

The Concept of Ecologically Oriented Progress and Natural Resource Preservation

M A Gasanov^{1, a}, K A Kolotov^{1, b}, K A Demidenko^{2, c}, E A Podgornaya^{2, d},
O V Kadnikova^{2, e}

¹ National Research Tomsk Polytechnic University
Lenina av. 30, Tomsk, Russian Federation, 634034

² Kemerovo Institute (branch) «Plekhanov Russian University of Economics»
Kuznetskiy avenue 39, Kemerovo, Russia, 650992

E-mail: ^ahursud1@yandex.ru, ^b594950@bk.ru, ^cksenan@mail.ru,
^dkatje.siberia@gmail.com, ^eksanita@list.ru

Abstract. The most important issue of scientific and technological progress is considering the environment challenges of industrial development. It means that the progress must be ecologically oriented and environmentally friendly. The most adequate concept for the approach to the issue of “man - society – nature” relations is the ontology of the noosphere - the idea of a common space for human beings and nature. It presents an ideal example of an optimistic attitude towards the coordination between accelerating the scientific and technological development and natural resource saving. However, to maintain the balance between human needs and environmental processes determined by this concept, it is essential to include the lean production training into technological development of society.

Introduction

A low level of the environmental education development in modern universities can be explained as follows. By historical standards, environmental education, especially in its modern form, is yet very young. In fact, it is still in its infancy; many universities do not have complete and comprehensive courses on the environment considering its social component. Ecology as a scientific field and educational subject still exhibits more problems than solutions. Social background plays an important role too, revealing critical underestimation of the environmental crisis with the modern society being occupied with the crisis another of another origin.

As a result, environmental education and promotion of a moderate approach to the use of nature for satisfying people’s needs has neither consistent concept, nor explicit method. The noosphere concept is aimed at filling the gap in teachers’ and students’ outlook on environment. The concept can determine the essence of the conveyed knowledge of the environmental management.

Material and method

Nowadays the planet’s wildlife is involved in human activities and the very life support of human society. This state of affairs determines another priority of the modern environmental education which should be paid particular attention to. The wildlife is being destroyed gradually resulting in the loss of



biological diversity, the irrevocable losses of animal and plant species, etc. This destruction is not so obvious and it seems to be not of people's concern. It can be demonstrated with a simple example. The consequences of industrial wastewater pollution are rather evident, so this topic can be considered as early as at elementary school level. However, it is more difficult to observe how living organisms provide the purity of natural water, the atmospheric composition, recycling of household and industrial waste, and restoration of disturbed biosphere communities.

Implementing the idea that the diversity of life forms is the only condition of the effectiveness of the said processes is a complex but vital task in modern environmental education, requiring a high level of worldview as well as art of teaching.

The primitive form of what we call "environmental education" was implemented in the ancient Western and, in particular, Eastern civilizations. The ecological component was a part of the worldview of philosophy founders: Confucius [1-2], Lao-Zi [3-4], Democritus [5], Aristotle [6]. In modern history general environmental education accompanies the genesis and the development of ecology as a science.

Environmental science originates from biology as a knowledge about the connection between living organisms and the environment. The idea of the necessity of a specific research of relations between species and their environment was developed along with understanding that living organisms have been evolving and that the environment is critical for this process. Such an understanding is known to be completed and presented in Charles Darwin's "struggle for existence" [7].

A closer connection of ecology as a science and environmental education was formed coincidentally with the introduction of the word "ecology" into the scientific community in 1866 by Ernst Haeckel. Not only living organisms and their communities, but also the biosphere itself became the object of environmental knowledge [8]. Finally, a critical progress shift in the development of environmental education occurred concurrently with the foundation of social ecology in the 1970s. This science considers environmental education to be its priority.

Modern environmental education has a long-standing tradition of forming the knowledge about the relationship between people and nature. Initially it was based on natural science, which was introduced in the school curriculums of Western Europe and Russia in the late XVIII century. Subsequently environmental education in our country has evolved significantly.

In the 1920-30s, mass implementation of the training forms and methods activating students' cognitive and practical activity in studying and protecting environment was started. In particular they were implemented at natural science lessons and during extracurricular activities. In the 1930s nature-oriented knowledge was included into educational program in biology and geography. Many of these programs remained unchanged until the late 1970s. In the 1950-60s environmental education and training of young people expanded rapidly around the world. All the former USSR republics adopted Nature Protection Law and; environment protection themes were enhanced in the learning process. In 1970-80s education in the field of environmental management and conservation was emphasized. An innovation in environmental education was the development of educational programs in nature protection elective courses.

Environmental education received a new development impetus at the beginning of the 1990s. The formation of the system of environmental education was based on a number of methodological principles formulated in the 1980s [9]. At present stage the following set of statements concerning the ecology of human society is accepted:

- humankind is connected with the nature by its origin, existence and future;
- human history is a part of the history of nature and the integrity of the environment is the foundation of life in the biosphere;
- ecologically healthy environment along with social conditions are the basis of people's physical and mental health;
- labor is the basis of the interaction of people and society with the nature, a factor of the transformation of nature;

- transformation of environment is inevitable but limited, so the objectives of reasonable human activity must take full account of the manifestations of nature laws etc. [10-11]

Results and discussion

The four interrelated components can be identified as the core of the modern environmental education:

1. Cognitive - basic ideas about the principles of the interaction between nature and society, global environmental problems and their solutions etc.
2. Axiological - the system of values concerning diversified social and personal significance of nature.
3. Regulatory - the basis of ethical and legal standard of nature management, the rules of conduct in the environment.
4. Activity-related - the types of students' activities aimed at forming cognitive and practical skills of ecological character.

Existing principles of environmental education include the principle of the unity of knowledge-adjustment-action; the principle of continuity; the principle of interconnection of global, national and local approach to the analysis of environmental problems and the ways of solving them; the principle of inter-disciplinarity etc., which formed the basis of environmental education along with the ones abundantly applied in didactics.

At present, the position of a new humanistic approach to ecological culture has been strengthening. Along with it, it is essential to decide which perceptions of bio-social system "man-society-nature" should be first and foremost applied to environmental education and training, and which principles of former consumer culture demand a critical review.

Global environmental crisis requires a new world outlook to be integrated in the younger generation education and upbringing. The concept of "nature and society" system should be transformed into the "nature-society" system. The scientific and technological revolution and the rising degree of mechanization [12-17] reveals human's complete dependence on the animated and inanimate nature resources. This especially influence on the environment during mineral resources extraction [18-23]. This dramatic situation is to be the focus of teachers' attention.

Admittedly, the methodological foundation, required for research and development in students' environmental education, as well as for writing teaching materials, has yet to be developed. Even in developed countries the system of secondary and higher education does not offer well-established principles and criteria for conveying environmental knowledge. There is a certain gap between the relatively high level of school environmental education and the level of development of ecological pedagogical education.

In recent years, humanitarian science, natural science and technological culture have been facing an increasing opposition within each other. On account of this opposition environmental education contains rather full natural science content but classical one has been falling behind. In particular, social ecology and ecology philosophy are largely deprived of professional attention.

The noosphere concept (the theory of humankind possibility to balance their own needs, technological opportunities and natural resources) helps to eliminate the lack of humanitarian knowledge in environmental education. The primary role in noosphere studying, however, belongs to human knowledge that resulted not only in conquering nature, but also in creating conditions for harmonious coexistence of people and environment. These very components should be the determinants of the environmental education development, form its new principles.

F. Bacon payed attention to the special role of scientific knowledge in developing relations between society and nature [24]. He believed that knowing the laws of nature would enable people to meet their basic needs and interests. In this respect, F. Bacon considered that increasing human power was impossible without subordination to these natural laws. While cognizing them, science must help human beings move towards their goals using the shortest way, avoiding obstacles, and preventing mistakes, many of which may threaten the very existence of the human race.

These views were fleshed out and developed in the noosphere concept, which was widespread and scientifically recognized in the 20th century. The noosphere concept was introduced into science in 1927 by a French philosopher, mathematician and anthropologist Edouard Le Roy (1870-1954), who proposed defining the shell of the Earth including human society and its industry, languages and other attributes of sentient activity as noosphere [25]. However, it is a Russian scientist and philosopher V.I. Vernadsky, who is rightfully considered the main founder/creator of the noosphere concept, having developed the idea of noosphere as “biospherized society”.

V.I. Vernadsky was one of the first to realize that humanity had become a powerful geological and, perhaps, cosmic force, capable of transforming nature in a large scale [26]. He noted that people encompassed the whole biosphere with their lives and cultures, and was trying to deepen and expand the sphere of influence. The biosphere, from his perspective, was gradually transformed into the noosphere – the sphere of mind. V. I. Vernadsky considered the noosphere to be the highest stage of the biosphere development, where cognitive human activities became the determining factor. He suggested that the biosphere-noosphere transition was related to developing science, deepening scientific insight in natural processes, and organizing a rational human activity thereupon. The study of the noosphere is intrinsically optimistic, implying that humanity will find a way to restore and preserve the ecological balance of the planet, will develop and put into practice the strategy of crisis-resistant development of nature and society. Thus, the idea that people can manage the environmental development of the whole planet is rather optimistic and corresponds with the contemporary achievements in biochemistry, genetic engineering, mining and metallurgy. And it is precisely due to optimism, that the noosphere concept is so valuable for modern environmental education.

A prominent French paleontologist and philosopher Pierre Teilhard de Chardin (1881-1955) was developing the noospheric genesis problem simultaneously with V.I. Vernadsky [27]. He believed that the noosphere is originally shaped like a thin layer of thinking substance ("mental sheath or envelope of thought") which is detached from all of the Earth's shells.

However, as human thought penetrates deeper into the essence of the processes occurring in all the Earth spheres, the noosphere transforms into its higher state - the "Earth Spirit". Like V.I. Vernadsky, Pierre Teilhard de Chardin emphasized the role of science in accomplishing this task. Science, in his opinion, should be not only an effective tool of the world learning, but also a means of unity, synthesis of ideas.

Throughout the 20th century, many thinkers and representatives of various scientific specialties turned to the problem of the noosphere, trying to identify its origin and ways of subsequent development. In general, the followers of the noospheric future of humanity are characterized by an optimistic view on the perspective of developing the relationship between society and nature. However, there are only so many environmentalists ready to share such optimism nowadays. They consider that mankind has yet to prove, whether it is capable of playing the role of the organizer of a new world, free from the devastating crises, ecological disasters, wars and violence [28]. The problem of water resources technogenic pollution stands out with the special sharpness disturbing the harmony of the humans and the nature [29-32].

It is important for the development of environmental education that the idea of the noosphere does not contradict the concept of sustainable development, which is gradually achieving leading positions in explaining the prospects of modern civilization. Since the second half of the 1970's many prominent environmentalists, sociologists, economists, politicians, etc. concerned about the current situation, combined their efforts in order to design a new approach to building relationships between people and their environment. It is of high importance for studying geotechnical activities and mineral resource extraction [33-37]. Designing and producing powerful mining machines, constructors and engineers must ensure minimizing negative ecological consequences of their implementation [36-40].

As defined by the World Commission on Environment and Development, sustainable development is such development of Nations that meets the needs of modern humanity without compromising the well-being of future generations and their ability to meet their own basic needs. This implies that some parameters, such as key physical constants (composition of air, water, soil, mechanical properties of

the Earth's surface, gravity, etc.), gene pool, parts of major ecosystems in their original forms, human health are supposed to comprise a constant value over time. In this respect, environmental protection is becoming the task of utmost importance. Its ultimate goal is, on the one hand, to ensure safety of the environmental qualities which are supposed to remain unchanged, and, on the other hand, to ensure a continuous growth of useful plants, animals and other essential resources through balanced cycles of withdrawal and renewal.

The concept of sustainable development gained strong support not only with the specialists in the field of social ecology and human ecology, but also Governments and leaders of most countries in the world, which was reflected in the decisions of the United Nations Conference on Environment and Development held in 1992 in Rio de Janeiro. The need to move the entire global community to take a balanced and integrated approach to environment and development questions was declared at the Conference. In addition, the decision to form Green Cross International environmental organization was adopted there. The main purpose of the new organization was ecological education as a basis for sustainable development and changing system of values, as well as elimination of the consequences of the cold war for the environment.

Thus, the concept of the noosphere corresponding with the mainstream of sustainable development may contribute significantly to the formation of a coherent scientific structure of environmental education. Such structure should include a number of elements:

1. Environmental education of modern university students as a component of their organically built-in general culture.
2. Formation of humanistic University environment as a condition of development of ecological culture and practical preparedness of graduates to environmental education in its modern and progressive understanding.
3. Teacher ecologist training to improve their professionalism.

A scheme of consistent environmental education based on this structure should be built in higher schools. At the initial stage self-development and personality development of the students occurs, along with in-taking of the cultural and environmental priorities and values on impressional and emotional levels. In accordance with this dominant education in the ecological program is organized. At the second stage students gain necessary educational and methodical knowledge and develop professional competence of future specialists. As a result, a number of subjects of basic environmental education are formed: general ecology, social ecology, applied ecology, etc. At the third stage, the conditions for professional identification of students are created, based on environmental imperative. At the fourth stage students know paradigms of the system man-society-nature, integrate in research and academic activities in this field. In addition, situations stimulating students' creative self-development are created at this stage.

Conclusion

Understanding the specifics of sustainable development begins with accepting that a human, who has an inalienable right to a healthy and meaningful life is in the center of such development; environmental protection should be realistically the most important part of sustainable development; society moves to a co-evolutionary method of interaction with nature. This fully reflects the key point of the noosphere concept - focusing collective intelligence on ensuring the security of humankind in every respect and realization of human striving to personal and social well-being. To achieve these objectives it is necessary to intensify full potential of the noosphere concept, to make radical humanistic reorientation of the whole system of modern education values, to fully disclose the significance of nature for people's existence.

Acknowledgement

The research was made in National Research Tomsk Polytechnic University with financial support of the Ministry of Education and Science of the Russian Federation in the framework of scientific re-

search "The evaluation and improvement of the social, economic and emotional prosperity of senior citizens" contract № 14.Z50.31.0029.

References

- [1] Hobson J M 2004 *The Eastern origins of Western civilization* (Cambridge: Cambridge University Press) 366 p.
- [2] Bonevac D and Phillips S 2009 *Introduction to world philosophy* (New York: Oxford University Press) 296 p.
- [3] Henricks R G 1992 *Lao Tzu: Te-Tao Ching – A New Translation Based on the Recently Discovered Ma-wang-tui Texts (Classics of Ancient China)* (New York: Ballantine Books) 488 p.
- [4] Roberts M 2004 *Dao De Jing: The Book of the Way* (Berkeley: University of California Press) 322 p.
- [5] Guthrie W K 1979 *A History of Greek Philosophy - The Presocratic tradition from Parmenides to Democritus* (Cambridge: Cambridge University Press) 362 p.
- [6] Richo K 2008 *Ancilla to the Pre-Socratic Philosophers* (London: Forgotten Books) 316 p.
- [7] Desmond A and Moore J 2009 *Darwin's sacred cause: race, slavery and the quest for human origins* (London: Allen Lane) 290 p.
- [8] Hopwood N 2014 *Haeckel's Embryos: Images, Evolution, and Fraud* (Chicago: University of Chicago Press) 508 p.
- [9] Zhironkin S A, Khoreshok A A, Tyulenev M A, Barysheva G A, Hellmer M C 2016 Economic and technological role of Kuzbass industry in the implementation of national energy strategy of Russian federation IOP Conference Series: Materials Science and Engineering 142 (1) 012127.
- [10] Tyulenev M, Zhironkin S, Kolotov K and Garina E 2016 Background of innovative platform for substitution of quarry water purifying technology Pollution Research 35 (2) pp 221-226.
- [11] Tyulenev M A, Lesin Yu, Vik S and Zhironkin S 2016 Methodological Bases of Advanced Geocological Problems Resolving in Neo-industrial Clusters Proceedings of the 8th Russian-Chinese Symposium "Coal in the 21st Century" pp 333-336.
- [12] Khoreshok A A, Mametyev L E, Borisov A Y, Vorobyev A V 2016 Influence of the Rigid Connection between Discs in the Tetrahedral Prisms on Equivalent Stresses When Cutting Work Faces IOP Conference Series: Materials Science and Engineering 127 012039.
- [13] Khoreshok A A, Buyankin P V, Vorobiev A V, Dronov A A 2016 Simulation of Stress-Strain State of Shovel Rotary Support Kingpin IOP Conference Series: Materials Science and Engineering 127 012014.
- [14] Khoreshok A A, Mametyev L E, Borisov A Yu and Vorobyev A V 2015 The distribution of stresses and strains in the mating elements disk tools working bodies of roadheaders. IOP Conference Series: Materials Science and Engineering 91 (1) 012084.
- [15] Kovalev V A, Gerike B L, Khoreshok A A and Gerike P B 2014 Preventive maintenance of mining equipment based on identification of its actual technical state Symposium of the Taishan academic forum – Project on mine disaster prevention and control pp 184-189.
- [16] Aksenov V V, Khoreshok A A and Beglyakov V Y 2013 Justification of creation of an external propulsor for multipurpose shield-type heading machine - GEO-WALKER Applied Mechanics and Materials 379 pp 20-23.
- [17] Lekontsev Yu M., Sazhin P V, Temiryayeva O A, Khoreshok A A and Ushakov S Yu 2013 Two-side sealer operation Journal of Mining Science 49(5) pp 757-762.
- [18] Zhironkin S A 2001 Factoring and leasing development at coal mining industry of Kuzbass as an important element of its financial part Ugol' 4 pp 29-30.
- [19] Zhironkin S A 2001 Governmental factoring development of TEK Kuzbass Ugol' 6 p 62.
- [20] Zhironkin S A 2002 About measures of vixel circulation development and vixelability definition of fuel-and-power complex' enterprises Ugol' 4 pp 47-48.

- [21] Zhironkin S A 2002 Prospects and new possibilities investment attracting to Kuzbass coal mining industry *Ugol'* 6 pp 31-36 .
- [22] Tyulenev M A, Khoreshok A A, Garina E A, Danilov S and Zhironkin S 2016 Adaptive technology of using backhoes for full coal extraction Proceedings of the 8th Russian-Chinese Symposium "Coal in the 21st Century: Mining, Processing, Safety" pp 111-115.
- [23] Khoreshok A, Tyulenev M and Vöth S 2016 Conditions for Minimum Dynamic Loading of Multi-brake Hoists Proceedings of the 8th Russian-Chinese Symposium "Coal in the 21st Century" pp 239-245.
- [24] Bacon F 2014 The Essays and Counsels, Civil and Moral of Francis Bacon: all 3 volumes in a single file (Moscow: B&R Express) 302 p.
- [25] Le Roy 1958 *Essai d'une philosophie première: l'exigence idéaliste et l'exigence morale* (Paris: Sirocco Pub.) 366 p.
- [26] Lapo A V 2001 Vladimir I. Vernadsky (1863–1945), founder of the biosphere concept (Moscow: Science) 278 p.
- [27] Aczel A 2007 *The Jesuit and the Skull: Teilhard de Chardin, Evolution and the Search for Peking Man* (London: Riverhead Hardcover) 408 p.
- [28] Khoreshok A A, Zhironkin S A and Tyulenev M A et al. 2016 Innovative technics of managing engineers' global competencies IOP Conference Series: Materials Science and Engineering 142 (1) 012122.
- [29] Lesin Y V Luk'yanova S and Tyulenev M 2010 Mass transfer of dispersed particles in water filtration in macro-grained media *J. Journal of Mining Science* 46 (1) pp 78-81.
- [30] Tyulenev M A and Lesin Y V 2014 Justification complex purification technology open-pit mines wastewater Symposium of the Taishan academic forum – Project on mine disaster prevention and control pp 441-444.
- [31] Tyulenev M, Zhironkin S and Litvin O 2015 The low-cost technology of quarry water purifying using the artificial filters of overburden rock *Pollution Research* 34 (4) pp 825-830.
- [32] Lesin Y V, Luk'yanova S Y and Tyulenev MA 2015 Formation of the composition and properties of dumps on the open-pit mines of Kuzbass IOP Conference Series: Materials Science and Engineering 91 (1) 012093.
- [33] Tyulenev M A, Zhironkin S A, Garina E A 2016 The method of coal losses reducing at mining by shovels *International Journal of Mining and Mineral Engineering* 7 (4) DOI: 10.1504/IJMME.2016.10000781.
- [34] Tyulenev M A, Gvozdkova T N and Zhironkin S A et al. 2016 Justification of Open Pit Mining Technology for Flat Coal Strata Processing in Relation to the Stratigraphic Positioning Rate *Geotechnical and Geological Engineering* 34 (6) doi:10.1007/s10706-016-0098-3.
- [35] Efremkov A B 2011 Forming the subterranean space by means of a new tool (geohod) Proceedings of the 6th International Forum on Strategic Technology IFOST 6021037.
- [36] Efremkov A B and Timofeev V Y 2012 Determination of necessary forces for geohod movement Proceedings - 2012 7th International Forum on Strategic Technology IFOST 6357729
- [37] Efremkov A B and Aksenov V V et al. 2012 Force parameters of geohod transmission with hydraulic drive in various movement phases Proceedings - 2012 7th International Forum on Strategic Technology IFOST 6357716.
- [38] Aksenov V V, Efremkov A B and Beglyakov V Y 2013 The influence of relative distance between ledges on the stress-strain state of the rock at a face *Applied Mechanics and Materials* 379 pp 16-19.
- [39] Golik V I, Rasorenov Y I and Efremkov A B 2014 Recycling of metal ore mill tailings *Applied Mechanics and Materials* 682 pp 363-368.
- [40] Golik V I and Efremkov A B 2016 Physicochemical Processes of Metal Lixiviation in the Disintegrator IOP Conference Series: Materials Science and Engineering 125 (1) 012038.