

Interdisciplinarity in natural science and humanities as the basis for the development of education

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Abstract. The author analyzed the contradictory statements regarding the present and future of Russian education related to the choice of knowledge priorities between natural sciences and humanities. The author notes that pedagogical science should abandon the paradigm choice between the humanistic values of education and rationalistic technological approaches to the learning process. The author believes that the changes in humanities knowledge should be considered as a consequence of changes in the natural science knowledge. This fact testifies to the mutual penetration of various ways of thinking and the dualistic unity of seeming opposites. By interpreting the technocratism as a concept of the power of professionals based on scientific and technical knowledge, the author suggests that the development of education should be based on dualistic unity, and not on the contrast between natural science and humanitarian knowledge. The author notes that at the current stage of the development of civilization the priority task is to prepare transprofessionals with integral interdisciplinary professional competencies that are able to solve professional tasks at the intersection of various sciences, while understanding the social consequences of their actions. According to the author, technocratism ensures the transition from ideas about the desired image of a graduate of an educational institution to a truly developed professionally competent person with fundamental education. At the same time, humanistic values determined by the culture and national traditions of their country should provide high ethical and moral personal qualities of a transprofessional, without which sufficient civic responsibility and an active life position in conditions of continuous technogenic transformations in all spheres of life are impossible.

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1 Introduction

Analyzing the development vectors of education, some researchers note that “the successful development of the digital economy is impossible without competent personnel, which requires adequate educational systems meeting the needs of modern digital challenges” [1]. Others, on the contrary, believe that “humanitarian resistance will become an incentive for the development of education of the future, for the emergence of new forms of education, and for the use of new methods of teacher training” [2].

It should be noted that “in the context of a new network educational reality education can become a link between the rapidly developing world of virtual, digital objects and solutions and the world of physical objects and technologies immersed in the world of social relations, meanings and people” [3].

The practical needs of optimal management in a particular area of public life and the achievement of deliberately desired results pose the need to predict a specific situation, stages of its implementation, as well as all kinds of potential consequences. Forecasting the future, anticipating the prospects for the development of various phenomena and processes, is based on the study of what happens in the present or was in the past, the clarification of the main development trends.

The opposition of statements regarding present and future education means that in modern reality, marked by the transition to a new digital technological landscape in all fields of science, production and education, the integral interdisciplinary approach to conceptual theoretical understanding and practical pedagogical implementation of the main goals of education and the solution of educational problems of the pedagogical community on “the formation of a new type of professionalism – *transprofessionalism* – readiness for interprofessional communication and transdisciplinary synthesis of knowledge” becomes fundamentally important [4].

2 Results and Discussion

With the total technologization of all areas of life of modern society, such competencies as the development of creative independent thinking; critical attitude to available factual information; availability of prognostic skills based on theoretical conclusions to predict the consequences of the implementation of various processes in practice, including socio-economic processes; and finally, the ability to dialectically identify contradictions that are sources of social progress, should be critical. Since students master the above competencies during the development of natural science knowledge, it is expected that the fundamentalization of education is necessary to educate young people in creative thinking [5], which provides a conceptual basis for a common scientific worldview. This is caused by the acquisition of fundamental knowledge that gives understanding about the scientific worldview as a holistic system of concepts

and principles about the general properties and laws of the development of nature, society, and personality.

However, some authors believe that “the consequence of the natural-scientific determination of public consciousness and the education system as a whole is negative development trends, which include technocratism, which has set guidelines for the activities of higher education for many decades” [6]. The phenomenon of “technocracy” was repeatedly transformed in accordance with the goals and objectives of the leaders applying it. Since there is no unambiguous interpretation of this concept in modern conditions, we will adhere to the wording according to which the government “strives for a single exceptional policy paradigm based on the use of instrumental rational methods” [7]. In fact, technocratism can be interpreted as a theoretical concept of the power of professional experts based on scientific and technical knowledge. It is necessary to state that in the current realities of the Russian society at different levels of power structures there are not enough professionals in their field, there are not enough *technocrats* who have gained power due to their professional knowledge. The field of education, unfortunately, is no exception.

The phenomenon of “technocratic thinking, the main characteristic of which is the shift of values to motives, motives for goals, the transformation of full-fledged activity into a set of individual operations” [8], is considered as a negative feature of a person. To overcome the “costs” of technocratic thinking, the need to “humanize education” is declared. In our opinion, the negative consequences, which are often determined by technocratic thinking and technologization of all spheres of human life and activity, are due not so much to the natural science worldview of leaders, organizers, and “implementers” of the educational process, as well as to the methodological features of the exact sciences connecting theoretical and empirical methods of knowledge, but to the personal qualities of certain officials.

Moreover, we can agree with the protest moods of the pedagogical community, which are based on the fair criticism of “increasing bureaucratization and formalization to the detriment of the content and quality of education; in transferring the emphasis from the value of a teacher as a carrier of knowledge and an expert in a particular field to the satisfaction of students and their parents with teaching in line with the client-oriented approach and the consequent conflict situations” [2]. However, in our opinion, it does not seem entirely legitimate to focus only on the humanitarian aspect of resistance «based on the values of humanism and the national-cultural traditions of Russian education» [2].

It is not the way of thinking that is to blame of “cretinism of narrow professionalization” and “shifting worldview guidelines” [8]. In response to this statement, we note that the natural science worldview underlying technocratic thinking and rationality inherent in it are not

synonyms with the “functional person” [8], who is unable from the standpoint of humanism to assess the goals of the development of society and the ways to achieve these goals. This is evidenced by the great physicists and *technocrats* – carriers of scientific and technological progress: P.L. Kapitsa, I.E. Tamm, I.G. Kurchatov, A.D. Sakharov, S.P. Korolev, M.V. Keldysh, N.G. Basov, A.M. Prokhorov, Zh.I. Alferov, V.L. Ginsburg, and many others. Having received universal recognition of their professional colleagues in Russia, and some even abroad, being Nobel Prize winners, they made a significant contribution not only to their fundamental science – physics. Many of them became great humanists of their time and made a significant contribution to the development of our state and the entire world community “cultivating the *values of professionalism*” and humanism outside the “*humanization of education*” [8]. The lives of these distinguished scientists and personalities prove the indisputable statement that true professionals are people who not only know their immediate chosen field of activity, but also bear the full burden of responsibility for the consequences that may result from its implementation.

It should also be noted that it is still not indisputable that “the classical canons of knowledge developed exclusively within the framework of natural science knowledge focused on accuracy, calculability and marginal rationalization, limit the possibilities for meaning, not allowing us to comprehend the individual nature of man, in relation to which the laws of objectification, typification and unambiguous, purely rational interpretation cannot be applied” [9]. Meanwhile, it is impossible to identify methods, principles or means of research that are purely specific to any science. It is possible to argue that there are only features of the application of the same research methods in various areas of knowledge, which is due to the different content of research, their objects, and subjects.

This fact allows concluding about the unity of the methodology of science, since initially all activities need to be organized. The methodological culture of the researcher in any branch of human knowledge necessarily implies a theoretical knowledge of various technologies and the possibility of their practical application. Having a methodological culture means knowing the methodology and being able to apply this knowledge in solving cognitive tasks. Knowledge of the methodological culture of research allows identifying the causal relationships between events in a variety of natural and socio-economic processes and phenomena. The logic of the cognition process allows considering any purposeful activity of a person from a general perspective. At the same time, it should be considered that we are not able to stop in our cognition of the world around us, and this process can be both subjectively significant for an individual person and objectively significant for the whole humankind at a certain stage of development.

At the same time, considering the priority importance of various sciences, it should be assumed that the natural

science, which is a worldview basis, “affects the change in “value-semantic orientations of a person and, interpreted through the prism of social demands of society, leads to “ups and downs of humanitarian knowledge” [10]. In such a context, the changes in humanitarian knowledge must be considered as a consequence of changes in knowledge of the natural science” [11], which in turn indicates the mutual penetration of various ways of thinking and the unity of seeming opposites.

This circumstance means that at the current stage of the development of civilization, the priority is not to establish the importance or priority of certain knowledge. The main prognostic trend for the development of society, and education as a reflection of the requests of society in particular, is the training of transprofessionals with integral interdisciplinary professional competencies that are able to solve professional tasks at the intersection of various sciences, while understanding the social consequences of their actions.

When solving the main task of modern education in training transprofessionals, it should be taken into account that a distinctive feature of their qualification characteristics is “the development and performance of not only related but also completely distant professions, the willingness to go beyond the established experience” [4].

This means that in modern conditions narrow profile workers of mass professions are being replaced by universal specialists who own end-to-end technologies, “the basis of which is the convergence of the most breakthrough - nano-, bio-, information technologies and cognitive sciences” [4].

“The latter is necessary for the creation and subsequent application of social and humanitarian technologies that include social, anthropological, and philosophical components and form flexible social competencies (soft skills) of specialists who are ready and able to work in an interprofessional environment” [4].

Mobility, tolerance, creativity, resistance to stress, communication skills, and many other universal personal qualities predetermine the success of a particular person in his professional activity and well-being in modern conditions.

To solve transprofessional problems that require new technologies to train specialists “ready to meet the socio-professional innovations of the future” [4], it is necessary to unite the efforts of representatives of the natural and human sciences.

It should be assumed that the rethinking of the prognostic goals of the development of education, which is the radical transformation of the system of Russian education to radically increase the efficiency of its functioning, should be based on a return to the formation of a fundamental holistic dualistic way of thinking of students, which is the unity of mastering natural science and humanitarian knowledge.

The need for the integration of natural science and humanitarian knowledge is due to the need for a

comprehensive perception and understanding of the surrounding world by students, and not the differentiation and fragmentation of obtaining disparate information through the prism of individual academic disciplines. The consequence of this is the rethinking of ideas about the scientific picture of the world in its entirety, the change in existing stereotypes of structuring knowledge, and the organizational foundations for its development. These circumstances unequivocally determine the revision of the content of education, the vector of development of which should be “aimed at “fundamentalization”, which ensures the strengthening of the intellectual potential of society by obtaining new knowledge” [5] and the presence of creativity in any human activity, as well as contributing to the formation of a unified science of man and society at the present stage of the cognitive activity of mankind. The indisputable fact is the formation, existence, and development of a person in a certain society, in interaction with other people and under their influence. As a result, it can be argued that an individual becomes a person only if he masters the cultural codes of a certain society, which form the mentality following the meanings and values of national and world culture. It is the mentality that determines the value-semantic sphere of the individual, his worldview, outlook, and behavior, as well as his attitude to specific aspects of public life. At the same time, the transfer to subsequent generations of “the cultural image of society in the totality of its shades” [5] occurs in the process of education. Since education is an object of pedagogical science, it seems especially important to focus on the social significance of pedagogy as a theoretical field of knowledge and as a practical pedagogical activity. Pedagogy has a special responsibility for mastering the younger generation of the cultural codes of their country and the formation of their national mentality.

This means that pedagogical science must finally abandon the paradigm choice between the humanistic values of education and rationalistic technological approaches to the learning process. It is the “technocratism” that contributes to the producibility of the educational process and ensures the transition from ideas about the desired image of a graduate of an educational institution to a truly developed professionally competent person with fundamental education capable of fierce competition in the world labor market. Humanistic values caused by the culture and national traditions of their country should provide high ethical and moral personal qualities of a “non-functionary”, without which sufficient civic responsibility and an active life position of a transprofessional in conditions of continuous technogenic transformations in all spheres of life are impossible.

Analyzing the methodological approaches to the design of education for the future [12, 13], it can be argued that the scientific developments of representatives of foreign and domestic research organizations in the same period differ in their prognostic positions. Thus, the representatives of the

domestic educational prognostics of the Soviet period are characterized by the desire to specify the image of the future, guided by regulatory documents and ideological guidelines (for example, the image of the “architect of communism”, etc.). The representatives of foreign pedagogical futurology do not set the regulatory vision of the future. The purpose of their many prognostic studies is to create the conditions for the development of universal abilities for learning and the formation of worldview patterns of a person. The theoretical basis of new foreign pedagogical concepts is the concepts of sustainable development, development of professional competencies demanded in the labor market, preservation of cultural diversity in a situation of professional mobility and migration of labor resources. As a result, despite terminological disagreements and the use of various classification grounds, the research methods used in the study of the problems of predicting the development of the field of education unite Western and domestic researchers. The unity of various prognostic concepts speaks of common problems in the conditions of the post-classical paradigm of science, which appeared in the second half of the 20th century. Modern science is at such a stage in the development of cognition, in which it is necessary to take into account the value and target attitudes of the researcher, to assess the social significance of the obtained results. Irresponsible solutions to research problems related to climate change on the planet, invasion of the human genome and general issues of genetic engineering, the introduction of artificial intelligence in all spheres of human life and many others, may lead to total catastrophic consequences on a global scale.

The analysis makes it possible to draw an unambiguous conclusion that “technical and humanitarian components of education require a reasonable combination” [8] to form among young people, the current student body, not only transprofessional competencies, but also general cultural moral values and solid moral principles that will allow achieving not only professional heights and career growth, but also becoming spiritually developed individuals [4]. “The humanistic style of relations at the university, the humanization of its educational environment and the introduction to the culture as a living embodiment of the world of human values and meanings” [8] are the necessary didactic conditions of the educational process at the present stage, but they must not be declared, but created in daily practical pedagogical activities.

The current pedagogical reality is rightly criticized for its lack of “a clear targeted strategy that ensures unity of action and the overall effectiveness of the development of the educational system” [14]. These circumstances are a consequence of the lack of logic in building causal relationships between events and prognostics, which allows predicting the results without experimenting with a huge number of employees of educational organizations of different levels, students, and their parents.

These facts confirm the insufficient number of *technocrats* in the top echelons of power and indicate the lack of natural science thinking among most managers in many areas and, above all, in the field of education. Meanwhile, modern challenges to education make it possible to predict the main promising vectors of its development caused not only by the need to train transprofessionals for productive work in the innovative production sector. A modern educational organization is obliged to consider the didactic needs of people with special educational needs; provide continuous education at different stages of adulthood; assess the possibilities and consequences of the application and widespread introduction of information educational technologies into educational practice. Pedagogical science needs to analyze “local innovative educational practices (mixed learning, mass open online courses, distance education, etc.) to identify the feasibility and possibilities of their distribution in different areas of education”, assess the positive and negative factors of total digitalization of education; determine the relationships between formal and non-formal education and much more [15].

These promising prognostic problems require a clear logic for building relationships between events and the ability to analyze and synthesize many factors of influence, formulate theoretical conclusions and, as a result, create new innovative concepts for the development of education that correspond to the modern needs of society as a whole and each individual person.

3 Conclusion

Analyzing the predictive goals of education and reflecting on what the pedagogy of the future will face, we can say that the future will not be the way we imagine it now. We do not know much of what is to be known to man in the world around him. However, forecasting the future, and searching for productive ways to improve and improve it are inextricably linked with the analysis of the current state of development of science and society.

The existing debate about the primary value of scientific or human knowledge, as well as about the ways of thinking corresponding to them, can be continued indefinitely. However, this dispute is useless, just as it is senseless in human cognitive activity to oppose concrete scientific knowledge and rationality, folk wisdom, and social morality.

In our opinion, such opposition harms the development of education in the future, since the laws of the physical, mental, and social development of a person are the same. Only in the dualistic unity of the thought process is humanity able to structure actual knowledge and implement the education process that is contemporary to this stage in the development of civilization more effectively.

In the heat of scientific discussions about the priorities of natural science or humanitarian knowledge, the oppositions of technocracy and humanism, it should be understood that the opposite of natural science and humanities exists only in the heads of individuals.

Natural science thinking by no means interferes with the search for culturally determined meanings in the humanitarian spheres of activity, including in education [9].

The analysis shows that the dualistic unity of the “natural science – humanitarian”, the interdisciplinary nature of various knowledge will ensure the development of creative independent thinking of students who in the future will become professionals in their field, *technocrats* who have gained power due to their transprofessional personal qualities. The sphere of education will be replenished with managerial and teaching staff capable of «adequate interpretation of the phenomena of education, upbringing, and personal development» [7].

The modern vector of education development should be focused on the conceptual understanding of the need to reform the educational system on a new pedagogical platform by the professional community of teachers. In this context, the conceptual awareness of the need for integral natural science and humanitarian interdisciplinarity [11] as the fundamental basis for the development of education, providing a productive solution to educational problems, becomes fundamentally important.

References

1. A.V. Solovov, A.A. Menshikova, Higher Education in Russia **30(1)**, 144 (2021)
2. I.Ya. Murzina, Education and Science **22(10)**, 90 (2020)
3. V.V. Vikhman, M.V. Romm, Higher Education in Russia **30(2)**, 22 (2021)
4. E.F. Zeer, E.E. Symaniuk, Education and Science **19(8)**, 9 (2017)
5. V.A. Testov, Education and Science **19(8)**, 29 (2017)
6. A.A. Somkin, Education and Science **21(3)**, 9 (2019)
7. I. Sánchez-Cuenca, *A Technocratic Order* (2017)
8. T.A. Fugelova, Education and Science **5(94)**, 63 (2012)
9. A.F. Zakirova, E.N. Volodina, Education and Science **20(9)**, 9 (2018)
10. N.N. Belozerova, Education and Science **9(138)**, 166 (2016)
11. N.Yu. Safontseva, On natural science and humanities interdisciplinarity in pedagogical studies, *Materials of the XVI International Scientific and Practical Conference*, Volume Part 1 (Rostov-on-Don), pp 320–324 (2021)
12. M. Malitza, E. Gheorghiu, *The Double Helix of Learning and Work. Arguments for Vocational Contents in Higher Education*, Paper 4 (2006) Retrieved from: <http://eng.newwelfare.org/2006/02/17/the-double-helix-of-learning-and-work-arguments-for-vocational-contents-in-higher-education/>
13. J. Botkin, M. Elmanjra, M. Malitza, *No Limits to Learning. Bridging the Human Gap. A Report to*

- the Club of Rome* (Pergamon Press, Oxford, 1979)
14. V.I. Zagvyazinsky, *Education and Science* **8(127)**, 4 (2015)
 15. M.V. Klarin, I.M. Osmolovskaya, Prospects for the development of didactic research in Russia. In: *Russia-Italy: Cooperation in the Humanities and Education in the 21st Century* (Institute for Strategy of Education Development of the Russian Academy of Education; University of Bologna (Italy), Moscow, 2021)