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Contemporary Practice of Natural Science Training in Higher Education Institutions in Poland, Hungary and the Czech Republic: Neurobiological Aspects of Psychology

Valentyna BILYK[1],
Vitalii HONCHARUK[2],
Inna ROZHI[3],
Kateryna VASYLENKO[4],
Natalia PSHENYCHNA[5]

[1] National Pedagogical Dragomanov University, Kyiv, Ukraine, valya-bilyk@ukr.net
[2] Pavlo Tychyna Uman State Pedagogical University, Uman, Ukraine, gvitalii1975@gmail.com
[3] Pavlo Tychyna Uman State Pedagogical University, Uman, Ukraine, inna.rozhi.93@gmail.com
[4] Drahomanov National Pedagogical University, Kyiv, Ukraine, katevasilenko1995@gmail.com
[5] Berdyansk State Pedagogical University, Berdyansk, Ukraine, natali122436@gmail.com, ORCID ID https://orcid.org/0000-0002-0351-4950

Abstract: *The article examines the program principles and subject content of natural science training of future psychologists in Central Europe (Poland, Hungary and the Czech Republic). The choice of these countries for the study is due to the fact that despite short period of membership in the European Union, the countries achieved a significant progress in developing national education systems. The purpose of the article is to identify the main trends in natural science training of future psychologists and their correlation with the latest ideas of neurobiology, which is gradually becoming complementary to psychological, pedagogical and other humanities. Using methods of analysis (content analysis of educational programs; analysis of educational content for accordance with the latest advances in neurobiology), comparative method, statistical methods and extrapolation method, it was found that natural science training in universities in Poland, Hungary and the Czech Republic partially corresponds to practical application of neurobiology in the professional practice of psychologists. We present specific aspects of qualitative differences in the conclusions. We also calculated that the quantitative ratio of major subjects differs: the volume of credits for natural science training of future psychologists in the curricula of the analysed higher education institutions in Poland is about 6%, in the Czech Republic - 9-10%, and in Hungary - 11-12%.*
The international significance of the article lies in identification of positive practical and formal approaches to neurobiological training, which requires organizational and methodological reforms of psychological education in Eastern Europe.

Keywords: *Scope of education; interdisciplinary integration; study credits; practical training.*

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Introduction

In the period of globalisation in general and European integration in particular, the issues of integrative training future professionals of the new generation: comprehensively developed, competent, really in demand on the labour market. It should be noted that the classical system of higher education is no longer able to meet the requirements of the present, and therefore needs appropriate reforms.

In the context of the general reform of the worldwide education system, the issue of modernizing the training of future psychologists in higher education institutions is relevant, and logically, the problem of transformation of their natural science training.

Natural science education of psychologists now needs to be reformed in the direction of convergence of natural sciences and humanities, among which neurobiology, neuropsychology, neuropedagogy, etc. come to the fore (Demchenko et al., 2021; Prots et al., 2021; Kosholap et al., 2021).

Previously, neurobiology was considered an effective tool for solving personal problems, but now scientists are proving its connection with the social environment (micro and macro). They argue this connection by the fact that the stimulus-filled environment during adaptation and socialization of the subject changes the personal neurogenesis of brain structures, which in real groups can be described statistically, Kempermann (2019). Establishing a correlation between plasticity of the brain and adaptation to the environment, formation of personal flexibility and mobility will better prepare a person for effective activity in a multimodal preliminary undetermined globalized society.

For psychology, psychiatry and criminology there are significant prospects for prevention of delinquency and deviant behaviour, to understand the biological interdependence of an individual and their environment (Cupaioli et al, 2021).

In the field of cognitive neurobiology today's researchers claim that in the laboratory it is easy to establish a link between neurobiology and higher mental processes in normal and pathological cases. Psychology here is at an intermediate level between pedagogy and psychiatry, so when designing the syllabus, it is appropriate to find the optimal combination of the scope of biological (neurobiological) and psychological training, Sullivan (2015). In this regard, cognitive neurobiology should become a principal subject of natural science training.

We have noticed that in all universities of Eastern Europe there are integrated disciplines, the name of which includes neurobiological categories,

but it is not always clear how the content of the discipline corresponds to current science, professional practice.

Therefore, the aim of the study is to find the most relevant neurobiological trends in natural science training of future psychologists in Poland, Hungary and the Czech Republic, to determine regional features of such training, to make appropriate statistical and qualitative conclusions on the correlation of educational content with the latest ideas in neurobiology.

We used such methods as analysis of the scope of education for compliance with the achievements of neurobiology, content analysis and statistical analysis of the scope of disciplines in credits.

The hypothesis of the study is that the natural science training in the countries of the former socialist camp (Poland, Hungary and the Czech Republic) has its national differences and is still on the stage of full adoption of the biopsychological concept of mental health and the corresponding concept of practical psychologists' training. The authors of the research studied the relevant experience of the post-Soviet countries (Russia, Ukraine) and developed Western European countries (Scandinavia) and against the background of their opposite models of science training can identify differences, negative and constructive aspects of reforming psychological education in Central Europe.

The ethics of the study is determined by the consent of the administrations of the analysed universities in Poland, Hungary and the Czech Republic to publish and analyse the generalized fragments of educational programs, which are listed in the following sections.

Neurobiological aspects of psychology

To understand the feasibility of building educational systems in Central Europe (Poland, Hungary and the Czech Republic) and compliance of scientific training of psychologists to global trends, let's consider current neurobiological approaches.

At the end of twentieth century, neuroscientists considered microphysical brain response, sensory responses, and motor coordination as major markers that could be used in pedagogy and psychology, Churchland (1986). But at that time there was no appropriate equipment for fine neuroimaging, and society was not ready for the total integration of the humanities and natural sciences. These problems have now been overcome, so there is a need to increase the scope of neurosciences in the humanitarian education.

The relevance of the study is given by the fact of universality of current neurobiology, which began to experimentally explain and

materialistically objectify humanitarian phenomena, in particular education and training through the cognitive processes that accompany it. It is clear that the actually measurable mental and brain processes underlie cognitive, behavioural and even social and cultural. Scientists have already made numerous recommendations for transformation of not only psychological education, but also all educational strategies in the framework of humanitarian and pedagogical integration (Friedlander et al, 2011).

Recent studies with neuroimaging of the fronto-parietal and subcortical brain networks have shown that "barely visible" age or pathological changes in the human brain are directly correlated with changes in the higher nervous system (Rosso et al., 2020). Such changes can be detected in parallel in the early stages and with the help of psychodiagnostics, and with the help of current methods of neuroimaging. This makes psychology and neurobiology complementary sciences that solve common problems. Therefore, it is necessary to introduce into the educational plans of psychologists' training disciplines which consider neurobiological mechanisms of age, degenerative or mechanical (trauma) changes. This will spare psychology of an excessive number of idealistic modalities and promote integration of medicine and psychology.

We have noticed that previously neurobiologists and neuropsychologists were more interested in pathological conditions, ailments and degenerative disorders of the brain. But recent studies apply experimental neurophysiological experience to normal states. Now one can trace a natural aging process and link it to psychological changes. Changes in the plasticity of certain brain regions, weakening of synaptic connections, on the one hand, age-related behaviour change, loss or maintenance of adaptability, flexibility of the psyche appeared mutually determined (Kelly et al., 2006). Thus, neurobiological markers can be used in psychological counselling or support of a person throughout their life.

Further we give some examples of how neurobiology managed not only to integrate into psychological science, but to solve problems that were previously considered purely humanitarian. For example, Gorman S. and Gorman J. (2019), based on the experience of social psychology, identified hyperactive zones of the brain, which are neurobiological correlatives of forming social ones based on common stereotypes, prejudices and interests. The neurophysiological specificity of the brain among representatives of marginalized social groups was also proved. In future, such research will help social psychologists to predict and resolve intergroup conflicts.

DeYong (2021) and co-authors of this work published an article in which, based on present neuro experiments and previous experience, proved

that there are specific and valid for laboratory detection biological mechanisms that shape and determine personality. Scientists acknowledge that genetics, ecology, and the environment have a significant effect on personality, but its phenotypic basis is in the individual functioning of the brain. Scientists predict that in the near future the neuroscience of an individual will turn from its current initial state into a discipline that is central to psychology. Early neurophysiological diagnosis of disorders and personality disorders is especially promising, as clients go to psychologists in case of exacerbation of disorders and in the absence of any objective brain research.

Convergence of psychology and neurobiology has made it possible to explore the value, style and taste advantages in development and learning. Such convergent studies have shown that "Pavlov's" conditional stimuli (CS), which were not previously associated with social behaviour and learning, can actually stimulate processes that are far from physiological needs. For example, the perception of food, smells and tastes, their change or improvement saturate the nervous system with positive stimuli, resulting in greater efficiency of work, education, conscious activity, Myers (2018). Thus, the general motivation of an individual to constructive behaviour, awareness of success, happiness grows. This suggests a closer connection between the brain zones responsible for the instinctive and social.

Therefore, the educational and scientific trends of Western European countries testify to the growing popularity and expediency of implementation of neurobiology as an interdisciplinary science in the system of natural sciences and humanities. In view of this, interdisciplinarity as a traditional educational category acquires a new meaning - integrity and holisticity in the development of patterns of functioning of an individual, social groups and humanity as a whole.

Natural science training of future psychologists in higher education institutions in Poland

In order to investigate the most important characteristics of natural science training of future psychologists in higher education institutions in Poland, in our opinion, it is advisable to start with an analysis of higher education systems in this country. According to the Polish "Ustawy o szkolnictwie wyższym" and the Law on Higher Education", the following educational levels are distinguished in Polish higher education institutions: First degree (bachelor's equivalent) - training lasts from 6 to 7 semesters (3–3.5 years) and ends with the student obtaining a qualification diploma and an academic degree "Bachelor" (BA, "Licencjat"), which allows him to start a

professional career, or grants the right to continue education at the second level (Chancellery of the Sejm, 2018). II degree (equivalent of master's degree) - educational programs of this level are intended for entrants who already have the qualification of the first degree. The study lasts 4-5 semesters (2-2.5 years) and ends with the recipient of higher education Dyplom ukończenia studiów wyższych / diploma of higher education and academic degree "Magister / Master". Especially interesting for our study is the Polish "Studia jednolite magisterskie / Unified Master's program", as it exists for such areas of training future professionals as: psychology, medicine and others. The program provides lifelong learning (9 to 12 semesters). In addition to the "Master's degree", a higher education applicant who is enrolled in this program is awarded Dyplom ukończenia studiów wyższych/ a diploma of higher education. Graduates with a master's degree can apply to participate in doctoral research. III degree (doctoral studies - the equivalent of postgraduate studies in Ukraine) - involves the implementation of higher education by researchers and obtaining after the defense of the dissertation of the scientific degree "Ph.D. / Doctor of Philosophy". The current model of training future psychologists in Poland is based on a five-year curriculum. Science training is part of the "Studia jednolite magisterskie / Unified Master's program" and consists of compulsory and elective courses.

Let's analyse the organization of natural science training of future psychologists in the leading institutions of higher education in Poland, in particular, in the Krakow Pedagogical University named after the Commission on Public Education, Warsaw University of Social Sciences and Humanities (2019a; 2019b), University of Gdańsk (2019) and University of Wroclaw.

Thus, as a result of our research it was found that the mandatory natural sciences, which are provided in the curriculum for future psychologists at the Krakow Pedagogical University named after the Commission on Public Education, a fragment of which is proposed in Table 1, include: "Biomedical bases of human behaviour", "First aid", "Brain mechanisms of mental processes" and an integrative course "Introduction into Biopsychology".

Table 1. Fragment of the curriculum for the training of future psychologists at Krakow Pedagogical University named after the Commission on Public Education

Disciplines	Tutorial type			Independent work of student	Credits ECTS
	Lectures	Seminars	Lab. work		
Compulsory subjects					
Biomedyczne podstawy zachowań ludzkich / Biomedical bases of human behavior	30			30	2
Pierwsza pomoc przedmedyczna / First aid	15		15	30	2
Mózgowe mechanizmy funkcji umysłowych / Brain mechanisms of mental processes	60	60		60	6
Wprowadzenie do biopsychologii / Introduction to biopsychology	60	60		60	6
Elective subjects					
Szkolenie Bezpieczeństwa życia i działań (BŻD) / Life Safety Training (LST)	15	15		30	2

Source: Authors' own conception

In the general list of elective disciplines there is only one discipline of the cycle of natural science training, namely: "Life Safety Training (LST)" (Table 1).

Thus, the coordinator of the courses "Biomedical bases of human behavior" and "First aid", Dr. Kowalewski, I., argues: based on knowledge about: health, pathogenesis and symptoms of mental disorders and human diseases, methods of their prevention, as well as knowledge of topographic anatomy and physiology, obtained during the study of the outlined disciplines, future psychologists develop social competencies. The scientist specifies that in the process of studying the discipline "Biomedical foundations of human behaviour", such competencies are formed as: K 01 - awareness of the need for knowledge about growth, physiological and mental development as a theoretical and practical component of health safe of their future customers; K 02 - awareness of the need for knowledge about the processes of growth, physiological and mental development as a

fundamental element of a professional approach to man in terms of education and psychology, especially during development; K 03 - awareness of the need to develop research on human health as a value and resource of society (Kowalewski, 2019).

Studying the discipline "Premedical first aid", Kowalewski noted, in addition to the competencies K 01, K 02 and K 03, future psychologists additionally develop competencies K 04 - awareness of moral and ethical principles in performing diagnostic and rescue operations, K 05 - demonstrating readiness to implement in future professional activities the skills of a healthy lifestyle and K 06 - demonstrating a willingness to cooperate and seek allies to implement a program to promote health in schools and society.

Having analysed the working curricula of these disciplines of natural science training, which are specified in the curriculum for future psychologists, we consider it appropriate to note that the purpose of their study is to provide students with social and professional competencies, the characteristics of which are described in detail by the authors of respective programmes, however, we did not find in the content of these programs coverage of the neurobiological mechanisms that may correlate with psychological competencies. The courses analysed in the following paragraphs are more in line with the current integrative paradigm of the humanities and natural sciences.

Instead, the integrative course "Introduction to biopsychology" logically combines the topics of natural science and professional training of future psychologists. The purpose of the course, as noted by Czernecka (2019) is to provide students with basic knowledge about the biological basis of the psyche, namely, the structure and functions of the human nervous system in micro (construction and operation of neurons and glial cells) and macro-dimensions (anatomy and physiology of individual parts central and peripheral nervous system), the main methods of diagnosing the structure and functioning of the human nervous system, adapted for use in psychodiagnostics.

The course "Brain mechanisms of mental processes", is a continuation of the course "Introduction to biopsychology". During studying it, students are introduced to the neurophysiological mechanisms of complex mental functions of man, covering such phenomena as language, attention and memory. Much of the course is aimed at studying the biological aspects of circadian rhythms and issues related to the asymmetry of the human brain (Krzywoszański, 2019).

Authors of curricula for the analysed courses Czernecka, K.,

and Krzywoszański, Ł., propose a more generalized interpretation of the competencies K 01 and K 02, which are formed in the process of teaching the disciplines "Introduction to biopsychology" and "Brain mechanisms of mental processes", express the opinion that they have social and professional significance. Competence K 01 scientists formulate as awareness of future psychologists of the need for knowledge about the processes of physiological development of man as a theoretical basis for understanding the complexity of the determinants of his behavior and mental functioning as himself and others, equally assessing the impact of biological, social and cultural factors; competence K 02 - as the willingness of future psychologists to apply scientific knowledge to justify the correctness of professional decisions and the ability to communicate effectively with specialists in other fields of neuroscience (biologists, physiologists, doctors) within certain issues related to mental functions (Czernecka, 2019; Krzywoszański, 2019).

The discipline "Szkolenie BŻD / Life Safety Training (LST)" is offered as an elective, but for students who have not chosen it at the first level of study, it will be mandatory to study at the second or third level of study in master's / doctoral studies.

Thus, having carried out a detailed analysis of the curriculum for the training of future psychologists at the Krakow Pedagogical University named after the Commission on Public Education, we have reason to say that science training is 18 credits, which corresponds to 6% of total credits (300 ECTS credits). But only two disciplines directly take into account the achievements of the present neurobiology.

Let's turn to the content of science education in other institutions in Poland. Warsaw University of Social Sciences and Humanities is one of the leading institutions of higher education for the training of future psychologists in Poland and the only private educational institution in the country that has the right to award the degree of Ph.D. of Psychology. Given that the lecturers of this educational institution actively carry out research and implement in the educational process the international experience of training future specialists, take an active part in such international student exchange programs as Erasmus +, Atlantis and Santander Universidades and work closely with US, EU, China, Vietnam and Korea are implementing their training programs for 1-2 semesters in universities and colleges of these countries, we consider it appropriate to determine the state of natural science training of future psychologists at this university (Warszawski Uniwersytet, 2019).

An analysis of the curriculum for the training of future psychologists,

which is available on the official website of the Warsaw University of Social Sciences and Humanities, suggests that it identifies five blocks of educational modules. The first three: block of compulsory subjects, block of elective subjects and block of specialization subjects - are the basis of university psychological education. The other two: (block of language subjects and block of general subjects) are additional blocks of the plan (Table 2).

Table 2. Fragment of the curriculum for the training of future psychologists at the Warsaw University of Social Sciences and Humanities

Learning effects	Names of blocks / modules	Credits
Przedmioty obligatoryjny / Compulsory subjects		
K_W01, K_W02, K_W03, K_W04, K_W05, K_W37, K_U12, K_U16, K_K18.	Biologiczne mechanizmy zachowania / Biological mechanisms of behavior	6
Przedmioty fakultatywny / Elective subjects		
K_W01, K_W02, K_W12, K_U01, K_U12, K_K18.	Biologiczne podstawy psychiki / Biological foundations of the mentality	4
Przedmioty specjalizacyjny/ Subjects of specialization		
K_W27, K_W28, K_W34, K_U10, K_U11, K_U17, K_K07, K_K10, K_K19.	Neuropsychologia i neuronauki / Neuropsychology and neuroscience	6
Przedmioty ogólny / General subjects		
K_W40	Bezpieczeństwo życia i działań / Life Safety	2

Source: Authors' own conception

As can be seen from Table 2, the subjects of natural science training belong to the three main blocks of training of future psychologists and to one additional one. In the block of obligatory subjects, in particular, natural science training is represented by the module "Biological mechanisms of behaviour". There are 6 credits for its study during the first year of study. In the block of elective subjects, the module "Biological foundations of the mentality" is highlighted.

In accordance with the requirements of the university from the list of elective modules, students must choose at least 2 of the 10 provided each year. Thus, during the five-year period of study, students will be required to choose the module "Biological foundations of the psyche", for the acquisition of which there are 4 credits. The authors of the program included the integrative module "Neuropsychology and neuroscience". This module is the most relevant to the latest trends. Its main task is to thoroughly study the human brain and the cerebral mechanisms of higher mental functions by students. The topics of the module have a complex level structure, according to which the principle of detailing the study of the human nervous system from the molecular and genetic levels of individual molecules (e.g. proteins) and individual genes to the cellular level (neurons) is embodied; from the level of histological structures and cytoarchitectonics of individual parts of the human brain, such as the mantle of the brain, to more complex structures, such as the cerebral cortex, and to the highest level, namely the human brain and nervous system as a whole, and brain mechanisms memory, emotions, thinking, etc. The introduction of such principles of learning, according to the authors of the program, will allow students to form knowledge (K_W27, K_W28, K_W34) about the structural and functional organization of the human nervous system, patterns of its conditioned reflex activity and mechanisms of conditioned reflexes, physiological bases of simple and complex forms of human behavior and neurophysiological foundations of individuality (Program kształcenia na kierunku Psychologia 2019). A detailed analysis of the working curriculum of this module indicates its interdisciplinary status.

The authors of the program claim that students who will study according to the program created by them will be able to demonstrate skills (K_U10, K_U11, K_U17), namely: to study unconditioned human reflexes, make reflex arcs and determine their type (monosynaptic or polysynaptic), assess individual level excitability of the cortex of the large hemispheres and features of internal inhibition, to investigate the basic physiological mechanisms of attention, memory, emotional state and motivation for various activities.

The acquired knowledge and skills, according to the authors of the program, will contribute to the formation of future psychologists' competencies (K_K07, K_K10, K_K19), which include: a) understanding by the student of the complex nature of the relationship between psychology and neuroscience; b) their awareness of the need for continuous natural science education and renewal of knowledge in neuroscience.

Coordinator of the module "Biologiczne mechanizmy zachowania/

Biological mechanisms of behaviour" is Sobańska, M. (2019) The coordinator of the module Sobańska, M., notes that the study of the training course presented by her presupposes the formation of knowledge among future psychologists (K_W01, K_W02, K_W03, K_W04, K_W05, K_W37), about the structure and activity of nerve and glial cells; mechanisms of transmission of nerve impulses in a neuron and in a synapse; the action of the main neurohormones and neurotransmitters; structure and functioning of the central and peripheral nervous system of a person; functional connections between the activity of the central nervous system of a person and his cognitive and motor-emotional activity; the main mechanisms responsible for the perception of external stimuli in receptors; neurophysiological mechanisms of regulation of muscle activity and internal organs; basic psychophysiological measurement methods and biological mechanisms underlying the measured variables, Sobańska (2019).

Having completed the study of the module "Biological mechanisms of behaviour", students must be able (K_U12, K_U16,) to distinguish on diagrams and drawings of the structure of the peripheral and central nervous system of man; structural elements of the neuron; to connect the activity of human internal organs with individual departments of the CNS; to combine sensory phenomena with the functioning of the human nervous system and its receptors; differentiate electrophysiological signals: Electrocardiography, Electromyography, Purulent-septic infections and Electroencephalography; assess how changes in the levels of main neurohormones and neurotransmitters affect human behavior and mental health.

During the study of the module "Biologiczne mechanizmy zachowania / Biological mechanisms of behaviour" future psychologists develop competence (K_K18), which implies their understanding of the complexity of the links between psychological research and other fields of knowledge, including science; awareness of the need for constant study and updating of their natural science knowledge in order to expand the scientific worldview and apply them in professional activities.

Author of the program of the elective module "Biological foundation of mentality" Jabłoński S. notes that the purpose of this course is to acquaint students of psychology with basic knowledge of the biological mechanisms underlying the relationship between the brain and mental processes, as well as to create a conceptual framework for further training in psychology. The explanatory note to the program states that after completing the module (discipline) and confirming the learning outcomes, the student can (K_K18) reflexively apply the basic concepts of neuroscience and knowledge (K_W01, K_W02, K_W12) about the structure

of the nervous system and its functional organization, to characterize cognitive dysfunctions on the basis of knowledge about the structural organization of the human nervous system and functional connections of its structures (K_U01, K_U12), Jabłoński (2019).

"Bezpieczeństwo życia i działań / Life Safety " - a training module that belongs to the block of general disciplines, and, as noted in the training program for future psychologists, aims to form in them scientific knowledge about the dangers of different origins and means of protecting people and the environment from them actions (K_W40). To study this module there are 2 credits in the first semester of the first year of study (Warszawski Uniwersytet Humanistycznospoleczny (SWPS, 2019).

Thus, having analysed the curriculum for the training of future psychologists at the Warsaw University of Social Sciences and Humanities, we have reason to say that the structure, names and number of disciplines system of natural science training of psychologists has significant differences from a similar system implemented in Krakow Pedagogical University named after the Commission on Public Education. However, in both universities it is 18 credits, which corresponds to 6% of the total credits (300 ECTS credits).

Analysing the curricula for the training of future psychologists at the University of Gdańsk / University of Gdańsk (Uniwersytet Gdański, 2019) and the University of Wrocław / University of Wrocław, (Warszawski Uniwersytet Humanistycznospoleczny (SWPS) (2019), we concluded that the structure, content and number of credits of natural science training of future psychologists at these universities fully correspond to those of Warszawski Uniwersytet Humanistycznospoleczny / Warsaw University of Social Sciences and Humanities (Uniwersytet Gdański, 2019; Warszawski Uniwersytet, 2019).

Thus, our analysis of curricula and training programs for the training of future psychologists in higher education institutions in Poland gives grounds to distinguish similarities and differences in the implementation of natural science training. It is worth noting that the identified differences in the names of disciplines of natural science training in the analyzed curricula, at first glance, give the impression of its significant differences in different institutions of higher education in Poland. However, a detailed analysis of the content of educational programs indicates that all disciplines of the natural science component of the training of students of psychology are professionally oriented and aimed at forming the professional and social competencies of future psychologists. We consider it expedient to emphasize that the natural science component in the system of general

training of future specialists in this field in these universities is realized through the same number of ECTS credits and is 6% of the total credits.

Training of future psychologists in Hungary

Higher education in Hungary has a long history and dates back to its founding in the south of the country, in the city of Pecs, the first university (1367).

Today's higher education in Hungary is represented by more than 20 accredited public or private educational institutions, including universities and colleges. Some colleges operate as part of universities and have the status of "colleges-faculties". Universities may also offer courses equivalent to colleges. The college course lasts from 4 to 5 years and corresponds to the Bachelor of Science program. According to the university program as well as the college program, the duration of students' study is from 4 to 5 years, but corresponds to the Master of Science program.

The training of future psychologists in Hungary, as well as in Poland, is carried out according to the system of continuous five-year general education. It should be noted that Hungarian students start their studies with basic general and psychological education and acquire special professional knowledge only in the last years, and in some cases - even after graduating from university.

We will analyse the organization of natural science training of future psychologists in the leading universities of Hungary, in particular in Eötvös Loránd Tudományegyetem / University of Budapest named after Lorand Etvěš (2019), Pázmány Péter Katolikus Egyetem / Catholic University named after Pázmány Péter (2019) and Szegedi Tudományegyetem / University of Szeged (2019).

For analysis, we offer a fragment of the curriculum for future psychologists at Eötvös Loránd Tudományegyetem / Lorand Etves University of Budapest (Table 3).

As a result of our research, it was found that the compulsory natural sciences, which are provided by the curriculum for training psychologists at the University of Budapest named after Lorand Etvesh include: "Physiology and Anatomy I and II", "Practicum on Physiology and Anatomy", "Evolutionary psychology and behavioral genetics" (Table 3.) (Gallupe, et al., 1992).

Given that higher education institutions in Hungary are autonomous and have the right to independently draw up and approve student training plans, the fact that the heads of primary schools are aware of the importance of natural science training for future psychologists is considered to be one of

the disciplines chosen by the educational institution. Two disciplines from the cycle of natural science training were introduced for study, namely: "Introduction to Neuroscience" and "Neuroscience Practicum" (Table 3).

Table 3. Fragment of the curriculum for the training of future psychologists at Lorand Etves University of Budapest

Disciplines	Credits ECTS	Number of hours per week	Semester	Tutorial type	Final control
Mandatory disciplines					
Élettan és Anatómia I és II / Physiology and Anatomy I and II	6	3	1,2	lecture	exam
Gyakorlat a az Élettan és Anatómia / Practicum on Physiology and Anatomy	3	2	1,2	practical work	test
Evolúciós pszichológia és Magatartásgenetika / Evolutionary psychology and behavioral genetics	4	3	2,3	lecture / practical work	exam
Disciplines chosen by the educational institution					
Bevezetés az Neurotudomány / Introduction to Neuroscience	4	3	3	lecture	exam
Gyakorlat a az Neurotudomány / Neuroscience Practicum	3	2	4,5	practical work	test

Source: Authors' own conception

According to the authors of the curriculum, additional study of professionally oriented disciplines of natural science training will expand and deepen the training of future psychologists (Eötvös Loránd Tudományegyetem, 2019).

A detailed analysis of the curricula in the disciplines of natural science training of future psychologists at the Lorand Etves University of Budapest shows that they are all integrative and have a neurobiological

orientation. Interestingly, all theoretical courses are accompanied by practical training, which takes place either together with theoretical, as in the course of studying the course "Evolutionary Psychology and Behavioural Genetics", or in parallel with theoretical, as, for example, in teaching disciplines "Physiology and Anatomy I and II" and "Practicum on Physiology and Anatomy" which are studied in 1 and 2 semesters respectively. Alternatively, a series of theoretical and practical classes are practiced, as in the process of teaching the discipline "Introduction to Neuroscience", the theoretical part of which is studied in the 3rd semester, and the practical course "Neuroscience Practicum" - in 4 and 5 semesters.

Catholic University named after Pázmány Péter has a common history with the Lorand Etves University of Budapest and is one of the oldest private universities in Hungary. It consists of two institutes and five faculties, including the Faculty of Social Sciences and Humanities, which includes the Institute of Psychology (Pázmány Péter Katolikus Egyetem, 2019).

An analysis of the training plans of future psychologists at the Catholic University named after Pázmány Péter shows that its volume, as at the Lorand Etves University in Budapest, is 20 credits, ie 11.1% of the total credits (180 ECTS credits). However, the structure of scientific training is somewhat different (Table 4).

Table 4. Fragment of the curriculum for the training of future psychologists at Catholic University named after Pázmány Péter

Disciplines	Credits ECTS	Number of hours per eek	Semester	Tutorial type	Final control
Compulsory biological disciplines					
Anatómia / Anatomy	4	3	1	lecture	exam
Neyroanatómia / Neuroanatomy	4	3	2	lecture	exam
Élettan / Physiology	4	3	2	lecture/ lab.work	exam

Etológia / Ethology	3	2	2	lecture	exam
Compulsory scientific disciplines					
Bevezetés a biostatisztika (Az elmélet) / Introduction to biostatistics (theoretical course)	3	3	3	lecture	exam
Elective disciplines					
Bevezetés a biostatisztika (Gyakorlati kurzus) / Introduction to biostatistics (practical course)	2	2	3	practical work	test

Source: Authors' own conception

As can be seen from Table 4, in the curriculum of Catholic University named after Pázmány Péter, the disciplines of natural science training of future psychologists are represented in three sections, namely: biological disciplines ("Anatomy", "Neuroanatomy", "Physiology"), scientific disciplines ("Introduction to biostatistics (theoretical course)"), and elective disciplines ("Introduction to biostatistics (practical course)"). We consider it necessary to emphasize that, although the course "Introduction to biostatistics (practical course)" belongs to the elective courses, but in the program of the theoretical course "Introduction to biostatistics (theoretical course)", in the section of recommendations that are mandatory, it is stated that the theoretical course should end with the formation of future psychologists' practical skills, and therefore requires study of the course "Introduction to Biostatistics (practical course) (Pázmány Péter Katolikus Egyetem, 2019).

Thus, due to this clarification, we have reason to believe that the number of disciplines of natural science training, which are compulsory for future psychologists, and the number of credits allocated for its implementation is increasing.

University of Szeged is one of the largest in Hungary. Its structure includes 12 faculties. Szeged Institute of Psychology - a structural unit of Faculty of Humanities.

The analysis of the curriculum for the training of future psychologists at the University of Szeged, a fragment of which is shown in Table 5, gives grounds to state: natural science training is mandatory for higher education bachelor's / master's degree in psychology and is 23 credits, which corresponds to 12,8% of the total teaching load (180 ECTS credits) (Szegedi Tudományegyetem, 2019).

A detailed analysis of the work programs in the disciplines of natural science training of future psychologists, which are reflected in the

curriculum of the University of Szeged, indicates that all natural science disciplines, namely: "Physiology and Anatomy I and II", "Practicum in Physiology and Anatomy I and II", "Ethology and behavioural genetics", "Neuropsychology and Neuroscience" and "Neuropsychology and Neuroscience Practicum" are professionally and practically oriented.

Table 5. Fragment of the curriculum for future psychologists at University of Szeged

Disciplines	Credits ECTS	Number of hours per week	Semester	Tutorial type	Final control
Compulsory disciplines					
Élettan és Anatómia I–II / Physiology and Anatomy I and II	6	3	1/2	lecture	exam
Gyakorlat a az élettanról és az anatómia I–II / Practicum in Physiology and Anatomy I and II	3/4	2/3	1/2	practical work	test
Etológia és magatartásgenetika / Ethology and behavioral genetics	3	2	2	lecture / practical work	exam
Neuropszichológia és neurotudomány / Neuropsychology and Neuroscience	4	3	6	lecture	exam
Gyakorlat a neuropszichológiába és az neurotudomány / / Neuropsychology and Neuroscience Practicum	3	2	7	practical work	test

Source: Authors' own conception

Thus, despite the form of ownership and autonomy of higher education institutions in Hungary to organize the educational process, in the structure of curricula for future psychologists a significant number of credits from 20 to 23 is provided for the implementation of science training, which is approximately 11-12% of total credits. Most natural science disciplines are represented by integrative courses with a professional focus. Considerable

attention is paid to the formation of future psychologists' practical skills, so theoretical courses are accompanied by practical or laboratory work.

Higher psychological education in the Czech Republic

Czech higher education is one of the oldest in Europe. Its roots go back to the middle of the XIV century, when the world-famous Charles University was founded. Modern higher education in the Czech Republic is represented by 62 higher education institutions, among them: 24 - public educational institutions, 4 - state higher education institutions and 34 - private.

The training of future psychologists in the Czech Republic, in contrast to the five-year general education in Hungary and Poland we analysed, consists of three stages, after which each graduate receives a bachelor's, master's or doctoral degree, respectively.

Given that higher psychological education in the Czech Republic is in high demand among entrants, we will analyse the organization of scientific training of future psychologists in the country's leading universities, namely: in Prague Charles University, Masaryk University and in University of Palacké.

The website Czech National Institute of Education notes that the development of science education in the Czech Republic has a history of approximately 350 years and has at various times been linked to scientific achievements and social needs and goals. Now, according to the authors of the site, despite the fact that in the Czech system of higher education much attention is paid to the study of natural sciences by students, dissatisfaction with its quality is growing in society. According to the authors of the site, dissatisfaction with the quality of natural education is caused by the remoteness of theoretical training from its practical application. Scientists note that in most institutions of higher education disciplines are taught as isolated "minor sciences", which leads to misunderstanding by future professionals and future psychologists in particular, the importance of science training and weakening the motivation of students to study science (Český Národní Ustav Pro Vzdělávání, 2019).

Given the fact that Charles University like Oxford and Leiden, Bonn or the Sorbonne, Bologna and the University of Geneva, belongs to the Association of European Universities (Český Národní Ustav Pro Vzdělávání, website, 2019), we consider it expedient within the framework of our research to analyze the state of natural science training of future psychologists in this institution of higher education.

Charles University in Prague is the oldest institution of higher education in Central Europe and the most prestigious in the Czech Republic. Its structure includes 17 faculties, 3 institutes and 6 centres of educational, scientific and research activities.

Future psychologists are trained at Charles University in Prague at the Department of Psychology, Faculty of Philosophy. The list of courses of natural science training of students-psychologists in this institution of higher education is shown in table 6.

Table 6. Fragment of the curriculum for the training of future psychologists at the Univerzita Karlova v Praze (2019)/ Prague Charles University

Disciplines	Credits	Semester
Požadované kurzy / Compulsory courses		
Anatomie, fyziologie a genetika / Anatomy, physiology and genetics	3	1
Neurofyziologie / Neurophysiology	3	2
Fyziologická psychologie / Physiological psychology	4	3
Bezpečnost zdraví, život a životní prostředí / Safety of health, life and the environment	2	4
Volitelné kurzy / Elective courses		
Neurobiologie poruch chování / Neurobiological mechanisms of behavioral disorders	3	1–6
Vybrané kapitoly z patologické neurofyziologie Selected sections on pathological neurophysiology	3	1–6
Neurobiologie poruch paměti / Neurobiological mechanisms of memory disorders	3	1–6
Neurobiologie poruch duševních procesů / Neurobiological mechanisms of disorders of mental processes	3	1–6

Source: Authors' own conception

After analysing the curriculum for the training of future psychologists, contained on the official website of the Prague Charles University, there is reason to assert that the scientific training of future psychologists is 18 credits, that is, 10% of the total volume (180 credits) and is represented by compulsory and elective disciplines. Elective science disciplines, two of which are compulsory, students have the right to choose from their proposed list in the curriculum throughout their studies.

As can be seen from Table 6, the compulsory natural sciences disciplines provided for in the curriculum for future psychologists at Charles University in Prague include: "Anatomy, physiology and genetics",

"Neurophysiology", "Physiological psychology" and "Safety of health, life and the environment".

Unfortunately, neurologically oriented disciplines are presented only as optional. The list of optional courses includes "Neurobiological mechanisms of behavioural disorders", "Selected Chapters on Pathological Neurophysiology", "Neurobiological mechanisms of memory disorders" and "Neurobiological mechanisms of mental process disorders". We consider it expedient to emphasize that the analysis of curricula in these disciplines indicates their professional orientation and logical sequence of study.

Masaryk University is the second largest and one of the most prestigious higher education institutions in the Czech Republic, included in the QS World University Rankings / Ranking of the best universities in the world. Some lectures and even some courses at the university are taught by professors of elite American and European universities (Masaryk University, 2019).

The structure of the university includes 9 faculties and research institutes. According to the official website of the university, the Faculty of Philosophy, which trains future psychologists, is in special demand among applicants, University of Masaryk (2019).

Given the above, we consider it appropriate in the framework of our study to determine the state of implementation of natural science training of future psychologists at the University of Masaryk (2019).

The analysis of the curriculum for future psychologists, which is available on the official website of Masaryk University, gives grounds to claim that the scientific research of future psychologists is 16 credits, ie 8.9% of the total (180 credits).

As can be seen from Table 7, the disciplines of natural sciences include: integrative course "Biological Sciences", which combines modules "Anatomy", "Physiology" and "Fundamentals of Genetics", and also professionally oriented courses "Neurophysiology", "Physiological Psychology" and "Neuropsychology".

Table 7. Fragment of the curriculum for future psychologists at Masarykova univerzita / Masaryk University

Code	Disciplines	Credits	Semester
Compulsory courses /Požadované kurzy			
	Biologické vědy / Biological sciences:	5	1
	Anatomie / Anatomy		

PSA_001	Fyziologie / Physiology Základy genetiky / Fundamentals of genetics		
PSA_011	Neurofyziologie / Neurophysiology	3	2
PSA_008	Fyziologická psychologie / Physiological psychology	4	3
PSA_056	Neuropsychologie / Neuropsychology	4	9

Source: Authors' own conception

The explanatory note to the analyzed curriculum states that after successful study of the proposed natural sciences students will have a systematic knowledge of the structure and functioning of the nervous system and neurophysiology of the higher parts of the human brain, which will allow them to successfully use the latest research in neuroscience when diagnosing diseases of the human nervous system and correcting neuropsychiatric disorders (Masarykova univerzita, 2019).

Scientists from Masaryk University J. Válek & P. Sládek (2018) share this view and emphasizing the importance of natural science training of future professionals, including future psychologists, argue that it is the natural sciences that contribute to the formation of their core competencies, namely: the ability to solve problems and to form flexibility and adaptability; ability to develop innovative solutions and develop creativity and systems thinking; ability to industry and interdisciplinary communication and teamwork; ability to withstand stress and stressful situations (Válek & Sládek, 2018).

Palatsky University is the oldest university in Moravia and the second oldest university in the Czech Republic. Today it is an advanced higher education institution with a wide range of educational and research programs, which according to international rankings is among the best universities in the world. According to the official website of the Palacky University, its mission is to promote students in all areas of research, develop their critical and creative thinking, as well as provide quality education in a wide range of natural, medical, social and human sciences at bachelor's, master's and doctoral levels (University Palackého in Olomouci, 2019). Given the above, in our opinion, it is advisable to analyze the state of implementation of natural science training of future psychologists at this university.

The training of future psychologists at Palatsky University is carried out by the Department of Psychology, which belongs to the structure of the Faculty of Philosophy. The guarantor of the training program for students of psychology at the Palatsky University is Ph.D. Š. Matus says that the

program is designed in accordance with European standards for the training of future psychologists, and the curriculum covers both neurologically oriented disciplines and "related", including science (anatomy, physiology, genetics and others). This type of curriculum, according to the scientist, will allow future graduates of psychology, not only to continue their careers as psychologists, but also to apply the acquired knowledge and skills in other fields.

Analysis of the curriculum for future psychologists, which is on the official website of the Palatsky University and fragmented in Table 8, suggests that the mandatory disciplines of natural sciences, which are provided by the curriculum, include: "Fundamentals of Anatomy and Physiology", "Neurophysiology", "General Psychophysiology".

Table 8. Fragment of the curriculum for the training of future psychologists at Univerzita Palackého / Palatsky University

Code	Disciplines	Credits	Semester
Požadované kurzy / Compulsory courses			
PCH/ZAFD	Základy anatomie a fyziologie / Fundamentals of anatomy and physiology	6	1
PCH/ZAFN-	Neurofyziologie / Neurophysiology	4	2
PCH/PFYN	Obecná psychofyziologie / General psychophysiology	4	4
Volitelné kurzy / Elective courses			
PCH/ETLD	Etológia és magatartásgenetika / Ethology and behavioral genetics	3	3

Source: Authors' own conception

In the general list of elective courses there is only one discipline from the cycle of natural science training, namely: "Ethology and behavioural genetics". We consider it appropriate to emphasize that this discipline, although "standing" in the section of elective courses, but has the label – "povinné ke studiu / required for study".

So, let's summarize: natural science training of future psychologists at the Palatsky University is 17 credits, ie 9.4% of the total (180 credits).

Given the information on the importance of natural science training for future professionals, which is available on the website of the Czech National Institute of Education and our analysis of curricula and training

programs for future psychologists in higher education in the Czech Republic, we have reason to say that natural science training for future psychologists in the country compulsory and characterized by professional orientation. However, in contrast to the curricula and training programs for future psychologists at Hungarian universities analyzed above, the natural sciences component does not have separate practical courses, i.e., it is more theoretical.

Thus, the analysis of scientific works, curricula and training programs for the training of future psychologists in higher education institutions in Poland, Hungary and the Czech Republic indicates the presence of both similarities and a number of differences.

Despite the extreme variability of disciplines that form the basis of natural science training of future psychologists, in the above curricula of higher education institutions of these countries, we consider its appropriate to emphasize that their content is fully adapted to the peculiarities of their future professional activities the main methodological approach in the implementation of natural science training is competency, because in all our analyzed curricula in natural sciences disciplines, the result of training is determined by the formation of relevant competencies.

The main difference, in our opinion, is that in higher education institutions in Hungary, teachers pay considerable attention to the implementation of practical training of future psychologists in the disciplines of the natural sciences. On the other hand, theoretical training prevails in higher education institutions in Poland, and even more so in the Czech Republic. There are also significant differences in the number of credits provided by the curricula of the universities of the analyzed countries for the implementation of natural science training: from 6% of the total in Poland to about 9-10% in the Czech Republic and 11-12% in Hungary.

Conclusions

Thus, analysis of scientific works, curricula and training programs for training future psychologists at higher education institutions in Poland, Hungary and the Czech Republic indicates both similarities and a number of differences.

Despite extreme variability of disciplines that constitute the basis of natural science training of future psychologists, in the analysed above curricula of higher education institutions of these countries, we consider it appropriate to emphasize that their content is fully adapted to the peculiarities of their future professional activities; the main methodological approach in implementation of natural science training is the competence

one, because in all the curricula in natural science disciplines we have analysed, the result of training is determined by formation of relevant competencies.

The disadvantage of certain universities is that neurobiological disciplines are in the blocks of elective disciplines.

The undisputed leaders in the practical orientation of natural science training are the analysed institutions of higher education in Hungary, in which theoretical courses of natural science training are always accompanied by practical or laboratory work.

Czech researchers are modernizing the existing system of natural science training for future professionals, specifically: creation of new educational programs (curricula), which should include integrative, professionally oriented natural science disciplines, and the theoretical courses should be strengthened with a practical orientation. This will help students realize the importance of scientific knowledge for future professional activities and the ability to use them in everyday life. The scientists note that under such conditions, it is possible to increase students' motivation to study natural sciences and create broader preconditions for future professional employment and competitiveness of graduates on the present-day labour market.

Attention is focused on the fact that teachers pay somewhat less attention to the practical training of psychology students with natural science training in higher education institutions in Poland, and the theoretical nature of the natural science training of future psychologists in higher education institutions in the Czech Republic is noted.

It is established that the natural science training of future psychologists in higher education institutions in Poland, Hungary and the Czech Republic has certain differences, namely: the state of implementation of its practical part and the number of credits in the curriculum. It is noted that the amount of credits for natural science training of future psychologists in the curricula of the analysed higher education institutions in Poland is about 6%, in the Czech Republic - 9-10%, and in Hungary - 11-12%.

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statistics on distribution of training modules in universities; Valentyna Bilyk and Vitalii Honcharuk identified a neurobiological thematic component in the content of natural training of psychologists. Kateryna Vasylenko finalized the text of the article.

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