Sc.D. (Pedagogical sciences), Senior Research Fellow **IRYNA KOZLOVSKA**
Lviv Polytechnic National University
Address: 12 Stepan Bandera Str., Lviv, Ukraine, 79013
Phone: +380989601993
E–mail: ink55@i.ua

Ph.D. (Pedagogical sciences), Associate Professor, **MARIANNA PAYKUSH**
Lviv National Medical University named after Danylo Halytskiy
Address: 69 Pekarska St., Lviv, Ukraine, 79000
Phone: +380679268376
E–mail: marianna.gron@gmail.com

Ph.D. (Pedagogical sciences), Associate Professor, **IRYNA PASTYRSKA**
Lviv Polytechnic National University
Address: 12 Stepan Bandera Str., Lviv, Ukraine, 79013
Phone: +380681103766
E–mail: irynna.pastyrska@gmail.com

INTEGRATION OF NATURAL SCIENCES CONTENT INTO PROFESSIONAL TRAINING OF FUTURE DOCTORS

ABSTRACT

The article deals with the problem of integration of natural sciences content into professional training of future doctors. The aim of the article is defined as methodological substantiation of the expediency of integration of natural sciences content into the professional training of future healthcare professionals. The authors define special features of natural sciences knowledge and of natural sciences training of a future doctor, special features of teaching natural sciences, and substantiate possibilities of integration of the content of the natural sciences component into professional training of future medical workers. The ways of integration of teaching natural sciences with professional practical training in the process of preparing medical specialists have been elaborated. It has been found that it is advisable to overcome inconsistency between separate academic disciplines by way of their integration while accounting the aspects of their self–organization. It has been established that integration of the aims of teaching natural sciences with professional training of future medical workers is based on the idea of purposefulness and motivation of teaching the fundamentals of these sciences.

Keywords: *natural sciences training, natural science disciplines, doctors' education, integration, professional practical training, professional competence, motivation, teaching content selection criteria.*

INTRODUCTION

The growth of significance of integrative processes in the world generates a series of contradictions between the possibility of integration of the content of natural sciences disciplines as of a problem of general pedagogical scope and its place in the real practice of modern professional education; the tendency towards integration in professional training of specialists and insufficient level of development of the theory of integration as far as future medical workers' training is concerned; objective unity of natural sciences training and professional practical training of future medical workers and their separation in the real teaching process.

To solve these contradictions, theoretical and methodological substantiation as well as the elaboration of the ways of integration of natural sciences training into the professional practical training of medical workers is required.

The lack of attention towards integration of the natural sciences component into the content of training future doctors has a negative effect on their future practical activity. As practice shows, some medical workers have no sufficient knowledge of natural sciences; this doesn't promote their professional growth and professional competence. It enforces the necessity of enhancement of the role of the natural sciences component in the system of education of medical specialists.

Teaching of natural sciences in a higher professional school has the important tasks of creating firm grounds for special knowledge, mastering methods of scientific cognition, training for practical activities, forming intellectual skills, general intellectual development etc. As some studies prove, the low level of mastering natural disciplines is usually caused by the absence of interest and underestimation of their role in the process of forming special knowledge and skills, as interest in the object studied is directly related to the recognition of its value (Dolnikova, 2000).

THE AIM OF THE STUDY

The aim of the article is methodological substantiation of the expediency of integration of natural sciences content into the professional training of future healthcare professionals. According to the aim of the research the following objectives have been set**:** to define special features of natural sciences knowledge and of natural sciences training of a future doctor, special features of teaching natural sciences, and to substantiate possibilities of integration of the content of the natural sciences component into professional training of future medical workers.

THEORETICAL FRAMEWORK AND RESEARCH METHODS

The reformation of higher medical education in Ukraine is closely related to general scientific and pedagogical innovations concerning educational process optimization thus requiring the renovation of structural elements of the pedagogical system. Given the whole pedagogical process is covered, the formation of competence as the result of training a future specialist, e.g. a doctor, can be achieved. New approaches to solving this problem provide availability of profound knowledge and skills in medical and biological physics, medical chemistry, biochemistry, biology, etc., as natural sciences education is the basis for gaining a speciality.

To overcome inconsistency of separate disciplines one should practice their integration keeping in mind self–organisational aspects. By now a great experience of integrating various subjects has been accumulated, and stages of moving from local, partial integration to the creation of integrated syllabus have been charted. The integration of objectives of natural sciences education and professional training of medical workers is based on the idea of purposefulness and motivation of teaching the fundamentals of these subjects in higher medical institutions.

The main task of such training in conditions of a new paradigm of higher medical education is to turn it into an effective means of professional activity, providing its correspondence to the demands of modern medical workers. Being based on general pedagogical regularities, integration of students' professional and natural sciences knowledge has to take into consideration not only peculiarities of a definite branch – medicine, but also of the disciplines indispensable for a complete professional education.

The article presents the methodological rationale for integrating the content of natural science education in the training of future doctors in the context of improving the quality of their future professional activities.

In modern pedagogy, a great amount of research into the problem of integration has been accumulated (V. Bezrukova, F. Belyayeva, S. Honcharenko, R. Hurevych, I. Kozlovska, D. Kolomiyets, O. Sergeyev, V. Sydorenko, M. Chapayev etc.). The question of integrative processes in the natural sciences education is in the centre of investigation in a number of scientific works (M. Hapontseva, K. Huz, O. Danylyuk, V. Zavyalov, V. Ilchenko, O. Levchuk, L. Rybalko, A. Stepanyuk, V. Fedorova, O. Yavoruk etc.). The issue of training future doctors has been researched (L. Bykov, L. Borysov, I. Bulakh, H. Lerner, M. Mruga), in particular, the issue of teaching natural sciences disciplines in the process of training future medical workers

(A. Bekrenyev, A. Hladun, L. Dolnikova, Ya. Kmit, N. Stuchynska, T. Temerivska, etc.) has been investigated. These works have influenced the establishment of an integrative approach in professional education, medical education, in particular.

At the same time, theoretical analysis of scientific works and practical experience have revealed that the issue of integration of natural sciences training of future medical workers has not been the subject of special research yet.

RESULTS

Natural sciences knowledge has two special features:

1) more developed mathematical apparatus of relevant theories as well as methods and means of experimental research aimed at developing methods of solving problems with direct access to practice;
2) specific ideological component that is based on general and more visual picture of the nature that contributes to the man's understanding of the world and of the place he occupies in it.

Thus, "we can speak about the scientific outlook and scientific picture of the world, not opposing them to humanitarian–oriented mythological, religious, metaphysical and philosophical outlook which now has a tendency of integrating with the natural scientific outlook" (Granatov & Plugina, 2006, p. 51). Specific features of natural scientific culture consist in the facts that, first and foremost, knowledge about the nature is constantly improving in logical and notional aspects and is characterized by a high level of mathematisation and objectivity, presents the most authentic layer of human knowledge, being very important for the existence of a man and the society. Besides, this knowledge is deeply specialized. In any case, for a man in general, natural scientific culture is the most important means of socialisation and the grounds for his forming a general "picture of the world and a man's place in it".

Knowledge integration is provided by pass–through relations between notions and terms, theories, and regularities, and the content is filled with statements about conservation of the biosphere's stability, about living organisms' origin unity, genetic and historical unity of nature and society cognition and nature integrity at all levels of organization of everything alive (Paykush, 2011). It enables substantiation of elements of knowledge about the nature on the basis of common, uniform components of nature (the laws of conservation, periodicity, processes orientation), this being the necessary condition for students' understanding of nature's integrity. Understanding occurs when an unknown item, the object (of new knowledge) is included into a unity, the system of understandable things. General nature regularities are a pass–through means of integrating knowledge of natural sciences into professional training of future medical workers (Rybalko, 2011, p. 42).

When scientific activity is intensified, attention to the problems of science integration is enforced, especially to the problems of interaction of natural, technical, humanitarian ("humanization of education"), social and economic sciences. Revealing the material unity of the world is no longer a privilege of physics and philosophy; social, economic and technical sciences got actively involved in this process. The material unity of the world in the fields where the man transforms nature cannot be disclosed only by natural sciences because the society interacting with it is also the matter of the highest level of development. Technical sciences which reflect the laws of motion of material means of human activity and which are the link connecting the man and nature, also testify of the materiality of human activity means that are used to discover and transform the nature. Now it is possible to claim that substantiation of the material unity of the world has turned to be the matter of not only philosophy and natural studies but of the science as a whole, it has turned into the task of general scientific character that requires enforcement of interaction and integration of the above–listed sciences.

The integration of natural sciences education means usage of central general scientific principles and methods through the whole process of teaching. The principle of subsidiarity, the principle of appropriateness, the principle of symmetry, the method of modelling and mathematical methods are the most important for the integration of natural and scientific disciplines. Integration of these sciences will let reveal the fundamental unity of "nature – man – society" in the process of teaching, will increase students' interest in learning this cycle of disciplines, will provide an

opportunity to intensify the educational process and ensure high quality of its results (Krasnobokyi, 2003).

The results of the teaching activity analysis justify it's being a kind of cognitive learning process and its grounding on regularities common to scientific cognition and, thus, having common resemblance in structure, methods and ways of thinking. In particular, the theory and methodology of learning natural sciences subjects have a number of fundamental works, which have elaborated a concept of teaching that has a modern method of scientific cognition as its philosophic fundamentals. The didactic content of the concept implies that despite all the differences between scientific and teaching cognition, in both cases the process follows the general scheme of scientific learning. In practice, this concept is realized at the level of structuring teaching material content, while the activity aspect of the problem is barely reviewed (Galatyuk, 2012).

Basic knowledge of natural sciences is the grounds for learning clinical disciplines and an essential component of professional training of future doctors. Numerous significant discoveries in modern biology were made on the basis of good knowledge and application of the laws of chemistry, physics, and mathematics (Bykova, 1986). These subjects ought to become components for the development of horizontal integration.

In conditions of higher medical education reformation, it is important that from the first year of studying students should have the possibility of understanding and feeling the practical meaning of every subject from the cycle of natural science disciplines that is studied and in this or that way "works" for the model of a specialist. Sometimes the students' interest in learning a subject decreases if its value for clinic practice is not clear. At the same time, the interest grows if the student understands what he is learning in the fields of histology, biochemistry, pharmacology – disciplines being far from therapy, but in the course of teaching being strongly associated with the spirit of a clinic. Teaching any knowledge and skills at any theoretical department should be considered from the perspective of future practice.

In this relation they find extremely urgent the problem of integration of the educational content: both of the inner integration – for natural and scientific disciplines, and of the outer one – for natural, scientific and special disciplines in the course of training medical workers. Integration in education "is associated with such important problems as productivity, personal orientation, and nature appropriateness" (Rybalko, 2012, p. 105). At present training of medical specialists in natural sciences provides sufficient knowledge, skills, and abilities though it has not yet turned into an effective tool for professional activity. As practice shows, the absence or insufficient level of natural sciences knowledge by some doctors weakens their professional thinking thus lowering the effectiveness of the treating process and increasing the probability of a medical mistake.

The natural sciences content in the education of future doctors implies the existence of the scientifically grounded system of didactically and methodically substantiated teaching material, which contains natural sciences component in training medical specialists that we view as the result of acquiring selected knowledge, skills and values necessary for the successful fulfilment of professional activity.

Formation of the content of doctors' training in natural sciences is done at several levels: selection of the teaching material with the purpose of detecting possibilities of integration within natural sciences education; structuring of the content based on the integrative approach and professional orientation towards medical knowledge and skills without breaking the logic of teaching appropriate disciplines; analysis of the possibilities of using synergetic approach to forming the content of natural sciences training; formation of the integrated synergetic system of the content of natural and sciences training of a future doctor in the context of competence approach.

Orientation towards natural and scientific knowledge means its restructuring according to the needs of doctors' training that is the basis for developing the selection criteria of relevant teaching content, in particular: using modern achievements of natural and medical sciences; foreign and home experience in creating curricula; compliance of the complexity of the content and scope of natural sciences training with the real learning opportunities of students specializing in medicine;

scientific level and practical value of the teaching material in natural subjects for future doctors; taking into account general pedagogical and methodical possibilities for implementing the teaching material in the process of teaching and studying; optimization of the scope of natural sciences disciplines with regard to special features of professional training of future doctors.

Specifics of learning natural sciences disciplines in a higher medical educational institution lies in "the development of clinical thinking of future specialists in medicine that starts from studying such fundamental or natural sciences disciplines as normal anatomy and physiology, pathological anatomy and physiology, microbiology, medical genetics, pharmacology, the Latin language. In the process of these studies the main purposes imply the intensive development of cognitive processes: memory, thinking, observation, judgements" (Temerivska, 2004, p. 8).

Natural sciences education of future doctors has to be an effective instrument of professional activity, providing appropriateness to the demands to modern specialists, as natural sciences cycle of disciplines not only covers a great part of medical education but also provides students with the knowledge and skills of practical value for their future work, at the same time developing abilities of proper, creative usage of acquired knowledge in future professional activity. Knowledge of natural sciences disciplines is used while diagnosing the patient according to the whole complex of data about him, it provides the right choice of methods of observation, nursing, opens chances for individual approach to every separate case and promotes taking effective decisions in non–standard situations.

Natural sciences education pays special attention to integrated courses, as it is the basis of the scientific picture of the world. Its transition from anthropocentrism to biocentrism is inevitable, and, thus, the change of the educational content is required. The man should be convinced of the unity of everything existing in the Universe, and therefore the idea of general unity and mutual conditionality ought to be the methodological basis of formation of the content of education. The concept of unity, which came from ancient religious and philosophical studies, recognizes as true only the knowledge that reveals the unique essence of "the relation of everything with everything" in everything that exists. This criterion of the truth of knowledge is of great importance at present, when we are building the higher school of future able to train people with scientific and theoretical thinking, with the thinking that is, first of all, integrated. The way from everyday thinking to scientific thinking is multi–level and difficult. Transformation of the "childish" mind unable to understand objective relations of the world into scientific and theoretical thinking of a future doctor is possible only on the grounds of the integrated knowledge system. Not accidentally, attention to natural sciences education is a priority in the course of developing such a system (Styrkina, 2001). Educational programmes of many countries stake right on it.

At the same time, formation of the content of natural sciences training of future doctors requires sticking to a number of requirements, namely: unambiguousness of scientific terms that are used in the process of studying clinical and natural sciences disciplines; relevance of a professionally oriented content of natural sciences disciplines to the field standards of training medical specialists; provision of the motivation to study natural sciences disciplines with the aim of using them in practical professional activities; optimisation of the scope and level of theoretical complexity of natural sciences training for the future doctors to be able to acquire this knowledge; renovation of the teaching content by modern scientific achievements adapted to the level of education and students' aptitude for assimilation; preservation of the logic of constructing teaching subjects on the basis of fundamental ideas and theories; reliance on natural sciences knowledge and skills in the process of studying clinical disciplines; knowledge natural sciences is the base for studying general medical disciplines; integrated knowledge and skills in medical and natural sciences provide the base for studying special disciplines.

CONCLUSIONS

The integrated approach in the system of medical education can promote more profound understanding of processes that take place in living organisms and the influence of external factors on them. Basic knowledge of natural sciences is the foundation for studying clinical disciplines and an important component of professional training of future doctors. At present natural sciences

training of medical specialists is providing sufficient knowledge, abilities and skills though it has not yet become an effective instrument of professional activity. Natural sciences education of future doctors should become the foundation of their professional activity, ensuring compliance with the requirements to modern specialists, as natural sciences cycle of disciplines not only constitutes the bulk of medical education, but also provides students with the requisite knowledge and its practical application skills, at the same time developing the ability to appropriately and creatively use the acquired knowledge in future professional activity. The challenge of integrating natural sciences component and professional component in training future doctors requires further research.

REFERENCES

1. Bykova, L.A. (1986). *Psikhologo–pedagogicheskiye rekomendacii po razrabotke metodycheskikh ukazanii dlиa studentov medikov* [Psychological and Pedagogical recommendations for the development of methodical instructions for medical students]. L–d: LPMY, 64.
2. Dolnikova, L.V. (2000). *Integratyvno–dyferenciyovanyi pidkhid do strukturuvannya zmistu pryrodnychykh dyscyplin u medychnykh koledzhakh* [Integrative and differentiated approach to natural sciences content structuring in medical colleges]. Pedagogical Sciences of Ukraine, Institute of pedagogy and psychology of professional Education. K., 187.
3. Galatyuk, M.Y. (2012). *Rozvytok navchalno–piznavalnoyi kompetentnosti starshoklasnykiv u procesi vyvchennya pryrodnychykh predmetiv u koledzhah* [The development of teaching and learning competence in the study of natural science subjects in colleges]. Institute of Pedagogy and psychology, Rivne State Humanitarian University, 297.
4. Granatov, G.G. & Plugina N.A. (2006). Metod dopolnitelnosti v integracii nauchnykh kultur. [Additional method in scientific cultures integration]. *Pedagogicheskije nauki*, 6, 46–52.
5. Krasnobokyi, Y.M. (2003). Integraciya pryrodnycho–naukovykh dyscyplin u svitli kompetentnisnoyi paradygmy osvity [The integration of natural sciences in the light of competency paradigm of education]. *Theory and methods of teaching basic subjects in high school*, 8, 83–89.
6. Pastyrska, I.Y. (2012). *Integraciya zmistu predmetiv pryrodnychogo i gumanitarnogo cykliv yak zagalnopedagogichna problema (kinec XX – pochatok XXI stolittya).* [Integration of content of natural and humanitarian cycles as general pedagogical problem (the end of XXth – the beginning of XXIst century)]. Uzhgorod: Transcarpathian State University, 206.
7. Paykush, M.A. (2011). Zagalni pytannya gotovnosti vykladacha biologichnoyi fizyky do integraciyi teoretychnykh ta fahovykh znan maybutnikh medykiv [General questions of preparedness of biological physics teacher to integrate theoretical and professional knowledge of future doctors]. *Theory and methods of e–learning: scientific research journal*, 2, 124–129.
8. Rybalko, L. (2011). Ekologo–evolyuciynyi pidkhid do integracii znan pro zhyvu pryrodu [Ecological and evolutionary approach to integrating knowledge about wildlife]. *Biology and chemistry at school*, 3, 40–43.
9. Rybalko, L.M. (2012). Suchasni pidkhody do rozvyazannya problemy integraciyi zmistu pryrodnycho–naukovoyi osvity [Current approaches to solving the problem of content integration of science education]. *Pedagogical Sciences: theory, history, innovative technologies*, 5 (23), 105–110.
10. Styrkina, Y.S. (2001). *Dydaktychni zasady pidgotovky maybutnikh uchyteliv inozemnoyi movy do vykladannya integrovanykh kursiv* [Didactic fundamentals of future foreign language teachers training to teach integrated courses]. Poltava, 240.
11. Temerivska, T.G. (2004). *Formuvannya piznavalnoyi aktyvnosti studentiv medychnogo koledzhu v procesi vyvchennya pryrodnycho–naukovykh dyscyplin* [Formation of cognitive activity of medical college students in the process of natural sciences study]. Ternopil, 20.

Sc.D. (Pedagogical sciences), Associate Professor **YURII KOZLOVSKYI**
Lviv Polytechnic National University