РОЗДІЛ 1. АКТУАЛЬНІ ПИТАННЯ ПІДВИЩЕННЯ ЯКОСТІ НАВЧАННЯ ДИСЦИПЛІН ПРИРОДНИЧО-МАТЕМАТИЧНОГО ЦИКЛУ В ШКОЛІ ТА ЗАКЛАДАХ ВИЩОЇ ОСВІТИ РІЗНИХ РІВНІВ АКРЕДИТАЦІЇ

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MEDICAL PSYCHOLOGY STUDENTS' PROFESSIONAL IDENTITY DEVELOPMENT BY LEARNING NATURAL SCIENCE

На сьогоднішній день недостатньо досліджень, спрямованих на вивчення природничих наук, зокрема «Медичної та біологічної фізики», майбутніми медичними психологами. Мета дослідження – показати ефективність методології формування причинно-наслідкових зв'язків між природничо-науковою та професійною компонентами майбутніх медичних психологів. Для проведення дослідження було здійснено анонімне опитування з використанням Google Форм студентів 1 курсу спеціальності «Медична психологія» Буковинського державного медичного університету, які погодилися взяти участь в опитуванні. Анкета складається з відкритих і закритих запитань. Статистичний аналіз кількісних даних здійснювали використовуючи непараметричні критерії U-критерій Манна-Уітні, Т-Вілкоксона, для аналізу якісних даних використовували χ 2 -критерій Пірсона, точний критерій Фішера та кореляційний аналіз Крамера.

Внутрішню узгодженість відповідей на питання оцінювали за допомогою альфа-коефіцієнта Кронбаха. Результати підкреслили важливість та ефективність формування причинно-наслідкових зв'язків у студентів університету шляхом виявлення та встановлення професійних акцентів під час вивчення дисципліни «Медична та біологічна фізика». 97 % респондентів підтвердили вплив фізичних факторів на психоемоційний стан людини та необхідність знань про них і можливість впливу на них. Отже, підхід акцентів «причина-наслідок» необхідно активно пропагувати та практикувати для фаховоорієнтованості дисциплін з циклу загальної підготовки майбутніх медичних психологів. Це сприятиме зростанню мотивації вивчення природничих дисциплін, в цілому, і «Медичної та біологічної фізики», зокрема. Важливим для майбутнього медичного психолога є створення та розвиток трансдисциплінарних елективних курсів із залученням фахівців з медичної та біологічної фізики, оскільки значення професіоналів у цій галузі з плином часу буде постійно зростати.

Ключові слова: *вища освіта, медична психологія, медична та біологічна фізика, природничі науки, психофізика, причинно-наслідкові зв'язки.*

Problem statement. As a consequence of military actions in Ukraine, there is a growing number of people who are in need of professional help for mental health. Therefore, today's challenges for modern society will only increase the request of services of professionals in area of medical psychology [1].

The knowledge acquired by studying the subject «Medical and Biological Physics» becomes the basis for understanding of the results of the impact on humans of natural and artificial physical factors, life processes in the human body, and also form professional competences, i.e. evaluating the results of functional diagnostic methods, laboratory and instrumental research, etc. [2].

The community of practicing medical psychology specialists in present is divided into two camps. The one makes a claim that during the training period excessive attention is paid to scientific and statistical methods that will never be used in daily practice, and they promote medical practice based on clinical intuition (certainly important, but not the only one) rather than scientific evidence [3]. Others believe that neglecting these components inhibits scientific innovation and scientific rigor [4, 5]. But the role of any subject in the educational system of any profile is determined by integrated approach and professional orientation. Technological advances and its effect on human evolution impact on specialists' motivation to analyze, understand, forecast, and use the complex of interdisciplinary tools.

A basic understanding of scientific principles and research methods in psychology are important during training time. The following example can emphasize the role of subjects with a high degree of scientific knowledge in the curriculum of «Medical Psychology» students. Suppose a student is interested in studying neuroimaging methods in psychopathology. The student needs to study elements of neuroanatomy, behavioural neurophysiology, medical physics, digital signal processing, general linear modelling and programming, as well as gain hands-on experience with neuroimaging-specific aspects of data gathering, processing and analysis. Some of the above subjects are still not available in a medical education. Developing branches of knowledge by today's innovations causes new challenges facing the learning of medical psychology [4].

Analysis of current research. Characteristics of modern learners [6], psychological problems of adaptation to high school learning [7], motivation [8], attitude [9] and psychological perception of natural sciences, in particular, in the system of medical education are presented quite widely [10, 11]. However, papers devoted to the problems of natural sciences studying, in particular of the subject «Medical and biological physics», by students of the speciality «medical psychology» were not found.

The objectives of this study is to show the effectiveness of the methodology of cause-and-effect relationships between natural sciences and professional education components for future medical psychologists.

Findings. Natural science for medical psychology by means of cause-and-effect teaching approach. Clinical psychology is focused on understanding and treating mental and emotional distress, and typically involves forming competencies in areas such as human behaviour, cognition, emotions, and therapeutic techniques. The knowledge of natural sciences for students in «Medical Psychology» can be useful to understand cause-and-effect relationships of many mental disorders.

In addition, practical psychologists often use terminology that denotes the physical properties of matter, and it is characteristic for the field of materials science (flexibility, rigidity, elasticity, resistance, plasticity, stability, deformation, etc.), which is an integral part of natural science. Today, quantitative characteristics of these properties have already been developed in psychology. Moreover, understanding of that kind of terminology from the physical point of view allows us to use it consciously for practical medical psychology [12]. As well today the theories of quantum physics are widely represented in neuroscience and psychology [13,14], the branch of knowledge of quantum psychology is being born [15]. This clearly indicates the significant role of medical and biological physics to develop medical psychologist competencies.

It should be noted the importance of short historical discourses in the «Medical and Biological Physics» course studying, that vivid evidence how natural science gradually penetrated and complemented into psychology and vice versa.

Ernst Mach claimed in his psychophysics lectures in 1863, that «Physics, physiology and psychology stay in an indestructible relationship, so that for each of these sciences' salvation can only be found in cooperation with the other ones, and that each of them can be considered as an auxiliary science for the other ones». Emil du Bois-Reymond aforetime called the area that advanced chemical and physical approaches to physiology «organic physics». [16]

The contribution of Theodor Fechner (called «father of psychophysics»), Ernst Heinrich Weber, Hermann von Helmholtz, Wilhelm Wundt, Ernst Mach to the development of psychophysics is undeniable. They made psychology measurable, namely they developed measurement of psychological attributes.

Fechner has written: «The psychophysical experiment, which has so far only found an incidental place sometimes in the physical, sometimes in the physiological experimental room, now demands its own room, its own apparatus, its own methods». [17] Mach, in turn, believed that relative differences are important for perception (in particular, perception of weight, light intensity, sound intensity, temperature, distance and length) in any psychophysical experiments. Today, trends in the combination of physical, physiological and psychological research are often observed. This was typical for the works of the founders of psychophysics scientific area [17].

However, more than 150 years later, the problems remained unchanged. Having achieved significant success in the field of physiology (fundamental theories of vision and hearing, invention of the ophthalmoscope, etc.), Helmholtz devoted himself to physics. He claimed all his physiological work had been based on physics, but physiology students no longer knew enough mathematics and physics to follow them [16]. Evolution of medical education shows consciousness of the physico-mathematical components of studying are important and increased relatively recently [18]. Medical psychology, psychiatry, and neurophysiology are based on understanding the brain and objectification of its research result. But this was only possible thanks to physico-mathematical, chemical, engineering and medical components' combination.

Ask any psychologist: «Why do you want to sleep when it's raining? ». Will his answer be related to the impact of the sound spectral composition on the auditory system, and then on the nervous system? In order to associate these events, knowledge of physics and the ability to use them in physiology (neurophysiology) are required.

Let's consider some areas of study of subject «Medical and biological physics» and propose a cause-and-effect teaching approach for medical psychology students (Table 1).

The main task of a natural science teachers is actualization of natural science knowledge for medical psychology and emphasising the transdisciplinarity in the system of medical education.

Table 1 shows some examples of the «cause-effect» pair (natural science knowledge – psychology knowledge pair) that should be formed for students during study of the subject «Medical and Biological Physics».

Table 1

Some examples of the «cause-effect» pair for «Medical psychology» speciality students during «Medical and biological physics» studying for relationships building and discussions

Cause	**Effects**
I. Mechanical oscillations and waves	
sound frequency, sound intensity, sound spectrum	pitch, quality, volume of sound
Sound (acoustic) spectrum	sound interpretation by humans
psychophysical laws and regularities, human perception age effect, sound (acoustic) spectrum	acoustic illusions, sound quality
acoustic environment, the spectral composition of sounds, psychophysical laws and regularities, frequency response of the ear, frequency bandwidth	the therapeutic effect of sound
the Weber-Fechner law (a logarithmic pattern in the «stimulus intensity - receptor system response» system)	emotional state, perception system
Examples	
1. Environmental noise pollution. Negative effect	
acoustic discomfort, noise level in the range of 50-60 dBA	– challenges in processing and analyzing information, – learning disabilities, – deterioration of mental activity quality, – modification of reflexes, – sleep disorders, – irritability

Acoustic shock	– stress disorders, – fear of loud sounds (phonophobia), – complaint of muffled or distorted hearing, without a clinical picture of hearing loss
2. Environmental noise pollution. Positive effect	
selected spectral composition of noise (for example, white noise)	– calming and relaxing effect, – quality and depth of sleeping
selected spectral composition of noise (for example, pink noise)	– fight against depressions and neuroses, – concentration, memory improvement, – reducing anxiety
selected spectral composition of noise (for example, red (brown) noise)	sleep improvement (in research) [19, 20, 21]
3. Infrasound	
– infrasound of a frequency of up to 10 Hz and a high acoustic load (80-90 dBA) (below the threshold of human hearing) – infrasound with a frequency above 12 Hz and an acoustic load of 90-110 dBA (audible sound)	– reduced attention, – slowness, – decreasing of cognitive abilities, intelligibility of speech, – sleep quality
II. Electromagnetic oscillations and waves	
level of light intensity, light sources (power, spectral composition, type), light regime	psycho-emotional state – effect on appetite, – quality of sleep, – emotions and mood, – Circadian rhythm, – reduction of labour productivity
Examples	
1. Photoreception	
– lack of light intensity (short daylight, gloomy weather, etc.)	depressive states
– the influence of long-wave and short-wave radiation in the visible range	feeling of «warm» and «cold» colours
2. Photo- and chromotherapy	
colour schemes for interior design	– influence on mood, – recovery of emotional state, – impact on decision-making
colour range of dishes	influence on appetite

In the given examples, there is clearly demonstrated the transdisciplinary approach of teaching in medical education. This approach in education of medical psychologists establishes cause-and-effect relationships to get a complete illustration of the patient's life situation.

Many teachers follow a traditional approach to teaching, seeing the teacher's main function as imparting knowledge, ignoring the students' expectations of learning [22, 23]. But despite the advantages of traditional teaching methods, they need to be supplemented with innovative approaches to improve student engagement and learning outcomes.

Therefore, the focus of this paper is to substantiate and highlight the transdisciplinary approach based on the formation of cause-and-effect relationships in the teaching of the subject «Medical and biological physics» for specialty «Medical psychology» students. Moreover, analysis of the impact of teaching methods on students' perception of the significance of knowledge of the subject «Medical and

biological physics» and the importance of systematic, structured and non-fragmentary using of transdisciplinary relationships during the subject studying are considered.

Sampling and data collection. The target group of investigation was a group of students studying in «Medical psychology» spatiality (1st year students, Bukovinian State Medical University) and was agreed to take part in the survey (33 persons). The survey was anonymous and was carried out at the end of the study of the subject using Google forms. Control group (CG) (10 persons) was a group, in which a traditional approach was used in teaching of the subject. In the research group (RG) (23 persons) the cause-and-effect relationship approach was put to the test.

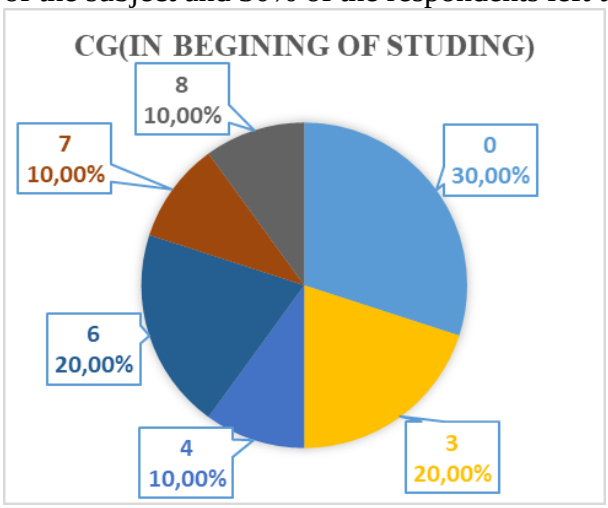
All questions were standardized; respondents had received the same questions with identical wording. Our questionnaire was designed to include both open-ended and closed-ended questions.

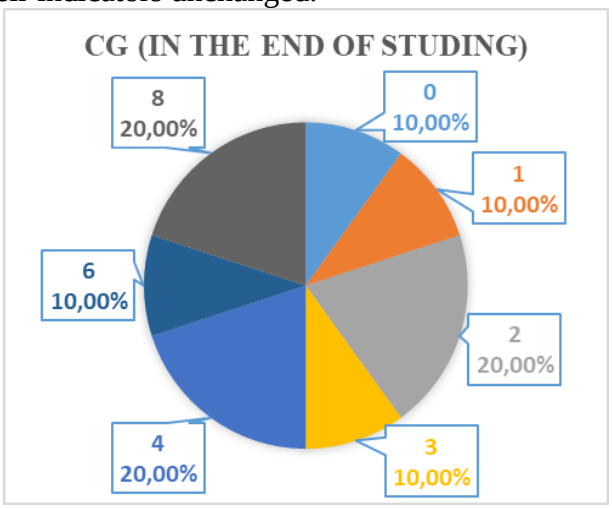
Statistical analysis. Statistical analysis of quantitative data was carried out using non-parametric Mann-Whitney U-tests, T-Wilcoxon tests. χ^2-Pearson's test, Fisher's exact test and Kramer's correlation analysis were used to analyze qualitative data. The internal consistency of the answers to the questions was assessed using Cronbach's alpha coefficient. Cronbach's alpha coefficient was 0.64. It indicated sufficient internal consistency.

In terms of gender, the sample is represented heterogeneously: the ratio of female/male is 90.63% (29 persons)/9.36% (4 persons). However, this does not affect the evaluated results, since there is no significant difference according to the results of the national multi-subject test (NMT) ($p=0.999$) and the graduating results in physics ($p=0.084$) and mathematics ($p=0.850$) by gender in the target group.

The NMT evaluation results and the graduating results in mathematics and physics had shown an average correlation ($r=0.512$, $p<0.05$), therefore the influence of various factors (differences in the quality of acquired knowledge depending on the school, which was graduated; time, which was spent for preparation and systematization of the knowledge in various subjects before taking the NMT; emotional and mental states during the test passing, etc.) was obvious on the final result.

According to the survey results, 36.4% of the students (12 persons) didn't expect to see the subject «Medical and Biological Physics» in the curriculum. It was 5 persons (50%) of CG and 7 (30.4%) persons of RG. 56.6% of the students (19 persons) expected to see the subject in the curriculum, and they associated it with the general training of the 1st year students, and it has not been seen for them the joining of «Medical and biological physics» learning and future professional skills. Two students associated the subject with future skills. The survey students' results about subject importance for future professional skills (a 10-point scale) in the beginning and in the end of the subject studying of CG and RG are presented in Fig. 1. The feeling of subject importance for future professional skills significantly increased during the training process for the RG ($p=0.008$), but did not change ($p=0.587$) for the CG. 30% of the respondents in CG indicated a decreasing of the feeling of subject importance for professional training in the end of studying of the subject and 30% of the respondents left their indicators unchanged.





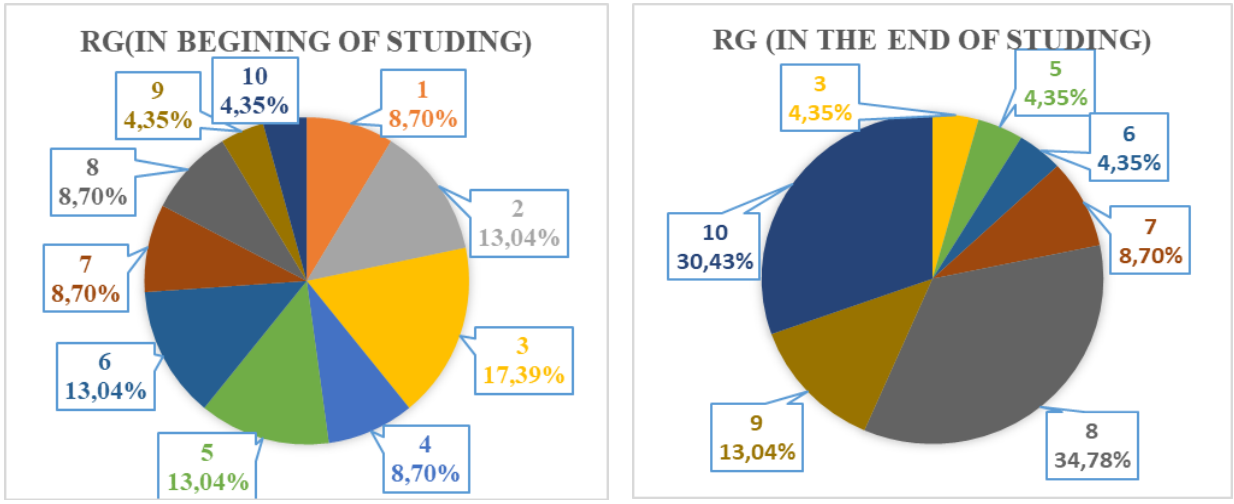


Figure 1. Comparative information about the distribution of feelings of the subject necessity for future professional activity in the beginning and in the end of the discipline studying in CG and RG

We have established the negative value of the correlation coefficient (V=-0.673) between feeling of subject importance for future professional skills and the subjective assessment of the quality of preparation for class in the CG. This result emphasized the importance of systematic, structured and non-fragmented transdisciplinary framework to teaching. 13% of the RG students indicated a correlation between decreasing subject importance and their subjective assessment of preparation for class, i.e. non-systematic preparation.

Students encounter various problems in subject learning:

- insufficient level of basic knowledge in physics, low motivation.
  - In our opinion, the main reason is the general tendency of decreasing in the quality of acquisition of natural and scientific disciplines, regardless of the country.
- a lot of supporting materials that students need to achieve results.
  - From our personal standpoint, adaptation of 1st-year students to high school study is the main reason for this problem.
- subjectively assessed own psychological traits, in particular lack of concentration, peculiarities of perception of various information (written, graphical, audiovisual, etc.)
  - In our opinion, the degree of a student's comprehension of the importance of self-improvement can have an impact in changing their attitude towards the subject of natural science as well. Some students realized that they have to take full personal responsibility for their own education.

Moreover, research suggests that students related main part of study topics (biophysics of the senses (hearing, vision), transport phenomena and biopotentials, ultrasound methods, electric currents' application in medicine, electric and magnetic fields application in medicine, X-ray radiation and sensors application) with future professional skills.

One of a lot of persuasive arguments of importance of a systematic, structured, non-fragmented transdisciplinary approach to the claim of cause-and-effect relationships for future practical activities is study about the interest in pre-class preparation. This study analyzed the extent to which students made appropriate revisions to pre-class preparation depending on the feedback of the teaching method they received. In RG 82.6% of students in contrast to the 33.3% of CG (p=0.002) positive answers concerning the interest in pre-class preparation.

Almost all students of CG and RG (32 persons) confirmed the impact of natural factors on a person's psycho-emotional state. One more persuasive argument of importance promoted teaching method is positive answers next questions: 1) do they need knowledge of the «Medical and biological physics» subject in future professional activities (70% students of CG in contrast to 100% of RG (*p=0,022)); 2)* do they need knowledge of the «Medical and biological physics»

subject for explanation of person's psycho-emotional state of (30% students of CG, in contrast to 91.3% of RG (*p=0,000)*).

Conclusions and prospects. Therefore, the approach of «cause-effect» accents must be actively promoted and practiced for the professional orientation of subjects in the cycle of general training of future medical psychologists. This will contribute to the growth of motivation to study natural sciences, in general, and «Medical and biological physics», in particular. The understanding by those seeking education of the necessity to introduce innovations into the system of professional activity will inevitably require the transdisciplinarity of education, and this, in turn, is evidence of the importance of science components in education. The task of the teacher will consist in the formation of educational accents. The professional orientation of «Medical and Biological Physics» affects the motivation of its study, especially interesting to the students of education are topics related to the human sensory system and methods of influencing it.

In the future, it is also important to develop opportunities to acquire knowledge and skills for the formation of the professional identity of medical psychologists in the creation and development of elective courses aimed to transdisciplinarity for the area of training «Medical psychology», since the importance of professionals in this field will permanently grow only.

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Fediv V., Olar O., Ivanchuk M. Medical psychology students' professional identity development by learning natural science.

Nowadays, it is a lack of research focused on the study of natural sciences, in particular of «Medical and biological physics», by future medical psychologists. The goal of this study is to show the effectiveness of the methodology of cause-and-effect relationships between natural sciences and professional education components for future medical psychologists.

To conduct this study, an anonymous survey was carried out among first-year students studying in specialty «Medical psychology» of Bukovinian state medical university who were agreed to take part in the survey. Opinions were collected by Google forms. Questionnaire was designed to include open-ended and closed-ended questions. Statistical analysis was carried out using non-parametric Mann-Whitney U-tests, T-Wilcoxon tests. χ2-Pearson's test, Fisher's exact test and Kramer's correlation analysis.

Results emphasized the importance and effectiveness of cause-and-effect relationships formation among university students through clarification, identification and establishment of professional accents during the study of the subject «Medical and biological physics». 97 % of respondents confirmed the impact of physical factors on a person's psycho-emotional state and necessity of knowledge about them and possibility of influence on it.

Promotion and practicing for the professional orientation of future medical psychologist of subjects in natural sciences, in particular «Medical and biological physics» of «cause-effect» approach will contribute to the growing of motivation to study natural sciences, one of important component in professional training. It is important creation and development of transdisciplinary elective courses, by involving medical and biological physics experts, for future medical psychologist since the importance of professionals in this field will permanently grow only.

***Key words**: medical psychology; medical and biological physics; natural sciences; psychophysics; cause-and-effect relationships.*

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КРИТЕРІАЛЬНЕ ОЦІНЮВАННЯ НАВЧАЛЬНИХ ДОСЯГНЕНЬ УЧНІВ З МАТЕМАТИКИ (ДОСВІД ОБ'ЄДНАНИХ АРАБСЬКИХ ЕМІРАТІВ)

Контроль і оцінювання навчальних досягнень учнів з математики є вагомим складником освітнього процесу. У вітчизняній освітній практиці ці процедури частково унормовані Державним стандартом базової середньої освіти, де наведено вимоги до обов'язкових результатів навчання учнів з математичної освітньої галузі. Однак постає проблема стосовно процедур і засобів для оцінювання груп загальних результатів не лише на завершальному етапі здобування загальної середньої освіти, а й на проміжних етапах. У цьому контексті доречно ознайомитися із зарубіжним досвідом, послуговуючись принципами компаративної дидактики. У статті описано досвід освітньої системи Об'єднаних Арабських Еміратів стосовно оцінювання навчальних досягнень учнів з математики. Розглянуто запроваджені у країні критерії для такого оцінювання: Criteria: A. Knowledge and Understanding (Знання та розуміння); Criteria: B Investigating Patterns (Дослідження закономірностей (патернів)); Criteria: C. Communication in mathematics (Комунікація в математиці); Criteria: D Reflection in mathematics (Рефлексія в математиці). Увага приділена і відповідним засобам-завданням, їхній специфіці для оцінювання навчальних досягнень учнів з математики за відповідним критерієм.

***Ключові слова**: оцінювання навчальних досягнень учнів, критерії оцінювання, показники рівня навальних досягнень, індикатори для оцінювання, підсумковий контроль.*

Постановка проблеми. Контроль і оцінювання навчальних досягнень учнів з математики є вагомим складником освітнього процесу. У вітчизняній освітній практиці ці процедури частково унормовані Державним стандартом базової середньої освіти (Постанова КМУ № 898 від 30.09.2020 року) [18], де наведено вимоги до обов'язкових результатів навчання учнів з математичної освітньої галузі. Державним стандартом передбачено, що учень: 1) досліджує проблемні ситуації та виокремлює проблеми, які можна розв'язувати із застосуванням математичних методів (ГЗР 1); 2) моделює процеси і ситуації, розробляє стратегії, плани дій для розв'язання проблем (ГЗР 2); 3) критично оцінює процес і результат