

# Didactic adaptation of medical information for the formation of valeological competence in engineering and pedagogical training

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**Abstract.** The article considers the complex use of methods of aggregation, scaling, balancing and expert assessments as a basis for creating a method of didactic adaptation of complex medical information as a meaningful basis for the formation of valeological competence in future teachers of vocational education. Emphasis is placed on diseases and pathological conditions with controlled and conditionally controlled risk factors with the highest morbidity and mortality rates in Ukraine and the world. The analyzed competence includes the basics of a healthy lifestyle, safe behavior patterns, and the provision of emergency care in critical situations. To implement these basic areas, the discipline "Health Pedagogy" was taken, which is taught at the Ukrainian Engineering Pedagogics Academy (Kharkiv) for students of educational levels "Bachelor" and "Master" from Ukraine and Germany. Medical information is combined here with psychological and pedagogical information by the method of aggregation. The amount of information is adjusted by scaling and balancing methods. Feedback on the didactic adaptation of medical information was got because of the use of the method of expert assessments and statistical processing of the results. Based on scaling and balancing methods, simplification of medical terminology and reduction of details of pathogenetic mechanisms of development of socially significant diseases selected for study have been carried out.

**Keywords:** Health Pedagogy; engineering and pedagogical education; didactic adaptation method; aggregation method; scaling method; balancing method; expert assessments method; didactics.

## 1 Problem statement

Modern vocational education, engineering and pedagogical are in a state of active search for scientific and practical approaches to creating optimal conditions in the educational process for the formation of valeological competence in students. It is this competence that reduces the risk of socially significant diseases, becomes one guarantor of the protection and strengthening of a healthy nation. The formation of valeological competence meets the interests of both the countries of the civilized world and the

personal interests of each person. Health is an indisputable value, and the best approach to maintaining, restoring or strengthening it is prevention. Primary and secondary disease prevention is implemented through exposure to controlled and conditionally controlled risk factors, the content and conditions of negative implementation of which are well known to health professionals. It is advisable to implement a significant part of prevention programs in the educational space.

The discipline "Health Pedagogy", taught at the Ukrainian Engineering Pedagogics Academy since 2019, is based on a group of socially significant diseases with the highest mortality rates in Ukraine and the world, the study of which distinguishes controlled and conditionally controlled risk factors. All other valeological disciplines known to us for non-medical students are based on the principle of emphasizing environmental issues or physical activity. They also use the traditions of valeology as a separate science that developed outside the medical educational environment. Medical science has accumulated significant amounts of information that should be mastered by students of medical higher education institutions (HEI) and physicians during long life learning. This information is full of descriptions of complex pathogenetic mechanisms and terminology derived from Latin and Greek. Non-medical students rarely need to master this amount of medical information. To study the program "Health Pedagogy" it was necessary to reduce the amount of information, simplify terminology, add didactic issues (*how to teach, what to teach*) and psychological and pedagogical information to master the program of the discipline (motivation to study the discipline and its topics). Thus, there is a contradiction between the significant amount of special medical information and the insufficient development of scientific methods for its application in the content of valeological disciplines.

## 2 Analysis of recent research and publications

Implementing the state health policy in Ukraine takes place within the framework of the Concept of Public Health System Development (2016), which provides favorable conditions for strengthening and maintaining human health as the highest social value. In December 2022, the Verkhovna Rada of Ukraine (Ukrainian Parliament) adopted in first reading Bill No.4142 "On the Public Health System", which is a logical continuation of the development of the national public health system. To carry out public health tasks, the state monitors diseases in real time; attracts medical workers for preventive work; develops and implements curricula aimed at acquiring knowledge, skills and abilities in health care management, taking into account the best European and international experience; plans and implements information and educational campaigns on disease prevention, the benefits of a healthy lifestyle, improving medical literacy. Disease's prophylaxis is carried out by the joint efforts of specialists and institutions of the health care system, education, non-government organizations.

The main causes of death of Ukrainians in the previous 2021 were heart attacks and strokes (over 350 thousand cases), COVID-19 (86 thousand), cancer (74 thousand), influenza and pneumonia (over 22 thousand), accidents including about 3.7 thousand people killed in traffic accidents, alcohol abuse, HIV/AIDS (over 2 thousand), diabetes. The total mortality rate was over 714 thousand (97.5 thousand more than the previous year), of which about 40% are premature (not related to natural aging) preventable by preventing the negative realization of risk factors [1; 2]. In 2022, the general trend in

all-cause mortality continues: the highest mortality rates are from diseases of the circulatory system, neoplasms, COVID-19. In developed countries, the number of prevented deaths is about a third lower [3].

The leading causes of death from noncommunicable diseases are closely linked. Risk factors for their development are obviously related to patterns of conscious behavior, such as overeating, chemical dependence, violation of work and rest, the principles of nutrition, non-compliance with the rules of hygiene and sanitation, ignoring diseases, sedentary lifestyle [4]. Conditionally controlled risk factors are considered being the action of environmental, infectious factors, occupational risks, stress. Because of the Russian attack on Ukraine, the death rate from external causes (military and civilian Ukrainians killed by the Russians) has increased, which is also conditionally precautionary because it depends on human actions. Besides military violence, external causes of death also include criminal violence, accidents and suicides, the level of which can be reduced through public policy, the quality of medical interventions and the promotion of safe behaviors [5; 6].

In Ukrainian non-medical HEI, the study of disease prevention principles related to the causes of death mentioned by us takes place as academic disciplines "Health Pedagogy" [7], "Life Safety and Health", "Fundamentals of Medical Knowledge". On the positive side, several curricula in these disciplines include many references to United Nations and World Health Organization publications, national demographic and medical statistics, and scientific and pedagogical work, but lack the structure of medical manuals and reference books [8]. However, most curricula do not emphasize the principles of evidence-based medicine, bioethics of experiments with laboratory animals, the obligation to maintain confidentiality of information received by teachers from students in the study of valeological disciplines [9].

The medical textbooks we reviewed do not have the accents from the point of view of modern pedagogy: apart from the list of control questions that allow learning the material, innovative learning technologies assaults, trainings, etc. The most common innovative technology in higher medical education are cases [10]. This exacerbates the problem of didactic adaptation of medical information for non-medical HEI.

### **3 Statement of basic material and the substantiation of the obtained results**

Didactic adaptation of medical information for the discipline of "Health Pedagogy" was carried out by aggregation, scaling and balancing methods previously used in other fields of applied science – mineral chemistry, laboratory medicine, neural network theory, statistics, information theory and systems analysis, telecommunications, physics and mathematics.

Thus, the *aggregation* of information (from the Latin *aggregatio*) is actually combining related categories of the general branch of the hierarchy to expand the context. In our case, medical information is aggregated with psychological and pedagogical information. The scaling method, which is traditionally used in the field of telecommunications and software development to change the total bandwidth of information transmission channels according to their load [11], is used by us in new contexts. For example, at the beginning of the study of any disease, we used minimal, but the most convincing information in order to motivate students to study it.

The *system analysis* method also requires *scaling* by determining the degree of detail. Minimal detailing involves setting tasks, research, analysis, preliminary judgment, confirmation, final judgment, implementation of the decision. An increase in detail involves breaking down research stages into sub-stages, increasing *feedback* elements, and therefore increasing the scope. Work with information is characterized by two successive methods of *decomposition* and *synthesis* [12].

The *balancing* method additionally influenced the simplification of medical information because it allowed to optimize it during the control of the *success of competence formation*. The criterion for reducing secondary information is its repetition in the course the minimum number of times.

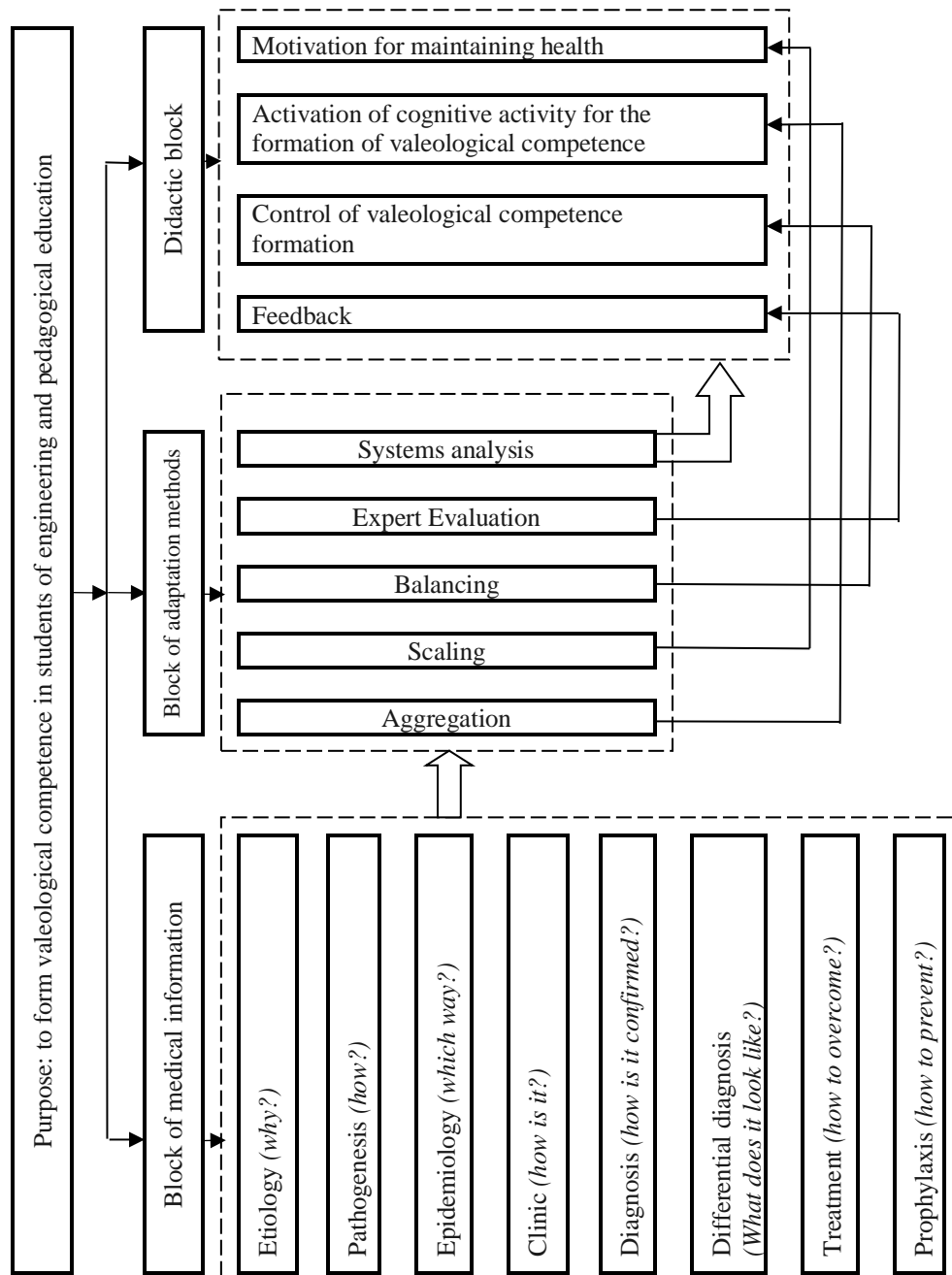
The *expert evaluations* method triggers the mechanism of adjusting the content of the discipline according to the feedback mechanism. Experts in the evaluation of the materials of the "Health Pedagogy" course were specialists in medical and pedagogical education and practice.

The purpose of studying the discipline "Health Pedagogy" for students of the engineering and pedagogical profile of the Ukrainian Engineering and Pedagogical Academy is to form their *valeological* competence. To achieve this goal, we combined medical and psychological-pedagogical information, and established connections between information and methods of its adaptation. The structural model of didactic adaptation is shown in Figure 1.

To realize this goal, we are introducing three blocks: a block of medical information, a block of methods of its adaptation, and a didactic block. The content of the block of medical information, which is redundant for students of non-medical educational institutions, has been simplified. For this purpose, the information is passed through the block of methods of its adaptation. At the same time, the *scaling* of information made it possible to increase the pedagogical influence on the level of motivation for health care by delving into the topics of the discipline that correspond to the personal interests of students and individual risk factors of their diseases. *Aggregation* activated students' cognitive activity due to awareness of their own success in approaching the best models of safe behavior. *Balancing* made it possible to evaluate the academic results of training, and therefore to monitor the success of competence formation. The answer to didactic questions: "*Why and how to teach?*", as well as the use of innovative methods (cases, trainings, mind maps and mnemonics) allows you to deepen the study of individual questions of the course.

For the didactic adaptation of medical information by methods of aggregation, scaling, balancing, system analysis and expert evaluations, the following principles are applied: 1. expediency; 2. ranking of information; 3. evidence-based medicine; 4. information integrity.

The principle of *expediency* requires not to abbreviate the information that leads to the understanding of the negative realization of the risk factors of diseases studied in the *valeological* discipline. For example, it is impossible not to discuss the mutual influence of such "diseases of civilization" as obesity, coronary disease, hypertension, atherosclerosis, tendency to thrombosis, diabetes, as well as their risk factors, such as overeating, abuse of cooking salt, fatty and sweet food, overwork, distress, smoking, alcohol abuse, sedentary lifestyle, hereditary risks, ignoring symptoms and the need for medical examination.



**Fig. 1.** Structural model of implementation of the method of didactic adaptation of medical information for the formation of valeological competence in engineering and pedagogical education.

The principle of *ranking information* involves the construction of its hierarchy, the determination of priority and secondary importance, which affects the decision about the possibility of reduction. The exclusion of any information should occur without harming the quality of the formation of valeological competence. Individual details of the pathogenesis of "diseases of civilization" can be reduced if they are not related to an understanding of risk factors. There may also be simplified medical terminology that has origins in Latin and Greek languages. Information ranking involves the use of *association* and *dissociation* techniques, as well as *scaling* and *balancing* methods. So, for example, when studying the topic of mental health, students are introduced to the elements of neurolinguistic programming, namely the techniques of association and dissociation. These techniques are used in "Swish pattern" and "Rapid treatment of phobias" psychotherapy methods. To perform the techniques, it is first necessary to reduce the image of the problem to the size of a black dot (for dissociation), and then enlarge the image to the state of a large white canvas (for association). In this way, sensory self-identification is scaled [13; 14]. Similarly, didactic adaptation of large volumes of information on the topic of mental health is taking place. When looking at psychiatry in a dissociated, large-scale way, we identified the topics students need for the formation of valeological competence: general issues of mental health, accentuation and psychopathy, endogenous psychoses, conflictology, psychological balance, overcoming stress and phobias. The content of these large chapters has been shortened for teaching in 4 academic hours (3 hours). When dealing with the topic of mental health, associate defined and return excessively abbreviated information, which is a balancing act.

Simplification of information must take into account certain limitations, neglecting which can devalue the adapted information. Thus, it became mandatory for us to adhere to the principles of *evidence-based medicine*, which include [15]: randomization of studies, orientation to the results of studies and experiments with a high level of evidence, namely statistically reliable randomized double-blind placebo-controlled experiments included in systematic reviews and the meta-analyses, reproducibility of experiments and others. Thus, when discussing drug therapy, the teacher should inform students whether they belong to the group of drugs with proven clinical effectiveness.

The principle of information involves *integrity* preserving its structure, which is used to describe nosological forms: description of etiology, pathogenesis, epidemiology, clinic, diagnosis, prognosis, treatment, prevention of the disease. At the same time, their following features were taken into account.

The *etiology section* describes the mechanical, physical, chemical, biological, psychogenic and genetic causes of disease. Infections, mechanical injuries, temperature factor, radiation, electric current, poisons of plant and animal origin, household and industrial toxic substances, genetic factors (heredity), distress, violence, working conditions, everyday life and environmental impacts are important for the discipline "Health Pedagogy".

The *pathogenesis section* highlights the mechanisms of disease development, the negative implementation of risk factors, which lays the foundation for further discussion of prevention options. For medical education, this section includes detailed descriptions of pathological processes from the molecular level to the level of organs and organ systems, the mechanisms of the realization of genetic information, stages of infection, life cycles of parasites, descriptions of the reaction of immune system, other

organs and organ systems to the development of pathology, in response to the pathogen within the compensatory mechanisms and in the event of compensation failure, stages of pathological process and their possible duration. The *epidemiology section* describes the patterns of occurrence and spread of diseases of various etiologies (infectious, non-infectious, and trauma) in the population. For infectious diseases, the details of human-to-human transmission, or animal-to-human transmission (source of infection, contagion, asymptomatic carrier, susceptibility), transmission way (contact, sexual, airborne, fecal-oral, parenteral) are important. The patterns of disease spread described in this section are considered for planning their prevention.

The *clinic section* covers the duration and course of the disease (laboratory parameters, symptoms and their incidence of patients of different ages, sex, comorbidities, heredity) during the incubation, prodromal, manifest and convalescent (recovery) periods of the disease, its outcome (recovery, death, formation of carriers, disability), complications. The *diagnostics section* describes laboratory and instrumental methods of disease diagnosis; data that confirm the diagnosis, help determine the severity and stage of the disease, monitor the effectiveness of treatment, issues of differential diagnosis.

The *treatment section* covers approaches to treatment, treatment methods (etiotropic, pathogenetic, symptomatic therapy, palliative care) and routines. The *prophylaxis section* describes health, pedagogical, socio-economic measures to prevent disease and prevent the negative implementation of risk factors. Preservation of the traditional structure of the description of diseases for medical education with the addition of a psychological-pedagogical block was used by us for the first time in the system of valeological education of Ukraine.

## 4 Conclusions

All diseases and causes of death have preventable and conditionally preventable causes. In modern valeological disciplines of engineering and pedagogical education, such risk factors should be given the greatest attention. Disease prevention is a joint effort of professionals and the public, but the systematic formation of a healthy lifestyle, safe behavior and emergency care should be formed in the educational environment. The instrument of this work is the valeological academic discipline, and the criterion of success – formation of valeological competence.

The best source of information for the formation of educational valeological programs is the medical environment (academic and practical). Our method of didactic adaptation of complex medical information allows to form valeological competence of future specialists in engineering and pedagogical field, to simplify complex medical information without losing its general structure and details necessary for the formation of modern ideas about healthy living and prevention of dangerous behavior. The method is universal, i.e. it can teach the basics of health care for non-medical students of any specialty. Its use sets a precedent for the widespread dissemination of modern valeological knowledge in society.

Prospects for further research are to improve methods of didactic adaptation of medical information for the formation of valeological competence for students of engineering and pedagogical education.

## References

1. The top 10 causes of death. World Health Organization, (2020). Available at: <https://www.who.int/news-room/fact-sheets/detail/the-top-10-causes-of-death>
2. International Classification of Diseases 11th Revision. Available at: <https://icd.who.int/en>
3. Turner L.: Life extension research: health, illness, and death. *Health Care Anal.* 12(2), 117-29, (2004). DOI: 10.1023/B:HCAN.0000041186.34205.98. PMID: 15487814.
4. GBD 2015 Risk Factors Collaborators. Global, regional, and national comparative risk assessment of 79 behavioural, environmental and occupational, and metabolic risks or clusters of risks, 1990-2015: a systematic analysis for the Global Burden of Disease Study 2015. *Lancet.* 388(10053), 1659-1724, (2016). DOI: 10.1016/S0140-6736(16)31679-8. Erratum in: *Lancet.* 389(10064), e1, (2017). PMID: 27733284.
5. Mostafavi F., Nasirian M., Zeinali M., Ardalan G., Mohebpour F., Daniali S.S., et al.: Evaluating Community-Based Programs in Promoting Traffic Behaviors and Safe Road Crossing Behaviors in Youth: An Application on Theory of Planned Behavior. *Int J Prev Med.* 12, 11, (2021). Available at: <https://www.ijpvmjournal.net/text.asp?2021/12/1/11/307475>
6. Weaver S.J., Lubomksi L.H., Wilson R.F., Pfoh E.R., Martinez K.A., Dy S.M.: Promoting a culture of safety as a patient safety strategy: a systematic review. *Ann Intern Med.* 158(5-2), 369-374, (2013). DOI: 10.7326/0003-4819-158-5-201303051-00002. PMID: 23460092.
7. Shtefan L.V., Shevchenko A.S.: Materials of academic discipline "Health Pedagogy". Kharkiv: Ukrainian Engineering Pedagogics Academy. 171 p. (2019). DOI: 10.5281/zenodo.4110899. [In Ukrainian].
8. Nikitin Ye.V., Servets'kyy K.L., Chaban T.V., et al.: Infectious diseases. Odesa: ONMedU. 252 p. (2012). Available at: <https://is.gd/jjvJbK> [in Ukrainian].
9. Shevchenko A.S., Shtefan L.V.: Formation of valeological competence in non-medical students. *Engineering and Educational Technologies*, 9(4), 8-23, (2021). DOI: 10.30929/2307-9770.2021.09.04.01.
10. McLean S.F.: Case-Based Learning and its Application in Medical and Health-Care Fields: A Review of Worldwide Literature. *J Med Educ Curric Dev.* 3, JMECD.S20377, (2016). DOI: 10.4137/JMECD.S20377. PMID: 29349306.
11. Bondi A.B.: Characteristics of scalability and their impact on performance. Proceedings of the 2nd international workshop on Software and performance, Ottawa, Ontario, Canada. P. 195-203. (2000). Available at: <https://is.gd/yn4aIz>
12. Soroka K.O.: Fundamentals of systems theory and systems analysis: a textbook. Kharkiv: KNAMG. 291 p. (2004). Available at: <https://is.gd/sUK7Jf> [in Ukrainian].
13. Kotera Y., Van Gordon W.: Japanese managers' experiences of neuro-linguistic programming: a qualitative investigation. *The Journal of Mental Health Training, Education and Practice.* 14(3), 174-185, (2019). DOI: 10.1108/JMHTEP-06-2018-0033.
14. Lytvynov R.N., Shevchenko A.S.: On the possibility of using the techniques of "Swish pattern" and "Rapid treatment of phobias" in general clinical practice. *Bull KhRIPHS.* 96(4), 36-40, (2020). DOI: 10.5281/zenodo.3939711. [In Russian].
15. van der Marck M.A., Melis R.J.F., Rikkert M.G.M.O.: On evidence-based medicine. *Lancet.* 390(10109), 2244-2245, (2017). DOI: 10.1016/S0140-6736(17)32851-9. PMID: 29165265.