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IMPACT OF EDUCATIONAL POPULARIZATION OF GENETICS ON THE DEVELOPMENT OF SOCIETY

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Apparently, there are practically no areas of science and activity in the social sphere that are not, to one degree or another, related to genetics. Current trends and advancements of post-genomic technologies initiate the geneticization of society – the awareness of different segments of the population about the basics of genetics and genetic technologies. These advancements hold great promise for unlocking new insights into genomics and improving our understanding of personalized lifestyle. An educational survey allows gathering feedback and opinions from all the parties involved in the education process, from students to teachers. Recollecting information is vital to make decisions that improve the quality of the educational experience. In 2024, at the Department of Biotechnology, Leather and Fur, for the first time, Kyiv National University of Technologies and Design students participated in the questionnaire study dedicated to International DNA Day, celebrated on April 25. The objective of the work is to analyze the level of awareness of students, their relatives and teachers in the field of genetics. The questionnaire was carried out using the Google-form. 173 people were invited to take the questionnaire. The questionnaire consisted of nine questions, such as «What modern achievements of genetics do you know?», «Do you support human genetic editing?», etc. Looking forward, the improvements in the science and genetic knowledge in the information field of various layers of society can develop a sustainable process of geneticization of the country's population.

Keywords: questionnaire, geneticization, biotechnology.

INTRODUCTION

Genetics, as a discipline, is an essential part of the modern world. However, analyzing the interaction between genetics and society can be complex. Genetics is not just a biological phenomenon but has for decades been a cultural phenomenon as well. From films to advertising and even public health announcements, many find themselves aware of the increasing pervasiveness of the field of genetics in contemporary society. Studying genetic metaphors gives one insight into the increased role genetics plays in the socio-cultural sphere today. The genomic imaginary is often constructed by science popularizes or communicators who introduce scientific concepts to popular consciousness. Despite the intentions of the popularizes, this genomic imaginary can impact the way civil society and legislators understand the role of genetics (Mannette, 2021).

The concept of geneticization entered circulation through the work of Lippman, a radical epidemiologist and dedicated activist for women's health. Over the course of three papers (1991, 1992, 1994), she developed a detailed account of geneticization as 'an ongoing process by which differences between individuals are reduced to their DNA codes, with most disorders, behaviours and physiological variations defined, at least in part, as genetic in origin' (Arribas-Ayllon, 2016).

The concept of 'geneticization' has been introduced in the scholarly literature to describe the various interlocking and imperceptible mechanisms of interaction between medicine, genetics, society and culture. It is argued that Western culture currently is deeply involved in a process of geneticization. This process implies a redefinition of individuals in terms of DNA codes, a new language to describe and interpret human life and behavior in a

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genomic vocabulary of codes, blueprints, traits, dispositions, genetic mapping, and a genotechnological approach to disease, health and the body (Mannette, 2021).

Participatory health research (PHR) is receiving increasing attention internationally as an approach for generating scientific knowledge to promote health equity for marginalized groups. The primary characteristic of PHR is the direct participation of those people in the research process whose work or living conditions are the subject of the research (Wright, 2021).

Participatory health research is closely related to the geneticization of society. In our opinion, the level of geneticization is determined by multi-level education, the development of molecular - genetic technologies and their practical applications in the sectors of the economy, and, undeniably, information support for new knowledge.

Apparently, that the level of genetic knowledge will depend on the professional skills of different sections of the country's population. There is no doubt that the objectivity of the assessment depends on the coverage of sections of the population. However, the first attempts to obtain data on people's awareness using the National University of Technologies and Design as an example, we hope, are worth attention. The objective of the questionnaire study is to analyze the level of awareness of Kyiv National University of Technologies and Design students, their relatives and teachers in the field of genetics.

METHODS

Questionnaires were completed by 173 adults. Participants were asked about their views on the nature of gene ("What do you know about DNA?"), gene localization ("Where are the genes?"), historical aspects of genetics ("What scientists' achievements, in your opinion, are related to genetics?"), future prospects of genetics ("Do you support human genetic editing?", ("In what cases do you think it is necessary to edit the genome?"), resources of genetic information ("How would it be more convenient for you to receive information about the achievements of genetics?").

The questionnaire was carried out using the Google-form. Analyses were adjusted for age, education and sphere of professional activity. Statistical processing of the results was carried out using Fisher's criterion.

RESULTS

Results revealed that 90% of respondents gave a correct definition of the term "gene". Paradoxically, when asked about gene localization, the number of correct answers from respondents who gave a correct understanding of the definition of a gene dropped to 80%.

The answers to the history of genetics turned out to be quite varied.

Only 51% of participants answered correctly that "What scientists' achievements, in your opinion, are related to genetics?". Most often, participants named Gregor Mendel, Bohemian monk who discovered laws of Mendelian inheritance, Thomas Hunt Morgan author who won the Nobel Prize in Physiology or Medicine for discoveries elucidating the role that the chromosome plays in heredity, James Watson and Francis Crick, authors of the double helix structure of the DNA molecule.

Unfortunately, only an insignificant number of participants are familiar with the name of Hryhori Levitskyi, only 8% indicated his name. While he is a Ukrainian botanist, a geneticist, a cytologist, a karyologist, the founder of cytogenetics, author of the first monograph on cytogenetics, *The Material Basis of Heredity*, which was published in Kyiv in 1924 (Kunakh, 2008).

We have to admit that none of the respondents indicated the name Theodosius Dobzhansky (1910-1975), Ukrainian-US geneticist and evolutionary biologist. The scientist from Nemyriv (Vinnytsia region, Ukraine) made history as a super-effective and extremely fruitful scientist. He made more than three hundred discoveries, many of which have been prominent in the further development of genetics and biology. During the lifetime of Theodosius Grygorovych, he became known as the "new Darwin": he studied the problems of the gene pool, the synthetic theory of evolution, and chromosomal mutations. However, his most fundamental work that went down in history is the four editions of his book *Genetics and the Origin of Species* (the name of the last is *Genetics of the Evolutionary Process*). Each subsequent edition had significant additions (Palamarchuk, 2023).

T. Dobzhansky not only met G.A. Levitsky and listened to his lectures, but also lived with him in the same apartment in Kyiv. His first teacher in genetics was, of course, G.A. Levitsky, who had a significant influence on the young entomologist, "infecting" him with genetics (Zakharov, 2020). Theodosius Dobzhansky made more than three hundred discoveries, many of which have been prominent in the further development of genetics and biology.

9% of participants reported in the questionnaires that Jennifer Doudna lab's research into RNA biology led to the discovery of CRISPR-Cas9 as a tool for making targeted changes to the genome. It is likely that such detailed awareness of respondents about the field of modern scientific achievements is connected with the fact that the event of the awarding of the Nobel Prize for the discovery of genome editing was recently covered.

Despite the fact that only 9% know the author of the genome editing method, 70% of respondents support the introduction of this latest technology into medical practice (Fig. 1).

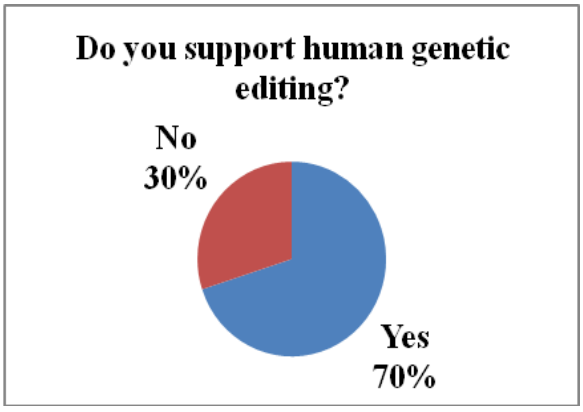

Figure 1. Distribution of opinions in answering the question "Do you support human genetic editing?"

The respondents' opinions on the purpose of using genome editing were quite different. 90% supporters of human genome editing believe that this is necessary if preventing children from inheriting a genetic disease that leads to disability and death.

To the question "What cases do you think it is necessary to edit the genome?" 88% of participants answered that this is necessary for "preventing children from inheriting a genetic disease, which leads to diseases that affect the quality of life".

22% of participants hope that genome editing will help to improve human intelligence.

An important purpose of the genomic technology, which was introduced by Jennifer Doudna and Emmanuelle Charpentier, 18% of participants of questionnaire study considered is the possibility to improve a person's athletic abilities.

And finally, 15% of questionnaire study participants believe that genome editing should be used to improve a person's appearance.

The last question we planned to ask was to find out the most acceptable form for receiving information. The question was formulated as follows: "How would it be more convenient for you to receive information about the achievements of genetics?".

The dominant majority of participants preferred Lectures on YouTube (82%).

Kyiv National University of Technologies and Design students were almost equally divided between classics and ultra-modernism. So, 33% of questionnaire study participants chose books, and 30% chose art objects.

24% and 21% of participants are ready to perceive information about the achievements of genetics through lectures on TV and advertising in the subway & transport, respectively.

Only 10% of respondents prefer to receive information via radio.

Our first results of monitoring knowledge of genetics in the student and student-related community of the Kyiv National University of Technologies and Design provide grounds for continuing the study with expanding the audience to obtain statistically significant results in different professional groups and ages.

CONCLUSION

The advent of 'omics' era and innovations in genetic and protein engineering approaches, application in industries besides food, pharmaceutics, like leather, textiles, requires a creative approach to the study of genetics at the department of biotechnology, leather and fur.

The questionnaire study revealed a generally correct understanding of the nature of the gene, as well as a good knowledge of the most significant and famous scientists - geneticists.

Gaps in the history of the contribution of scientists of Ukrainian origin can be explained by the silence of names that in one way or another challenged the totalitarian regime of the Soviet past, as well as insufficient educational work on this issue over the past 30 years.

The heritage of Ukrainian science is fantastically rich, but it is still underestimated and completely unknown to the world community.

In connection with this, the department staff held the DNA day in 2024 dedicated to Hryhori Levitskyi, the founder of world cytogenetics, the author of the term "karyotype". For students of Ukraine, especially now, when the country is fighting for its independence, it is important to remind that the scientist Hryhori Levitskyi was born, studied and worked in Ukraine and died in soviet gulag. Hryhori Levitskyi's book *Material Basis of Heredity* was published in Kyiv 100 years ago. The flowering of human cytogenetics led the way to the establishment of clinical genetics as one of the most important developments in medicine in the twentieth century (Jacobs, 2014). We consider it logical to continue the historical relay race and, in this regard, we are planning to dedicate DNA Day in 2025 to Theodosius Dobzhansky, timed to coincide with the 125th anniversary of his birth.

The 30% preference for receiving information through art objects stimulates the involvement of designers and artists to create original, modern and understandable objects dedicated to genetic research and its authors.

Arts in education are largely related to forming and questioning human relations with the world. Such practices and discourses are concerned with the development of meaning; they provoke and challenge our understanding of skill and technique; they query the idea of the artist and the art object; they problematize the relations between the artist, the object and the spectator (or the person who responds to the work); they encourage us to think about who we are, how our identities are formed and about our relations with others; they call us to

address issues of social awareness. Generally speaking, such practices and their attendant discourses provide new encounters for learning and how learning can be understood and through such encounters new subjectivities emerge. This produces a new ontological order within the pedagogic space, which is not about reproduction but one that is focused upon challenging and rearticulating subjectivities (Atkinson, 2007).

Looking forward, the improvements in the science and genetic knowledge in the information field of various layers of society can develop a sustainable process of geneticization of the country's population.

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