of the respondents had previous volunteering experience, but the number of those who had experience of scientific volunteering was significantly lower. Personal involvement in science projects and volunteering significantly increased the likelihood that this respondent would participate in Citizen Science projects. Thus, respondents in the V1 sample participate occasionally (47%) or continuously (16%) in science clubs, societies, etc. In the V1 sample, 54% of respondents participated in volunteer movements, and in 20% of cases these were science projects. In the V2 random sample, the following results were observed: 53% and 50% had previously participated in volunteer movements and volunteer activities, and these were scientific projects in 13% and 7% of cases for V2M and V2S, respectively.

Remarkably, the answers to the open questions demonstrate a vast awareness of young people about scientific projects. These include school projects, sociological research, various museum projects, etc. There are no statistically significant differences between the youngest and older groups of young people in the control sample and the sample of citizen researchers in real scientific projects on participation in volunteer movement and in scientific projects in particular.

Interest in scientific activity, volunteer activities, including those related to science, statistically steadily decreases with increasing age of respondents in the control random sample. More than 60% of respondents in the control sample (60% and 65% in the V2M and V2S samples, respectively) did not take any part in scientific clubs or other scientific activities. In other words, such participation is a little more

marked in the younger group. The differences in answers to the question "Would you like to take part in volunteer activities related to science?" are even stronger: 62% and 53% of the V2M and V2S samples, respectively, answered affirmatively.

Though the volunteer sample included not only the most interested in volunteering young people, yet there is a stable difference in the orientation to their future professional definition, which is noticeable in the group of young people under 18 years of age. While young people are still in school, their interest in science and in volunteering is more prominent. In response to the question "Would you still like to take part in volunteer activities related to science?" 93% of respondents answered "Yes". Of the respondents, 90% definitely liked their participation in the project, while 9% answered ambiguously ("Yes and no"). In general, 98% of the surveyed participants noted a positive experience, each of them indicating 3–4 options from the offered ones. For 73% of participants of scientific projects, who are citizen researchers, the important thing is to be interested, 64% learned something new, 46% contributed to the solution of a real scientific problem (Table 1).

In the structure of the disclaimer responses (If you didn't like it, then why?) the "Other" option took the first place, which was 13% of the sample. It was not quite clear what to do and how for 9% of the sample. It took too long for 6% of the sample. It was difficult to follow the study protocol in 4% of cases. Here is a transcript of some of the answers-comments: "the procedure of work is not worked out," "physically very difficult occupation", "it was difficult," "is not perceived as a real benefit to the scientific project," "only clear instructions were given without explanation" (Trans. by G. R., E. A., & M. K.).

In assessing the practical experience of participating in scientific projects as volunteers, interest, experience, training, future activities, and career, communication is in the first place.

**Table 1**

*The Structure of Responses to Closed Questions "Please, Indicate the Positive (Negative) Aspects of the Work You Have Done" (in %)*

| Answer options | V1 |
|---|---|
| Made a contribution to solving a real scientific problem | 46 |
| Learned something new | 64 |
| We talked with scientists, people with extensive professional experience | 23 |
| Who want to do scientific work in the future | 21 |
| It was interesting | 73 |
| We met new people | 20 |
| and the work was connected with the future profession | 13 |
| Received certificates that can be used in the portfolio | 17 |
| It was not quite clear what to do and how | 10 |

**Table 1 Continued**

| Answer options | V1 |
|---|---|
| It was difficult to follow the protocol of the study | 4 |
| It took too long | 8 |
| Participation was not voluntary | 2 |
| It was not interesting | 3 |
| Nothing new has been acquired | 3 |
| There was no information about the results of the work | 4 |

*Note.* More than one answer option was allowed.

Consider the motives in the question of the projective type "What do you think could motivate you to take part in such activities?" In all samples, the leading options are "An interesting experience that will come in handy in the future," "An opportunity to learn something new," "Communication with interesting people," which can be combined with the description "experience, communication, learning new things" (Table 2). However, these options have different grounds.

**Table 2**

*Structure of Answers to the Question "What do You Think Could Motivate You to Take Part in Such Activities?", % of the Number of Respondents*

| Answer options | V1 | V2M (<19) | V2S (19–35) |
|---|---|---|---|
| Nothing can motivate | 1 | 9 | 7 |
| Active life position | 29 | 24 | 23 |
| An opportunity to meet people important for a future professional career | 33 | 36 | 46 |
| Get certificates, diplomas | 33 | 26 | 23 |
| To feel a sense of belonging to science | 41 | 15 | 17 |
| Communication with interesting people | 52 | 43 | 45 |
| The desire to engage in scientific research | 55 | 24 | 20 |
| An interesting experience that will come in handy in the future | 62 | 51 | 52 |
| An opportunity to learn something new | 71 | 49 | 44 |

*Note.* More than one answer option was allowed.

The desire to engage in scientific research is reported by citizen researchers in 55% of cases, while in the control sample 24% of younger respondents and 20% of older respondents indicated such a desire. The desire to feel a sense of belonging to science is reported by 52% of the surveyed science volunteers, 15% and 17% in the V2M and V2S samples, respectively. Thus, in the control sample, interest in science,

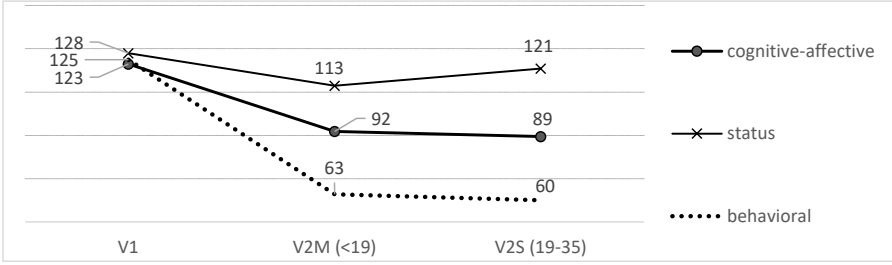
regardless of age, dropped from the third place in the ranking to the sixth place. In the volunteer group, "Communication with interesting people" is higher than in the control group, and this option does not depend on age. "An opportunity to meet people important for a future professional career" (46% in the older subgroup of the control sample vs. 33% and 36% in the volunteer group and the young control subgroup) does not differentiate between young citizen researchers and the younger subgroup of the control sample, but increases in the older groups. The assessment of the option "Get certificates, diplomas" is higher in the group of citizen researchers than in the control group. As noted above, the younger the respondents, the higher their estimates of interest in science. Active life position as an estimated characteristic of moral and value type is given by 29% of volunteers, and 24% or 23% in the V2M and V2S samples, respectively. The option "Nothing can motivate" occupies the lowest level in the rating, with 1% in the group of those who have experience of participation in the project (9% and 7% in the V2M and V2S groups, respectively).

For simplifying the analysis, the evaluations of supposed motives were structured into three groups according to the above-mentioned classification. In the method of analysis of the formalized survey, the cognitive-affective component was formed by summing up the share of responses (in % of the number of respondents) according to options "Communication with interesting people" and "An opportunity to learn something new"; the status component was formed through options "An opportunity to meet people important for a future professional career," "Get certificates, diplomas," "An interesting experience that will come in handy in the future"; behavioral one was formed through the options "Active life position," "To feel a sense of belonging to science," "The desire to engage in scientific research." Negative motivation (option "Nothing can motivate") was not considered in this structure.

Therefore, all three components in sample V1 (citizen researchers) take approximately equal values, being higher than in control sample V2 (Figure 2). The status component, as expressed motives for achieving some significant results in the future, has the highest value in all three samples, reflecting a statistically significant (checked on the basis of Pearson's Chi-squared criterion, Wilcoxon criterion, $p < .01$) upward influence of age while leveling the influence of experience of participation in citizen science projects (Figure 2).

**Figure 2**

*The Structure of the Components of the Supposed Motives in the Answers to the Question "What do You Think Could Motivate You to Take Part in Such Activities?", % of the Respondents*



The cognitive-affective component significantly increases in the group of respondents who has an experience of participation in citizen science projects and weakly though statistically significantly depends on the age of the respondents. The behavioral component significantly increases with the experience of participation in citizen research and statistically does not depend on the age of respondents. The experience of participation in projects significantly reduces the level of skepticism and increases the prospects for further participation in citizen science and in the volunteer movement in general. Note the gender characteristics of motivation for participation in the V2 sample. Males give status and cognitive assessments of motivation about 10% more often than females. Whereas there are no gender differences in the behavioral component.

## Conclusions

Modern social reality is characterized by the integration of science into all social spheres. The involvement of people from different social strata with backgrounds other than science is reconfiguring science at the institutional and epistemological level. An example of such changes is the transformation of Citizen Science in the practice of widening social participation. Citizen Science is well known and significant in the world practice. In Russia, interest in such practices is also growing. But so far, the infrastructural and informational support for CS in Russia is still inconsistent. As a result, it is practically unknown to the general public and completely dependent on the state's participation.

Citizen Science is a horizontal form of public participation that encourages people to work for scientific progress. Citizen Science is social participation in the broad sense, as it is a form of collective action aimed at the common good, embedded in certain institutional settings, having different directions of interaction, including centers of initiation of involvement. Direct scientific goals for professional researchers are performed by volunteers in the narrow sense of understanding CS. Understanding CS in a broad sense does not require that volunteers act as researchers. The most active projects involving volunteers are realized in biology, ecology, astronomy, and agriculture. In Russian scientific practice, CS is involved in the broad sense of the term, as there are strong institutional barriers to the fixation of scientific results and participation of non-professionals in scientific research.

Citizen Science practices demonstrate the possibilities of social participation in scientific research. Horizontal ties between different social strata (e.g., schoolchildren and outstanding scientists), which are normally separated by many institutional barriers, are expanded. As a result, people's trust in science and scientist by profession trust in the non-professional actions of volunteers increase. Volunteers can not only perform supportive goals in the implementation of scientific research, but also develop the engaging organizations themselves. Bringing the professional expertise of volunteers to the development of NPO work acts as one such important example (Obukhov, 2023). This increased involvement may also change the configuration of Citizen Science.

The social context of CS involvement is much broader than its scientific and organizational contexts. In addition to the obvious expansion of knowledge and attracting public attention to scientific problems and results, Citizen Science contribute to the democratization of science, the development of civic engagement of society, promotes the expansion of the community of interests and accustoms citizens to positive collective action for the common good, expands the social base of scientific activity, including through the recruitment of young people.

There are important grounds for criticism of CS. Critics warn of a possible decrease in the quality of scientific results, damage to the image of science, the risk of exploiting enthusiasm in the process of widely attracting free labor, risks in the legal field, discrediting positive scientific and social results due to organizational and informational failures. The opportunities for a drastic reduction in the cost of scientific work, voiced as the main advantage of CS, make sense only if the basic requirements for the scientific purity of experiments, safety, and legal validity of attracting non-professionals are met, which, for its part, also requires certain efforts and costs. Ignorance, lack of consideration of risks, and failure to comply with basic requirements lead to increased distrust of Citizen Science and science in general.

The development of scientific volunteering in Russia is not systemic and widespread. The state has formed a request to attract scientific volunteers. One example was the Genetic Research projects. The projects implied large-scale involvement of civilian researchers with the maximum expansion of geography and the number of voluntary participants. The problem of researchers and organizers was that they had no experience of interacting with volunteers, did not understand the structure of the organization of such work, and specific performers often denied the very possibility of a positive experience.

Empirical data obtained in the process of sociological research on the example of Genetic Research projects have presented the distrust of professional researchers to the wide involvement of non-professionals. However, as scientist by profession gain experience in specific work in citizen research, distrust of Citizen Science decreases.

In addition, the limitations for scaling up the involvement of volunteers in projects were the lack or poor use of infrastructure (including information and educational), misunderstanding of the motives of potential volunteers, difficulties in communication between scientist by profession and volunteers.

Based on the analysis, possible Citizen Science formats were formed, which depend on the degree of motivation of participants and their willingness to participate in scientific research, the degree and form of involvement in research, as well as the ability to be independent in specific activities.

Volunteer participation in general, and even more so in scientific research, is not a randomly organized process. Young people need to be accustomed to this activity. So, according to our data, more than 70% of volunteers were involved in scientific work by mentors (teacher, instructor, curator) or as part of training courses. More than half of the survey participants had previous volunteering experience, but the experience of scientific volunteering is much lower. Personal participation in research projects and volunteering significantly increased the likelihood that this

respondent would take part in CS. Interest in scientific activities, volunteer activities, including those related to science, decreases statistically significantly with an increase in the age of respondents.

Evaluation of the motivation structure of scientific volunteers depends on the type of actor, his role and place in the chain of research activities. However, there is a fundamental discrepancy in the estimates of the structure of the motives of potential volunteers on the part of the organizers, and the self-assessments of the volunteers themselves. The differences in estimates between real and potential volunteers in the control sample are not so fundamental, although there are important features.

Empirical data demonstrate that age differences in the opinions of potential or actual scientific volunteers are significant only in cases when the future benefit or potential result for their future career (status component) is estimated. The main factor in increasing social participation in Citizen Science in all other areas was the experience of participation in civic science and volunteer activities.

The opinion of young people under the age of 19 in the control (random) sample is much closer to the estimates of their peers in the sample of scientific volunteers than among the older part of the youth (from 19 to 35 years). In fact, based on the results of our research, we see that the youngest respondents are more likely to express a desire for science and volunteering. However, as they grow older, the trajectories of the development of the active part of the youth diverge. And the older the respondents, the more pronounced such differences are. It can be concluded that it is at school age that it is necessary to start learning to participate in activities useful to society. The scientific potential of young people, as well as the potential of volunteering in other fields, can be educated much earlier than is commonly believed.

Gaining experience, learning, and interest in science are important motivations for young people to participate as volunteers in scientific projects. The expansion of social participation turns out to be a significant component of education, which demonstrates significantly higher scores for all options in the survey of real scientific volunteers. In the assessments of real scientific volunteers, the status, cognitive-affective and behavioral components practically coincide. Whereas in the assessments of potential volunteers, the status component greatly exceeds the cognitive-affective and behavioral aspects, and the latter has the lowest rank. In addition, the discrepancies increase with age. In a subgroup of 19 to 35-year-old potential volunteers (control sample), the cumulative weight of such options as “Active life position,” “To feel a sense of belonging to science,” and “Desire to engage in scientific research” is two times lower than the status components and one and a half times lower than the cognitive-affective.

## Recommendations for Practice

One of the significant problems when discussing processes in Genetic Research projects was the disruption of communications, the lack of feedback between volunteers and scientist by profession.

It seems necessary not only to give people information about the implementation of certain projects, but also to inform society more systematically about inspiring

examples of CS, the history and practice of world science. Popularization of currently available successful practices is one of the important goals, first of all, in the work with young people.

Management practices often do not consider the possibility of scaling volunteer activities in scientific research. More public attention needs to be attracted to the opportunities that using citizen science can give. The international experience of involving citizen researchers in science is not sufficiently evident in the Russian scientific and information space. The available examples were the initiative of individual enthusiasts, but not a system of involving interested and caring citizens to scientific research.

In scientific projects, volunteers can also be involved in more complex activities based on their professional knowledge and skills. In Genetic Research projects, these functions are carried out by the organizers of work with young volunteers. These are teachers, methodologists, organizers of group work. We studied the motivation and self-performance assessments of this social group in separate plots; however, the results obtained turned out to be significantly different than for the groups discussed above. Therefore, we decided not to reflect them in this article.

## Limitations of the Study and Prospects for the Disclosure of the Subject

The limitations of the study include the unrepresentativeness of the sample of volunteers. In addition, we have not fully disclosed the organizational part of Citizen Science due to the limited scope of this article. The study of the development of social horizontal interactions in the practices of Citizen Science is one of the significant extensions of the ideas not disclosed in this work.

The participation of young people in Citizen Science is essential not only for the development and popularization of scientific research, but also for educational purposes. This applies to both natural sciences and humanities. An important educational component of Citizen Science may be a promising direction for future research. It is necessary to conduct a series of interviews with teachers and organizers of the work of circles on biology, ecology, and other related natural sciences for a more complete disclosure of the educational part of the subject.

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