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Research paper

Innovative Technologies Application in Education as a Condition for Education for Society Sustainable Development

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Abstract

The article presents the results of the scientific research on the issue of environmental studies based on ecological-evolutionary approach. The meaning and content of the term *ecological-evolutionary approach* and the conceptual ideas of ecological-evolutionary approach (the idea of evolution and ecocentrism) are explained. Teaching technologies based on ecological-evolutionary approach are characterized with the approach explained as the innovative technology that, in use, will provide modernization of environmental studies within the educational aspect for the society's sustainable development.
The pedagogical experiment results are presented, confirming the technology's effectiveness based on ecological-evolutionary approach and the implementation of ecological-evolutionary approach concepts and didactic fundament in teaching environmental subjects.

Key words: *education, education quality, education for sustainable development, technology, ecological-evolutionary approach, the idea of evolution, the idea of ecocentrism.*

1. Introduction

Humanity's entering the third millennium was marked by the shift of world community view on the future, recognition of education, welfare and person's health as the society's development priority that, in the context of worldwide tendencies, has to provide it with the balanced, ecologically safe existence. Therefore, the county's development at the current stage is impossible without renovating the education meaning as the basis of its intellectual, cultural, spiritual, social and economic progress. The education strategy has to be based on humanity's realization of nature's value.
Today there arises a necessity for conceptual changes in environmental studies education content, implementation of innovative approaches and innovative technologies in teaching, which can benefit creating the young generation of complex knowledge on nature, environmental studies capabilities, strategies of modern person's behavior in noosphere that are so necessary in today's globalized society.
Modern technologically advanced society becomes globalized, being the kind of society that has global developmental issues. This will inevitably leave a mark on education development, especially in the field of environmental studies. In 19th century environmental studies education complied with the linear development state of civilization demands and conditions, whilst the dynamics of society's changes was unimportant. In the second half of 20th century and in 21st century society's life changes lead to the education priorities shift, people's values transformations, and the educational field tendencies changes that reflect the overall direction of world changes.
The National Doctrine of Education Development of Ukraine points out the necessity for converting the type of educational system into humanitarian-innovative, achieving its competitive capabilities in Europe and the world, forming young generation that will be safe and mobile on the job market, capable of gaining their own spiritual world view, with necessary knowledge, skills and competence to integrate into society on different levels and with life-long learning. The success of the further changes depends on how conscious, systematic and logical the chosen modernization-centered direction is, and to which extend today's society socio-economic development realties, foreign experience and approaches to education renovations are considered when defining the educational strategy.

2. Problem search

2.1. Analysis of recent studies and publications

The world has recognized that the person's welfare, education and health are the main factors in their life quality, and the quality of education is the development priority in 21st century. Ukrainian scientists (O.I. Lokshyna, O.I. Lyashenko, L.M. Rybalko, and O.M. Topuzov) state that the education quality is a general indicator of society's development, within a certain time measurement. Therefore it needs to be viewed in the dynamics of such changes that characterize country's progress in the context of the worldwide tendencies. Thus, I.O. Lyashenko sates: "Changes concerning all social strata, are caused not only by the need for renovating

and changing them, but also mutual influences and regular changes that occur all around the world"

We agree with O.M. Topuzov's idea that the modernization is aimed at increasing the quality of education to the European level, changing school's orientation to the needs and demand on the job market, strengthening competitive capabilities of educational establishments and their alumni. Many researchers view environmental studies content modernization as the complicated process that includes historical-philosophic, ontological and ideological aspects. The historical-philosophic aspect presents philosophic introspection and socio-philosophic basis of education evolution in general, and the environmental studies education as its component. Scientists believe that to modernize education it is not enough, for it to comply with modern-day society's demands.

Education is formed according to the world development directions, specifically based on sustainable development, and predictions of its role in 21st century society. Ontological aspect implies adequacy in the content of education system scientific knowledge in relation to the imperatives of socio-environmental and socio-cultural people-nature relations evolution, and providing its sustainable development. Ideological aspect is connected to the formation of humanity's evolutionary, ecological and creative world-view as antropospheric and synergistical. All three aspects declare the environmental studies education renovation based on society's sustainable (ecologically balanced, harmonic and self-efficient) development that satisfies modern-day needs and does not endanger future generations capabilities to satisfy their needs; is understood as socially desirable and economically viable.

The ideas of sustainable development that provide for economical, ecological and social development factors coordination, reflect the world community realization of human-nature cooperation; the balance of social consumption and nature's ability to restore itself; considering rights and interests of modern and future generations. "21st Century Agenda" and society's Sustainable Development concept adopted on UNO conference on environment and development in Rio de Janerio (1992) need to change orientation of states national strategies in the direction of changes to every person on Earth consciousness and actions, renovate economic and social relations system, and more active citizens' participation in making environmental protection decisions. It is clear that renovation of economic and social system is impossible as the result of people's consciousness change, if there is no accordant education (which was mentioned many times in UNESCO regulatory documents). Thus, considering education demands and tendencies for sustainable development is one of the conditions of further development of every national education system, especially Ukrainian.

Environmental studies education is among the first to have its content oriented at society's sustainable development strategy in order to solve the problem of socio-environmental harmonization of human-nature relations; providing healthy and quality life for future generations; creating he understanding of life as the highest value among the youth; necessary life-skills that can adapt the personality to fully function in the conditions of modern social changes, realize that biosphere preservation is the condition not only for society's sustainable development, but also for humans' existence as a biological species. The problem is stated, but it will not have a goal-oriented nature without developing social approaches to implementing educational principles for sustainable development practically during teaching.

The UNO Economic Commission for Europe educational strategy for balanced development states: "Education for sustainable development needs to change the main focus orientation to providing knowledge for solving problems and finding important solutions".

The UNESCO regulatory documents specify that the new approaches to forming the education content have to provide for its quality renovation according to the prioritized goals of education for sustainable development, formulated by the world education community (International Education Bureau).

We see the modern education modernization in implementing innovative education technology based upon the newest methodological approaches. We believe that using ecological-evolutionary approach guarantees higher quality in environmental studies education, that will not only perfect its content, but also makes it possible to form the basis of complex ideas about environment in young generation, and make them more ecologically aware, be compliant with the ecologically safe behavior rules in the natural environment.

2.2. Statement of the objective and tasks of the study

The aim of present study is to scientifically spell out the meaning and content of ecological-evolutionary approach to education, explaining the innovative teaching technology for environmental studies methodological fundament, based on ecological-evolutionary approach.

In order to achieve the aim, the main problems are defined: 1) to explain the meaning of terms *ecological-evolutionary approach, ecological-evolutionary approach to education*; 2) to explain the conceptual ideas of ecological-evolutionary approach which, in use, will provide the modern environmental studies education quality; 3) to explain and scientifically spell out the teaching technology for environmental subjects based upon the ecological-evolutionary approach. The object of the research is the process of teaching the environmental subjects/disciplines in educational establishments.

3. The basic part of the study

3.1 The meaning and content of ecological-evolutionary approach

Ecological-evolutionary approach is considered to be the modern general scientific direction in methodology of nature cognition, as well as its objects as complete systems with an explanation of ecological connections, evolution and perspectives predictions for their balanced development. Implementing the ecological-evolutionary approach in teaching the environmental subjects provides a possibility to realize that all organisms, including humans, form their environment on their own (living conditions), provide its stability, sustainability, create optimal conditions for their existence; that the biosphere stability depends on its completeness and safe development.

The content of ecological-evolutionary approach is defined by the conceptual evolutionary, developmental or ecocentric ideas.

Implementation of the evolutionary idea in the content of environmental studies education provides a possibility to explain evolution of nature on different levels of matter organization, find the cause-and-effect relations and provide internal connections between the investigated objects. The ecocentric idea - a world-view ideology of ecological attitude to nature, environmental protection that presents nature as a value independent of people's preferences, that has a priority over humankind's goals and needs – provides the consideration of connections cognition between society and its natural environment, objects of wild-life and inanimate nature, as well as the ways of biosphere development and humanity's survival as the main subjects.

The implementation of evolutionary idea along with the ecocentric idea provides a possibility to show how an organic world has been developing and still does in the direction of complicating the natural systems structures, that corresponds to the adaptive abilities and the specifics of environment, illustrates the interconnected ties between different objects in nature, explains patterns in natural development, forming ecological ideation culture of the youth, value of nature and accordant behavior in the environment.

Conceptual ideas of ecological-evolutionary approach (evolution and ecocentrism) have a long-lasting formation history and do not lose their urgency in the scientific dimension, because their development in natural science caused the formation of modern global evolutionism concept as the system of ideas within the overall

nature development process in all of its different environmental-historical forms: universe and the solar system evolution, chemical evolution, Earth evolution, biological and social evolution.
Didactic basis of ecological-environmental approach implementation in teaching environmental subjects/disciplines are: the concept of environmental subjects teaching based on ecological-evolutionary approach, didactic conditions and didactic principles of this approach's implementation, didactic teaching model and technology based on ecological-evolutionary approach (developed by L.M. Rybalko, 2015).

3.2 The fundament of environmental studies subjects teaching technology based on ecological-evolutionary approach

The environmental studies subjects teaching technology based on ecological-evolutionary approach is viewed as a tool (way) of bringing to life certain ideas (of evolution and ecocentrism), ecological-evolutionary approach methodological principles in teaching. It includes three interconnected concepts that provide its completion: methodological, didactic and technological.
Methodological concept characterizes the technology's original principles system, including: complex approach to environmental studies education viewed as a functional and systematic unity of its components based on applying the ideas of evolution and ecocentrism that are provided by continuity, succession and consistency in the content, form and methods of education organization; the goals to be implemented among youth, are oriented on learning, and shaping complex knowledge on nature, environmental competence, ecological-evolutionary ideology, correct values (cherishing nature and its objects, themselves and other people, recognizing life as the highest value in the culture of human race), understanding the complexity of nature and its developmental principles; ecological-evolutionary approach conceptual ideas (ideas of evolution and ecocentrism) used as the means of end-to-end integration of environmental studies education content that determines the inclusion of every single environmental subject on ecological studies, information about evolution, history and environmental studies development and nature systems.
Didactic concept explains the environmental studies education aim and problem in the aspect of ecological-evolutionary approach implementation, as well as the results of education based on ecological-evolutionary approach that determine the following: objects, including a human, and their developmental principles; realization of unity between a person and their environment as a complex system where every other component directly or indirectly influences other ones causing the changes in the whole system's development and existence; recognizing that a type of person's behavior and their attitude to themselves, other people and nature, defines the cooperation strategy within a 'society-nature' system, the biosphere and noosphere development direction; realizing the nature of person, nature and society's mutual evolution development principles; recognizing the internal systematic and external ecological connections within every system (natural or social), evolutionary development and a right to exist safely.
Technological concept sets a scientifically based system of a teacher's goal-oriented pedagogical activity that provides the ecological-evolutionary approach implementation in teaching. It is determined by: the teacher's readiness for application of technology based on ecological-evolutionary approach ; complex inter-subject approach to teaching ecological and evolutionary (historical) information in the content of environmental studies subjects/disciplines; the systematic approach to studying nature and its objects as complex systems, explaining their internal systematic and external ecological connections, evolution, with a prediction on the balanced development perspectives; complete ecological orientation of environmental studies contents; using forms, methods and education technologies that can effectively bring about ecological-evolutionary approach; organization of classes and tours in nature, studying environment's ecological condition.
Didactic conditions for bringing about the education technology based on ecological-evolutionary approach that provide this process' effectiveness are:
1) Using biology content sources to explain the ideas of evolution and ecocentrism on inter-subject basis;
2) Providing the educational process with the means of education (textbooks, guides), methodological developments and instructions oriented on implementing the educational technology based on ecological-evolutionary approach;
3) Prioritizing research educational method in the context of ecological-evolutionary approach implementation;
4) Using education technologies based on ecological-evolutionary approach in the teaching process;
5) Applying didactic education technology model into the teaching process based on ecologic-evolutionary approach.
Therefore, we view the environmental studies subjects/disciplines teaching based on ecological-evolutionary approach as the specially organized system that implements conceptual ideas (of evolution and ecocentrism) and the methodological principles of the ecological-evolutionary approach to education and directs the teaching process at forming complex knowledge on nature, ecological competence, biological knowledge capacity and ecology-oriented thinking among the youth.

Table 1: Technologies components based on competency approach

Teaching process components	**Teaching process components content**
Target	Students' integral professional knowledge and professional and general competencies, corresponding culture formation
Stimulating and motivating	Formation of students' motivation to study and positive attitude to educational and cognitive activity with the help of special methods and forms of organization of training, favorable atmosphere, formed motives and knowledge fair assessment
Content-related	System of professional knowledge, skills and abilities, provided by educational and working educational programs on the corresponding educational disciplines
Operation and practical	Teaching organization system of methods, approachess and forms which promote competently oriented student learning; educational and methodic literature
Control-correction	The teacher's control over the educational process, which introduces a competency approach to learning, the solution of the goals and objectives of the training, the correctness of the implementation of educational tasks by students, the identification of difficulties, the disadvantages of the activities of the teacher and students, and their elimination. The control is carried out by conducting tests of students, oral interviews, modular control works.
Result estimating	Criteria, indicators and students relevant professional competencies development.

In addition to the teaching technology there was developed a biology teaching method based on the ecological-evolutionary approach that, in its fundaments, determines: the formation of ecological and evolutionary concepts in their unity and interconnection of the basic knowledge on wildlife based on ecological-evolutionary approach conceptual ideas (of evolution and ecocentrism); shaping the educational materials content on different wildlife knowledge completion levels using structural-logical schemes, ideographic concept descriptions and didactic thesauri; forming the ideas of nature development principles' meaning and impact and of ecological laws among the students, as this ideas are system-forming factors, ways of end-to-end wild-life knowledge integration; using modeling methods at teaching, the comparative-historical method to explain the peculiarities in wild-life function-

ing and development and the teaching process organization forms that benefit the ecological-evolutionary approach implementation. The content of the components of the learning process based on the competency approach is presented in Table 1**.**

3.3. The empirical research results

The effectiveness of environmental studies subjects/disciplines teaching technology based on ecological-evolutionary approach was estimated during a pedagogical experiment in general comprehensive schools conducted on biology classes by Professor L.M. Rybalko.

During the pedagogical experiment the subject student groups of 7^{th} to 10^{th} grade (Exp) students' teaching was conducted following the education technology based on ecological-evolutionary approach, based upon using original biology teaching methods with the ecological-evolutionary approach and an educational methodological provision system (biology textbooks, accordant guides for students and a methodological guide for teachers). In the control groups of 7^{th} to 10^{th} grade (Cont) the students studied according the classic education system following biology textbooks and guides that were based on ecological-evolutionary approach.

The achieved pedagogical experiment data analysis proves that students being taught biology on the basis of ecologic-evolutionary approach facilitated a major decrease in their quantity, with the lower (from 19,4 % to 4,9 % according to the cognitive criteria, from 18,2 % to 6,6 % according to the activity and creativity criteria, from 16,2 % to 7,4 % according to personal importance criteria and from 17,7 % to 6,4 % according to motivation and creativity criteria) and middle (from 53,8 % to 17,4 % according to the cognitive criteria, from 45,9 % to 19,8 % according to the activity and creativity criteria, from 43,4 % to 22,3 according to personal importance criteria and from 17,8 % to 6,2 % according to motivation and creativity criteria) levels of education, at the same time the number of students increase on satisfactory (from 24,0 % to 49,7 % according to the cognitive criteria, from 23,7 % to 47,2 % according to the activity and creativity criteria, from 25,8 % to 44,9 % according to personal importance criteria and from 26,0 % to 40,7 % according to motivation and creativity criteria) and on higher (from 16,0 % to 25,9 % according to the cognitive criteria, from 12,1 % to 26,6 % according to the activity and creativity criteria, from 14,5 % to 25,5 % according to personal importance criteria and from15,8 % to 33,2 % according to motivation and creativity criteria) levels (the data compared was gathered before and after the experiment). The changes in education level among the students in control groups are hardly noticeable.

The experimental 8th grade student groups education levels analysis, as well as, latter, the analysis of the same students level in 9^{th} and 10^{th} grade, who studied biology following the ecological-evolutionary approach and experimental biology textbooks and academic guides for 2, 5 years, provided a possibility to discover positive change dynamics according to every criteria (cognitive, activity and creativity, personal importance, motivation and creativity).

Quantitive and qualitative analysis of the pedagogical experiment results proves that the teaching technology based on ecological-evolutionary approach is effective along with the concepts and didactic principles represented within it, which confirms the research original hypothesis. The research has proven that the ecological-evolutionary approach application in teaching 7^{th} and 10^{th} graders biology substantially influences the quality of the students' knowledge: the formation of complex ideas about wild-life, biological knowledge capacity, ecological competence and ecological-evolutionary ideology.

3. Conclusions

The education condition for humanity's sustainable development is the path of education content modernization which, we believe, is in applying innovative technology in teaching. The ecological-evolutionary approach to teaching environmental studies subjects/disciplines was developed and its effectiveness was experimentally proven. The meaning of ecological-evolutionary approach is explained as a modern direction in methodology of nature and its objects as complex systems' cognition, the ecological, evolutionary connections explanation and their balanced development perspectives prediction. The ecological-evolutionary approach content is determined by the conceptual ideas of evolution or development, and ecocentrism, which, when implemented, provide a possibility to show how the organic world has been developing in the nature systems completion direction that complies with the environment's adaptive abilities and its specifics, illustrates connected ties between different nature objects, clarifies the environment development principles, interconnections within its systems that benefits the understanding of nature's unity, forming of ecological thinking among the youth, appreciative attitude to nature and accordant behavior in the environment. In order to practically apply the ecological-evolutionary approach in educational establishments, the teaching technology was developed that includes methodological, didactic and technological concepts and special methods.

References

[1] Lokshyna O. I. Zmist shkilnoi osvity v krainach Ievropeiskoho Soiuzu: teoria i practyka (druha polovyna XX – pochatok XXI st.): monohrafia [The content of school education in EU countries: theory and practice (late 20^{th} – early 21^{st} centuries): monography] - K. : Bohdanova A. M., 2009. – 404 p.

[2] Lyashenko O. I. Osvitni systemy yak obiekt monitorynhu yakosti osvity, Problemy yakosti osvity: teoretychni I praktychni aspekty. – Materialy metodolohichnoho seminaru APN Ukrainy, 15 lystopada 2006 r., Kyiiv.[Educational system as an object of education quality monitoring: theoretical and practical aspects. – Materials from methodological seminar of NAES of Ukraine, November 15, 2006] – K.: SPD Bohdanova A.M., 2007. – 31 p.

[3] Rybalko L. Navchania pryrodnychych predmetiv na zasadach ekoloho-evoliuziinoho pidchodu v zahalnoosvitnich navchalnych zakladach:teoria i praktyka: monohrafia [Teaching environmental subject based on ecological-evolutionary approach in general comprehensive educational establishments: theory and practice: monography], Poltava : FO-P Myron I. A., 2014. – 400 p.

[4] Rybalko L.M. Onovlennia shkilnoi pryrodnycho-naukovoi osvity na osnovi ekoloho-evoliuziinoho pidchodu, Postmetodyka.[Rennovation of the school environmental studies educational program based on ecological-evolutionary approach], 2012, No 5, 26–31pp.

[5] Stratehiia Evropeiskoii ekonomichnoii komisii OON z osvity v interesach zbalansovanoho rozvytku. Biblioteka Vseukraiinskoii ekolohichnoii lihy. Seria «Ekolohichna osvita I vychovannia» [UNO European Economic Commission Strategy on education for balanced development. All-Ukrainian Ecological League library. Series "Ecological education and nuture"],K. : Aspekt-Polihraf, 2006,No 3, 40 p.

[6] Topuzov O.M. Zabezpechennia yakosti zahalnoii serednioii osvity : na shliachu do ievropeiskych standartiv, Ukraiinskyi pedahohichnyi zhurnal, K, 2015. – No1. – 16-27p.

[7] Gladvin T. N. Shifting paradigms for sustainable development: Implications for management theory and research / T. N. Gladvin, J. J. Kennely, T. S. Krause, Acad. Manage Rev, 1999, V. 20, No 4, p. 874–907.

[8] Hanna M.D. Environmentally responsible management behavior: Is ecocentrism a prerequisite?, Acad. Manage Rev, 2005, V. 20, No 4, p. 796–799.

[9] UNECE : National Strategies for ESD : Russion Federation (2011) [electronic source] : www.unece.org/fv/env/esd/nap.html

[10] Tovazhnyansky L.L., Meshalkin V.P., Kapustenko P.O., Bukhkalo S.I.. "Energy efficiency of complex technologies of phosphogypsum conversion". *Theoretical Foundations of Chemical Engineering*. Vol.47, No.3, (2013), pp.225–230.

[11] Bukhkalo S.I., Klemeš J.J., Tovazhnyanskyy L.L., Arsenyeva O.P., Kapustenko P.O., Perevertaylenko O.Y. "Eco-friendly synergetic processes of municipal solid waste polymer utilization". *Chemical Engineering Transactions*, Vol.70, (2018), pp.2047–2052.