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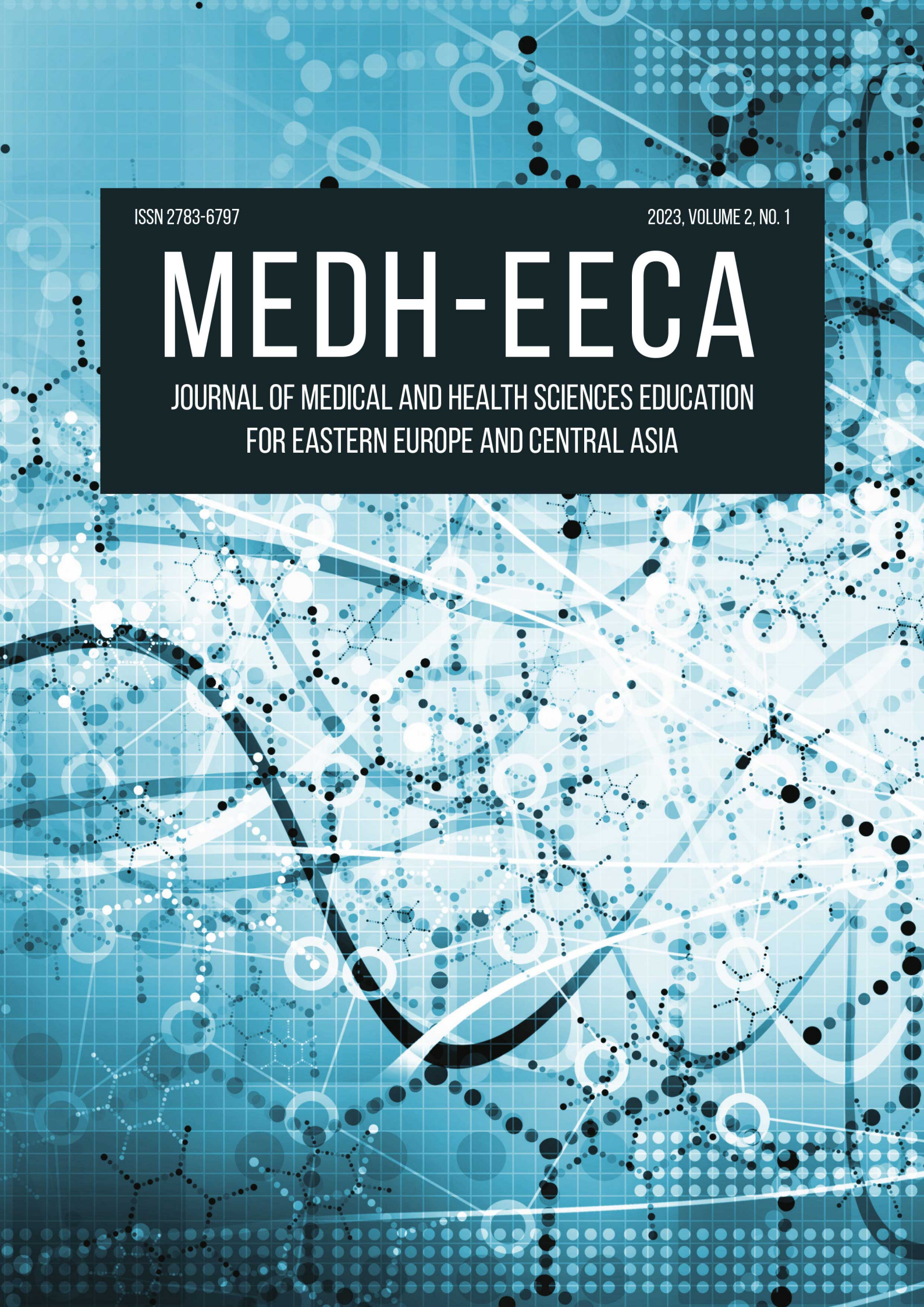

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Aims and Scope
The Journal of Medical and Health Sciences Education for Eastern Europe and Central Asia (MEDH-EECA, ISSN 2783-6797 is an annual, peer-reviewed, international general research and practice journal).
The purpose of the MED-EECA is to advance knowledge and disseminate research findings that are directly relevant to the practice of health science education, including multiple fields of medical, public health, nursing, and pharmaceutical training. The journal publishes scholarly papers on all aspects of health science education including: peer review evaluation and case studies; institutional accreditation and training programme accreditation related materials; the theory, practice and policies relating to management, improvement of quality in medical and other health sciences education; new initiatives and models in learning and teaching that impact on quality and standards; links between quality assurance and employability of healthcare staff; evaluation of the impact of quality procedures at national level; theoretical and practical analyses of quality and quality initiatives in health science training; comparative studies between institutions or countries, etc.
In particular, the journal specifically aims to become a platform available for Eastern European and Central Asian countries to share the new ideas and demonstrate rapid and significant advancements in reforming the training of human resourses for healthcare.
Original articles with scientific investigations and systematic literature reviews are welcomed from professionals of other health related fields on issues that have a direct impact on the area of staff training and strengthen evidence-based practice. Letters to the editor with commentaries on published papers or research and clinical issues, as well as short communications, will be taken into consideration and not left unanswered. This journal also provides space for announcements and an international calendar for professional conferences in the area of training of healthcare professionals.

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PUBLIC HEALTH WORKFORCE TRAINING: LESSONS LEARNED OVER THE LAST DECADES

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This editorial has an intention to review the last period of 30 years of reforms, development and activities of the Faculty of Public Health at the Lithuanian University of Health Sciences (LSMU) in the context of constant local, national and global challenges for public health and public health education. We believe that similar challenges in public health workforce training at the level of universities were also met by many our partner universities in Eastern Europe and Central Asia.

Public health bachelor level study programme was initiated at our university in 1994. This was an attempt to change the previous track of tradition of studying hygiene, sanitation, which was common in Eastern Europe and republics of former Soviet Union. Now, as it is obvious from the historical perspective, our understanding of „new public health" as multidisciplinary area was based more on theoretical model than on practical application and public health essential functions, competencies of health care human workforce [1–4].

The lessons learned from the COVID-19 pandemic showed that orientation of training toward competencies of public health graduates in the area of control of chronic non communicable diseases should be combined with parallel developing of work competencies in monitoring, controlling, managing local, regional, countrywide epidemics and global pandemics. Therefore, in 2021 there has been renewed attention and focus on essential public health functions (EPHFs), with the WHO proposing a unified list of 12 fundamental activities [5]:

- **Public health surveillance and monitoring:** monitoring and surveillance of population health status, risk, protective and promotive factors, threats to health, and health system performance and service use.
- **Public health emergency management:** managing public health emergencies.
- **Public health stewardship:** establishing effective public health institutional structures, leadership, coordination, accountability, and regulations and legislations.
- **Multisectoral planning and financing for public health:** supporting effective and efficient health systems and multisectoral planning, financing and management for public health.
- **Health protection:** protecting populations against health threats, including environment and occupational hazards, communicable and non-communicable diseases including mental health conditions, food insecurity, chemical and radiation hazards.
- **Disease prevention:** prevention and early detection of communicable and non-communicable diseases including mental health conditions, and injuries.
- **Health promotion:** promoting health and well-being as well as actions to address the wider determinants of health and inequity.
- **Community engagement and social participation:** strengthening community engagement, participation and social mobilisation for health and well-being.
- **Public health workforce development:** developing and maintaining an adequate and competent public health workforce.
- **Health service quality and equity:** improving the appropriateness, quality, equity in provision and access of health services.

- **Public health research and knowledge:** advancing public health research and knowledge development.
- **Access to and use of health products, supplies, equipment and technologies:** promoting the equitable access to and rational use of safe, effective and quality assured health products, supplies, equipment and technologies.

Following the essential functions, public health programs are constantly updated, for meeting the current need of the society.

Other lesson is related with our excess criticism toward medicalization in health care and health professional education. Now our three decades of experience shows, that teaching such subjects as foundations of anatomy, physiology at the initializations courses of the bachelor studies does not goes in wain – the bachelor graduates acquire better understanding of the context of health care, disease and risk factors management. In addition, in the later stage of studies in master's level these graduates have wider opportunities to study in medical field related study programmes such as Lifestyle Medicine, which requires more knowledge of medical subjects.

Next step in development of public health education at LSMU was initialization of the master level studies. TEMPUS JEP 11425-96 project with participation of French, Swedish and Finnish public health partners and experts was aiming to create Master of Management in Public Health Programme. The first cohort of students was enrolled in 1998. These TEMPUS collaborative efforts and also our involvement in BRIMHEALTH public health professional training programme – Baltic Rim Partnership in Public Health (1994-2003), close relations with the Nordic School of Public Health (Gothenburg, Sweden), Association of Schools of Public Health in the European Region (ASPHER) allowed to start our flagmanship Master of Public Health (MPH) Study programme in 1999, which was very well accepted in context of modern European public health context by the peer review experts. Despite this, feedback from public health field institutions (Municipality Public Health Bureaus, National Public Health Centre Departments have indicated that training component on practical skills should be enhanced in our training programmes. This is why MPH programme was reorganized into more field practice-oriented training programme in 2020. It also was an important lesson how balance between academic training and practical field competencies should be sustained.

Health education and disease prevention is one of eight primary health care functions (see Alma Ata Declaration, 1978). Therefore, practical implementation of these health promotion and disease prevention activities could be carried out using different health care organization and health education models – by primary health care doctors and nurses (general practitioners and advance practice nurses) and by primary public health care institutions (e.g. Municipality Public Health Bureaus in context of Lithuania). The group of LSMU public health experts, in collaboration with partners from Loma Linda University, Cornell University and Harward University, USA, as well as other international partners, has started drafting the concept of launching the "future master programme" in Lifestyle Medicine. This was the first such type programme in European Union, which opened new pathway for lifestyle medicine profession in Lithuania. Programme has started in 2016 and is recently becoming one of the most popular public health programmes in the area of public health. In 2019 lifestyle medicine professionals were officially integrated into primary healthcare sector as team members of physicians, while since 2023, each team of family physicians is obliged to employ lifestyle medicine professional and allocate specific tasks and resources to this new member of the primary health care team. Training mediators in unifying classical community-focused public health with person-oriented health services: targeting lifestyle-related risk factors for preventing, reversing or even treating noncommunicable diseases, working as members of medical teams, especially at primary healthcare level. Non-pharmaceutical interventions are applied, addressing the roots of noncommu-

nicable diseases, rather than management of the outcomes.

The following lessons, we learned during last 30 years, could be formulated:

- the period of 1990 after restoring Lithuanian independence was a challenge for health care sector, including public health in finding balance between teaching theory, doing research and providing practice competencies for the health staff;
- international collaboration and participation in the international frameworks and projects provides for us as professionals an opportunities to be in touch with the latest up to date information in the area of public health theory, research and training;
- leadership and initiatives at the university level, at the level of ministry and at the stake holder institutions play a major role in providing progress and innovations in the area of training the health care professionals;
- public health area is undergoing the constant transformation and continuous response to the contemporary challenges is inevitable;
- university teachers, programme developers and managers should remember that "the future specialists we train today".

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BLENDED LEARNING EXPERIENCE IN THE ADVANCED TRAINING OF MEDICAL PROFESSIONALS AT GRODNO STATE MEDICAL UNIVERSITY

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Abstract. COVID-19 pandemic has demonstrated that universities have to be prepared for rapidly restructuring their educational process and obviously facilitated the blended learning (BL) practice, while maintaining a high quality of performance. Being adopted widely at various stages of medical education, BL has certain advantages and concerns. The purpose of the study was to evaluate the effectiveness of BL at the level of advanced training and retraining of medical professionals as well as when providing extended adult education at Grodno State Medical University (GrSMU). Advanced training of medical professionals and extensive adult education have been found to be the areas that can obviously benefit from BL implementation. Thus, considering instructional potential for the effective BL application at various levels and stages of medical education seems critically important. Developing essential skills and competences in instructors and learners contributes to the effectiveness of BL process and brings benefits to both parties involved. We shared only two models to show our attempts at exploring the potential of BL approach. We believe there are many other ways to integrate technology tools into traditional classes.

Keywords: blended learning, hybrid learning, face-to-face instruction, medical education, advanced training and retraining, extensive adult education.

Introduction

In context of online sphere expansion, education is undergoing a kind of "digital transformation", characterized by the substitution of traditional face-to-face learning environment by the digital or virtual one based on the information and communication technologies (ICT). Due to various factors and challenges higher educational institutions (HEI) are forced to deliver several online courses and programs, although it may be difficult for them because of resources limitation, lack of experience or legislation restrictions. COVID-19 has obviously facilitated the introduction of distant and computer-based technologies as well, thereby triggered the digital learning practice in various educational environments [1–3].

The emerging new electronic and web-based modes of education have provided rationale for considering instructional potential for their effective application in the university education domain. Modern digital educational environment provides free access to quality education, still critically important is the integration of traditional and online education, an example of which is BL. Among several terms (hybrid learning, blended learning, web-enhanced learning, mix-mode instruction, etc.), infrequently used interchangeably, the term BL is the most common [4].

BL has been in focus since the beginning of the 2000s, since then it has passed several periods of its development: from the definition period (2003–2006), popularity period (2007–2009) to the present days of its active application [5].

Since the options of traditional and digital components of education are numerous, BL

can be considered both simple and complex approach [6]. One of the main challenges related to BL stems from various approaches to defining this learning mode. Although the first attempts to define BL occurred in the late 1990s since the Internet development and expansion, BL began to develop rapidly from the 21th century, including the definition of the term itself [4]. In over 30 definitions analyzed the most common consideration is that BL combines face-to-face instruction with technology-mediated instruction which uses ICT to mediate the learners and instructors' interaction [4]. Several other features and aspects of BL such as self-paced learning, student-centered learning, personalized and individualized learning, multiple approach learning are emphasized in the existing definitions as well [4]. Establishing the proportion of blending is another important BL concern. Several recommendations are available on the appropriate face-to-face and online interaction ratio, from 50% to 30%–79% of online delivery [7–9]. In addition to the clarification of the basic term, BL literature addresses several other issues: benefits and challenges of the learning mode for both instructors and learners, instructional design and implementation, learning outcomes, learner-instructor interaction, learners and instructors' perceptions and attitudes, future directions and trends [4, 10, 11].

Over the last two decades BL approach has been adopted widely at various schools and universities (at undergraduate, postgraduate and advanced training levels). It has been implemented in various subject areas including fundamental disciplines (chemistry, biology, statistics), computer sciences, humanities, languages, economics, engineering, medicine and health disciplines. Several publications on BL application in medical education appreciate BL models for their potential to cross boundaries of space and time and to improve collaborative and individualized learning effectiveness [12–14].

Nevertheless, e-learning has some disadvantages associated with high costs for platform maintenance and multimedia materials as well as technical training of both instructors and learners. In addition, medical education has definite specificity due to the requirements of practice orientation. Medical and health sciences are closely related to human health and involve a diverse collection of knowledge, skills, and practices, which have to be systematically updated to meet the changing needs and challenges. It is not sufficient for students to demonstrate certain manipulations distantly, it is necessary for them to be able to perform these manipulations with their own hands, at least using simulation equipment. Obviously, some criticism of overusing distance learning technologies in clinical medicine is quite warranted.

At the same time, the learned lessons of COVID-19 pandemic have demonstrated that universities need to be prepared for a rapid restructuring their educational process envisaging the situations when it can be impossible to provide education with a face-to-face instruction, while maintaining a high quality of performance.

The objective of this paper was to evaluate the effectiveness of BL at the level of advanced training and retraining of medical professionals as well as when providing extended adult education at GrSMU.

Methods

The study included:

- analysis of the present situation with the BL implementation at HEI, particularly of medical and health profile,
- consideration of instructional approaches to BL technologies at various stages of medical education (including advanced training and retraining medical professionals, extended adult education),
- personal experience in BL implementation at the academic departments of GrSMU (on the example of two academic departments) at various stages of medical education.

Results and discussion

The COVID-19 pandemic has introduced certain adjustments to all important processes of GrSMU. The University had to restructure its work, taking into account the need

to separate the staff and students. The HEI integrally and its departments proved to be prepared for the related challenges, since long before the pandemic the educational process was provided with electronic textbooks, electronic educational and methodological complexes, and the HEI's online educational environment (internal educational platform Moodle).

A really serious task during the rapid restructuring of all systems was to ensure the high quality of education under new conditions, which the University successfully coped with. A crucial part in this achievement belongs to the Belarusian legislation in the field of education. The adoption of the updated Code of the Republic of Belarus on Education legally approved that distant forms are suitable for ensuring high quality education if they allow achieving the goals of educational standards, standardized curricula and syllabi.

At the same time, the experience of GrSMU with full transition to distance learning during the pandemic restrictions has revealed certain difficulties in the development of relevant practical skills and, particularly, communication skills of students. Both practical and communication skills can be best developed only with face-to-face instruction mode or at least in a simulation center, or using group online forms of classes.

Currently, the educational process at the first and second stages of higher education has returned to the pre-pandemic full-time format. However, the system of advanced training of medical professionals has shown great flexibility. The Faculty of Advanced Training and Retraining of the University has become a kind of flagman of a new form of education – a mixed one.

The Department of Public Health and Health Service is one of the University' academic departments at which BL technologies were tested during the pandemic period, and now are widely used as well. These are a combination of distance education technologies, traditional face-to-face instruction in the HEI' classrooms as well as a new format of practice-oriented learning organized at the premises of a healthcare organization.

During the implementation of the advanced training course "Management technologies in healthcare systems" provided for healthcare top managers (course duration 80 academic hours, intramural form of study), as well as a retraining course in the specialty "Organization of health care" (course duration 12 months, extramural form of study) Ostrovets Central Regional Clinical Hospital (OCRCH) where a branch of the Department has been formed, was actively involved.

The advanced training course involved students' (the heads of healthcare facilities of the Grodno region) visits to OCRCH where they could directly familiarize themselves with the management technologies implemented in this healthcare facility, while the classes with the teaching staff of the Department during the study period (study cycle) were carried out on the basis of online educational platform of the University.

To ensure the quality of performance several forms of students' knowledge control were applied: "open" tasks that require the ability to analyze and find creative decisions; computer-based assignments in writing to master the skills of business writing; online testing as a form of intermediate control and final oral interview.

The retraining course, on the contrary, provided for the inclusion in the retraining program, which was implemented mainly on the basis of the University and its clinical bases located in the city of Grodno, only some online classes on certain topics instructed by the Head of the Branch of the Department (Head of OCRCH), these classes being mainly in the group form of online instruction.

The Department of Foreign Languages of GrSMU implemented BL technologies when delivering an advanced language course "English for scientific communication and research" for the University academic staff as part of extensive adult education.

The course (duration 30 academic hours) was designed to improve the English language and communication skills of the University academic staff involved in research. The first and final classes were conducted in a face-to-face traditional format. The rest 13

classes were provided using digital learning environment including online group meetings and discussions, individual online consultations etc. As a form of digital learning environment GrSMU internal educational platform Moodle was used. All the educational resources and instructional materials, assignments, tests and control instruments were uploaded on the educational platform.

Feedback and self-performance analysis revealed several advantages and disadvantages of this BL experience. The learners obviously benefited from flexible training schedule, calm environment, expanded possibilities of access to information sources, participation in interactive telecommunication events etc. However, BL as a learning technology has a number of difficulties for both instructors and learners, such as: lack (shortage) of technical capabilities or skills in working with technical means of e-learning, both among students and instructors, limited opportunities for the development of real communication practical skills and abilities, self-discipline and high degree motivation for learners and acceptance of new roles in the teaching process for instructors, etc.

Conclusion

The analysis of online and offline training combination in the system of advanced training of medical professionals (at the Department of Public Health and Health Service) and extensive adult education (at the Department of Foreign Languages) shows that this mixed form of educational process organization has many advantages. BL technology makes it possible to expand the circle of external stakeholders who are not only consumers of the "product" of the University's educational activities, but also directly involved in the implementation of educational programs for advanced training and retraining; significantly increases practice-oriented training (in healthcare management and research); introduces modern interactive teaching methods into the educational process; promotes the development and implementation of methods for designing digital classes; expands the use of active learning methods, primarily such as case-based learning (learning based on a clinical case, a practical medical and organizational situation); combines an individual approach implemented through teacher-student virtual communication in the Moodle system with team-based learning; uses various forms and methods of control (assessment of practical skills in real conditions, online testing, oral survey, performance of tasks in digital educational environment and many others).

The success of BL technology implementation depends largely on instructors and learners' experience and effective performance. BL instructors and learners are required to have adequate technical, interpersonal communication skills, good time management and team-building skills among many others.

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FEEDBACK OF MEDICAL STUDENTS AND LECTURERS ON IMPLEMENTATION OF THE INTEGRATED MODULE IN CURRICULUM

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Abstract. Purpose of the study is to explore medical students and lecturers' feedback on the implementation of the integrated module and integrated TBL in Anatomy, Histology, Physiology, in order to reveal the best practices to keep and shortcomings for amelioration. **Methods.** Feedback from the students and lecturers were collected at the end of the module through an interview with the focus groups. **Results.** Students agree that there is a logical connection in the module between the different courses as well as the topics within the courses. They mention, that such connection helped a lot in understanding the material. Studying the same organ system from different points of view further helped in retaining the knowledge. Students consider integration as the strongest part of the module. They also have mentioned that clinical problem in TBL (Team Based Learning) session at the end of the module, didn't require the knowledge of all three subjects, because the cases were not integrative and knowing just one particular subject was enough for problem solving. Lecturers agree that other subjects of the module helped students to better attain their subject. Teaching methods are adequate to achieve the learning outcomes. Lecturers think that students gained more and deeper knowledge within the module due to integration. **Conclusion.** Overall students as well as the lecturers are happy with the Integrated Module experience. Especially highlighting benefit of integration in terms of attaining the study material. For amelioration of the lack of the of integration in TBL, more collaboration between the lecturers of the modules is needed.

Key Words: Integration, Module, Medical Curriculum, Integrated Team Based Learning.

Introduction

Petre Shotadze Tbilisi Medical Academy (TMA) is a Higher Education Institution (HEI), based on the principle of self-governance, which carries out its activities in accordance to the Acting Legislation of Georgia and TMA Regulations. Present processes towards internationalization, as well as recent changes within Georgian educational system represent main challenges for TMA, while triggering and promoting continuous development of the institution.

During 2018 TMA successfully underwent authorization processes in accordance to updated national benchmarks criteria. Provided recommendations and advices were mainly considered for further development of educational programs.

In order to determine main priorities of Action Plan with precision, was conducted a large-scale survey among prospective employers. Findings of the survey, together with updated national benchmarks for medical education and recommendations, received following authorization process were used to plan consecutive modernization of educational program. This process in its' turn was carried out through active participation of European partners.

Aim of the study was to explore medical students and lecturers' feedback on the implementation of the integrated module and integrated TBL in Anatomy, Histology, Physiology, in order to reveal the best practices to keep and shortcomings for amelioration.

In order to reach the aim several steps have been planned:

Structuring new Integrated Curriculum

On the first step was strengthened the structure of Curriculum Committee. Representatives of all stakeholders were included which found its final composition under following formation: members of academic and invited teaching staff, students, alumni and prospective employers.

- Consequently, was developed a plan by the Curriculum Committee regarding highlighted areas for improvement, which required further consideration in regards to obtained recommendations, prospective employer survey and national benchmarks of medical education;
- Following working meetings with staff members from the Institute for Medical Education at the University of Groningen, was elaborated a working draft of competence-based learning outcomes. This draft was deliberated with academic/invited teaching staff and students during Faculty Council meetings of the School of Medicine, succeeding into formulation of final versions for program learning outcomes; Under direct guidance from the representatives of Antwerp University was developed an assessment method and format for each learning outcome;
- After wrapping up part of the work, the program underwent two-step external evaluation from the representative of Charite Medical University Berlin, recommendations of which were further applied for further refinement of the program;

Our MD undergraduate educational program – "Medicine" aims to prepare medical graduates in considering the role of the doctor within society and necessary competences, which in its turn considers following: student's further development in accordance to the contemporary international standards and up-to-date, evidence-based knowledge; as well as raising awareness towards structure of public health system and physicians' role within; developing clinical, communication and research skills, as well as establishing ethical values and prospective, which are relevant for medical practice.

In accordance to above stated plans were elaborated by the Curriculum Committee strategic development plan for educational program, which provides detailed description of necessary steps and activities that are to be implemented within upcoming years in regards to curricular development; as well as point out timelines and responsible parties for implementing particular activities.

Modernization of the educational program

For further modernization of the educational program, it was crucial to take into consideration main requirements of prospective employers. Upon national benchmarks for medical education and with prospective employers' direct participation was formulated a survey, which consequently was implemented by an outsource marketing company within frames of in-depth employer survey.

Among participants of the survey were:

- Postgraduate training module leaders, which within frames of residency program, have first-hand interaction with the resident trainees from the very beginning, thus are able to evaluate competencies of medical program graduates;
- Clinical specialists from the leading medical facilities of Tbilisi;
- Representative of NCDC (Centre for Disease Control and Prevention)
- Representative of State Regulation Agency for Medical Activities (under the Ministry of Internally Displaced Persons from the Occupied Territories, Labor, Health and Social Affairs of Georgia)

It is noteworthy, that during the interviews, special emphasis was drawn to the assessment of present state of medical graduates on the national level in general and not TMA graduates particularly. The results of the survey outlined lack of knowledge/skills/competences towards several directions namely:

- Theoretical knowledge, particularly within biomedical directions;
- Skills and abilities for performing practical and invasive manipulations;
- Critical thinking;

- Communication skills;
- Scientific-research skills and interpretation of research findings.

Student centered and outcome-based curriculum

TMA aimed structure student centered and outcome-based curriculum, which gives students more responsibility about their medical education, to be involved in self independent learning [1]

The outcomes of one-step educational program – Medicine describes clearly all the competences, which must be possessed by the graduate, and are fully compatible with the demands of national benchmarks for medical education and are coherent to the 7th level of National Qualification Framework and 2nd level of Higher Education System.

Development of learning outcomes for educational program "Medicine" was initiated from the second half of 2018, following in-depth survey, conducted among prospective employers in accordance to the updated national benchmarks for medical education. Findings of the survey were considered by the Curriculum Committee, which consequently made decision for further curriculum modernizations, through direct participation of European partners (University of Groningen – Netherlands, Antwerp University – Belgium, Charite Medical University – Germany). In frames of above stated partnership, knowledge and experience of each university representatives was applied for modernization of relevant program part.

Through direct cooperation between Curriculum Committee and European partners, were implemented following activities:

- On the first level was planned revision of program learning outcomes considering requirements of revised national benchmark indicators and international standards. Curriculum Committee came to a univocal decision to adopt internationally acclaimed CanMEDs competence framework and physicians' roles due to several reasons:
  - CanMEDs competence framework serves as foundation for national benchmarks of medical education;
  - Students, enrolled to TMA are represented by both national (citizens of Georgia) and international students. Thus, above mentioned framework is more common and relevant within international context.
  - Each university, representatives of which contributed further development of the program, use above mentioned framework, in order to determine program competences.
  - Recommendations for further development of the program, received following authorization process in 2018, were based on the roles of CanMEDs Qualification Framework.
- Through direct participation from European partners (Medical Education Institute of Ghroningen University) were planned and implemented staff training sessions and workshops for academic and invited teaching staff around "Educational program learning outcomes of and their correct formulation". The main goal of conducted meetings was to facilitate development of necessary knowledge and skills among faculty members for proper formulation of learning outcomes.
- Following above-described meetings, draft version of elaborated learning outcomes was disseminated among academic and at some point, invited teaching staff members; discussed during school of medicine council meeting and was formulated into final draft, considering comments and recommendations provided.

Duration of present educational program, as stated above, is determined by 6 years, with the process divided into 3 main phases:

- Basic, behavioral and social sciences (I–III years of study)
- Clinical sciences (IV–V years of study)
- General specialization (VI year of study)

Present educational program is fully considering and responds to the revised benchmarks for medical education:

Integration in medical education important tool to help students to apple their knowledge and skills in their clinical practice [1]

There are two types of integration in medical educational system vertical and horizontal. Tbilisi Medical Academy curriculum has been organized by:

Horizontal integration – Integrated modules are created based on body systems. These modules form two sets:

1. Normal – Normal Structure and Function (Anatomy, Embryology, Histology, Physiology); students are learning basic sciences which is also applied to abnormal functions of body systems [1–3].
2. Pathology – Basics of Disease and Treatment (Pathology and Pharmacology). They form two spiral loops and the last loop is taught in parallel in terms of organ systems with other integrated module – "Diagnosis of internal Diseases I/II with CBCR" that includes patient examination and diagnostics with consideration of clinical cases linked with taught material. This gives student deeper insight and vision of particular organ system, enables him/her to integrate different aspects of practical activities – communication skills, physical examination skills and practical procedures with clinical reasoning and team work in format of CBCR and TBL, as well as with writing reflections and personal development plan (PDP) in scope of portfolio assignments. In addition, the module "Biostatistics and Fundamentals of Research" is created (taught in VII semester) that facilitates to apply integrated knowledge of biostatistics and research methodology to practice-to perform literature review and write essay.

Vertical integration – between basic and clinical disciplines is taken into consideration from the first semester and implies following: Implementation process of each discipline (E.g.: Anatomy, Histology, Physiology, Biochemistry, Genetics, Microbiology) implies elements of vertical integration, in terms of clinical correlations, team-based learning (TBL) and case studies [1, 4, 5].

Methodology

Due to decried interest in basic subjects, integration in medical education should show the importance of basic knowledge in clinical basis. Final examination may be conducted within oral, written, combined (including written and oral components) and/or OSPE/OSCE format. During final, 6th year of studies is conducted examination of Portfolio, which in its' turn implies analysis of information, accumulated within Portfolio during 6 years and serves as a main precondition for awarding qualification.

Integration starts from the first year of the study, in basic subjects: Anatomy, Histology, Embryology, Physiology by teaching these subjects in integrated module. Modules are arranged according to thy systems. Integration has been achieved by creating integrated assignments and clinical cases/clinical scenarios during the semester and integrated Midterm and Final exam. Integrated assignments/clinical cases have integrated question from three subjects with anatomical diagrams/imaging (X-ray, CT etc.)/histological images with integrated open ended questions. Similar cases/questions/diagrams are being presented in an integrated module throughout medical courses. The establishment of clinical skills units, where students have opportunities to learn and practice skills in an intensive way, has also fostered integration, including the immediate application of concurrently learned anatomy, histology and physiology, especially using Anatomage Table, light microscopes, laboratory. Creation clinical skills departments, where students have the opportunity to intensively learn and practice skills, has also contributed to the integration, including the direct application of the anatomy, histology and physiology studied parallelly [1, 2, 6].

Integrated learning provides opportunities for students to experience patient-centered approach and allows them to apply integrated knowledge studied medical courses [1]. *"When students learn complex tasks in an integrated manner, it will be easier for them to transfer what they have learned to the reality of day-to-day work settings."* [7]

Integrated curriculum and early clinical exposure provide students with the opportunity for longer internships in clinical services, and

by providing students with guidance and support to learn from patients themselves rather than expecting to be constantly "trained" by busy clinical staff [1, 8].

In order to aggravate students' interest in learning process and help them to enhance critical thinking skills at in basic level of integrated curriculum was were placed:

- Physical examination and communication with simulated/standardized patient (SP) as well as discussion of relevant clinical correlations/cases;
- Multidisciplinary education, integration week in integrated Modules with integrated TBL Sessions
- Implementation of study courses through means and activities, which facilitate development of clinical reasoning and critical thinking abilities, such as:
  - TBL (Team Based Learning);
  - CBCR (Case Based Clinical Reasoning);
  - CBL (Case Based Learning).

Medical educators consider this paradoxical that structuring integrated curriculum requires a greater degree of values than traditional disciplines. In a course based on individual disciplines, concepts and key ideas can be defined in a well-structured approach existing in the disciplines. In an integrated curriculum, concepts and main ideas from multiple disciplines must be combined into a logical framework [1].

Integrated curricula can also be identified as key concepts or key ideas that go beyond disciplines. Behind for example, "homeostasis" can be used as a main concept to integrate from biochemistry and physiology [1] "Gastrointestinal Tract" can be main concept to integrate it in Anatomy, Histology, Embryology and Physiology, together with Multidisciplinary Education and integrated TBL sessions and integrated OSPE exams.

Objectively Structured Practical Skills Examination (OSPE) is conducted within frames of integrated modules on the basic stage of education and evaluates student's knowledge and practical skills around organ systems (Histology, Anatomy, Physiology etc.), as well as is implemented among disciplines, such as Microbiology, Radiology etc.

Objectively Structured Clinical Skills Examination (OSCE) is conducted by the end of 5th, 6th and 10th semesters, in order to evaluate student's clinical competences. Main topics of OSCE are as follows: practical procedures; communication skills, clinical record keeping, patient consultation and physical examination; all the competences, which have been covered by the students within frames of core disciplines (Internal Diseases, Surgery, Obstetrics and Gynecology, Pediatrics).

Curricula of modern integrated medical education emphasize students' self-management in learning. Students actively build or develop own learning based on a variety of experiences available to them [1].

In order to facilitate development of Clinical reasoning skills are used number of teaching methods, such as:

- Case Study – which considers discussion of situational tasks during both basic and clinical stages of studies. On the basic stage, this process implies discussion of clinical cases, correlations and situational scenarios under guidance of course leader. During clinical stage of education are discussed actual clinical cases.
- TBL (Team-Based Learning) – a method based on the teamwork-based discussion and solution of problem, which is adopted by TMA as an alternative method to PBL (problem-based learning), in order to enhance further active teaching component. TBL sessions are indivisible part of ICM (Introduction to Clinical Medicine) modules, as well as are implemented effectively throughout other disciplines. *"The development of a small group into a learning team is best described as a transformation process."* [9]. TBL is a useful approach to integration in clinical clerkships [10]. TBL showed that it has been increasing academic effectiveness and improves academic outcomes [11–13]. *"Team-based learning (TBL) is an active learning instructional strategy that provides students with opportunities to apply conceptual knowledge through a sequence of events that includes individual work, teamwork and immediate feedback."* [1]

Feedback from the students and lecturers about their opinion on curriculum reforms were collected at the end of each module through an interview with the focus groups.

Results

After starting integrated Modules in basic subjects (Anatomy, Histology, Embryology and Physiology) we have evaluated module implementation. At the end of the semester focus groups were held with involvement of students and lecturers, in order to reveal best practice to keep and shortcomings for amelioration.

All the students agree that there is a logical connection between the different courses as well as the topics within the courses. They mention that it helped a lot in understanding the material. Studying the same organ system from different points of view further helped in retaining the knowledge. All students consider integration as the strongest part of the module.

All the Lecturers agree that other subjects of the module helped students to better attain their subject. Teaching methods are adequate to achieve the learning outcomes. Lecturers think that students gained more and deeper knowledge within the module due to integration.

Conclusions

Integrated Modules in Basic subjects (Anatomy, Histology, Embryology and Physiology) helped students to apply knowledge of Biomedical and Clinical sciences in clinical problem solving and decision making, engaging in team work with colleagues and direct self-learning, applying evidence-based medicine principle and demonstrating critical thinking.

Overall students as well as the lecturers are happy with the module experience. Especially highlighting benefit of integration in terms of attaining the clinical reasoning skills. There were also a few good practices revealed, that can be used for other modules as well.

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ENHANCING LEARNING TRANSFER IN MEDICAL EDUCATION: CHALLENGES, STRATEGIES, CHALLENGES, AND PERSPECTIVES

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Abstract. In the fast-paced realm of healthcare, effective learning transfer within medical education is a matter of life and death. This article explores the challenges and strategies for enhancing learning transfer in medical pedagogy, emphasizing the crucial roles of medical educators and students in bridging the theory-practice gap. Global perspectives and successful practices are highlighted, along with standardization efforts. In post-Soviet countries, resource constraints and traditional teaching methods pose challenges, but innovative approaches are emerging. The article underscores the need for outcome evaluation and outlines an ongoing research project to advance learning transfer in medical education.

Key Words: learning transfer, training transfer, effectiveness of medical education, standardization of medical education, training intervention design.

Introduction

In the dynamic realm of healthcare, where every moment holds significance and lives teeter on the precipice, the imperative of effective learning transfer within medical education transcends the confines of academia – it emerges as a veritable matter of life and death. Envision a scenario wherein a recently graduated physician, armed with theoretical expertise yet lacking the seamless capability to apply it amidst the frenetic tumult of an emergency ward, confronts a pivotal medical crisis. The demarcation between success and catastrophe becomes tenuous, underscoring the unequivocal verity: learning transfer in medical education is not a mere scholarly pursuit; it constitutes a vital conduit. Within this discourse, we embark on a comprehensive exploration of the challenges, methodologies, and global perspectives that delineate this pivotal facet of medical pedagogy, which plays a pivotal role in preparing future healthcare professionals. The quality of medical training is vital in ensuring that physicians are well-equipped to deliver high-quality healthcare and address the health needs of individuals and communities effectively. To achieve this objective, it is crucial to focus on the efficient transfer of knowledge and skills acquired during medical education to real clinical practice.

Learning transfer, defined as the process of applying knowledge and skills acquired in one context to another, is a critical aspect of medical education. In this context, learning transfer pertains to the ability of students and medical professionals to apply theoretical knowledge and practical skills in the treatment and care of patients. However, enhancing learning transfer in medical education often proves to be a complex challenge, demanding a holistic approach.

This opinion article endeavors to raise awareness within the academic community regarding the effectiveness of professional training programs for medical specialists. Its primary objective is to explore effective strategies for enhancing learning transfer in medical education. We will also delve into the specific challenges faced by medical education in this realm and examine global perspectives on this critical subject. By presenting

case studies, good practice examples, and evidence from around the world, we intend to highlight successful strategies that can inspire further developments in medical education systems.

In the following sections, we will analyze the specific challenges of this process in the medical context, explore concrete strategies for enhancing learning transfer, and underscore the crucial roles played by medical educators and students in facilitating this essential transfer. Through this analysis and discussion, our aim is to emphasize the importance of this topic for the quality of healthcare and public health. Furthermore, we intend to state our research intention and actively contribute to the continuous development of medical education domain.

Methods

In the process of crafting this manuscript, we conducted a non-systematic literature review to investigate key aspects related to our subject of interest, medical education and learning transfer. Our research process began by identifying and selecting relevant sources of information. We used specific keywords related to the field of medical education and carefully examined the titles and abstracts of articles found in academic databases such as Google Academic, PubMed, PubMed Central, Research4Life, and the MedEdPublish platform of the Association for Medical Education in Europe (AMEE). Following this, we chose sources that proved to be most suitable for addressing our research questions. We extracted and analyzed relevant data and identified patterns and trends in the literature. It is important to note that this literature review is non-systematic, meaning that source selection was done in accordance with our research objectives but without involving a formal and rigorous selection process as in the case of a systematic review.

Results

Emerging challenges in medical education

Medical education aims to ultimately train well-prepared physicians with solid knowledge and practical skills, endowed with ethics and professional responsibility, capable of providing quality medical care and effectively addressing the health needs of individuals and communities in a humane manner. However, achieving this goal faces a series of common challenges on a global level, such as rapid changes in knowledge and technology, significant disparities between growing resource needs and ensuring access to quality education, the necessity of a multidisciplinary approach, demographic and global health changes, and the development of balanced professional competencies based on both technical skills and non-technical skills such as effective communication, situational awareness, decision-making, resource management, and teamwork, among others.

The situation becomes rather risky when medical education leans heavily towards theoretical knowledge, and students have limited opportunities to develop the practical skills required in clinical practice. Thus, there is a need to strike a balance between theory and practice and implement learning methods that allow students to engage in relevant practical experiences. It is true that transitioning to competency-based medical education (CBME) aims to close this ”theory-practice gap“ by establishing a specific set of competencies that a future physician must acquire throughout their professional training. However, to what extent do medical education institutions, especially those in low and middle-income countries in the post-Soviet space, succeed in implementing curricular reforms towards CBME? Another question that administrators of medical education programs must address is the extent to which the competencies acquired during professional training translate into their clinical performances. This challenge faced by medical schools and universities is not a new one, and best practices used in other fields can assist us in addressing it.

Learning transfer

Also known as training transfer, learning transfer has been studied in greater detail by researchers specializing in industrial

and organizational psychology, and from an applied perspective by management and human resources specialists, primarily due to the need to analyze the cost-effectiveness of training interventions for employees in enterprises and companies. Learning transfer can be positive, negative, or neutral, with a positive outcome being the primary goal of most training programs. Baldwin and Ford define positive transfer as "the extent to which learning resulting from a training experience transfers to the job and leads to significant changes in job performance," in other words, the vehicle through which training leads to expected institutional outcomes [1]. Three main factors influencing transfer are recognized in influential conceptual models in the field: trainee characteristics, intervention design, and workplace influences [2]. Primary trainee characteristics influencing learning transfer include the trainee's intellectual ability, self-efficacy regarding the training task, level of motivation, as well as job or career-related variables, and personality traits that significantly impact trainee motivation. The second group of constructs influencing transfer, either directly or indirectly through their impact on learning, includes the design and delivery of the intervention. Specifically, identifying learning needs, defining learning objectives, content relevance, prominent instructional strategies and methods, self-management strategies, and instructional environments are considered relevant to training transfer. Another category of variables related to learning transfer encompasses elements of the work environment, such as the strategic linkage of training, transfer climate, peer support and supervision, the opportunity to practice, and accountability.

One less explored aspect is the application of evidence regarding learning transfer in medical education, which is an extremely important and relevant topic. It refers to the ability of students and medical professionals to apply the knowledge and skills acquired in a learning context to practical and real-world healthcare situations. However, there are numerous researchers exploring this subject and coming to certain conclusions. It has been demonstrated that selecting appropriate instructional strategies is crucial for achieving favorable outcomes in medical education. One of the recent BEME reviews examines the efficacy of various teaching strategies in enhancing clinical skills among healthcare professionals in the clinical setting [3]. Another systematic review emphasizes the significance of learning transfer in medical education and its positive effects on clinical performance among healthcare personnel. The publication highlights the need for evidence-based interventions and well-founded strategies, including deliberate practice, frequent feedback, and contextualization within real clinical environments [4, 5]. Deliberate practice and repetition have been shown to be effective in acquiring clinical skills and transferring them into medical practice, as supported by other studies [6]. In a recent publication, the authors aimed to explore how workplace factors such as organizational culture, learning climate and leader support, influence learning transfer for medical trainees [7]. Another systematic review examined the impact of workplace environmental factors, a component of the model presumed to influence training transfer in behavioral health [8].

Original approach

In this paper, we discuss an original approach to the effectiveness of learning transfer as an alternative to the fact-based approach, highlighting the key actors of transfer. On the one hand, the trainers are taken into account, whose role is performed by medical educators, or instructor or teacher, and on the other hand, the beneficiaries of the transfer or the trainees themselves (students, residents and medical doctors).

Medical educators play a crucial role in ensuring learning transfer in medicine. Medical educators play a vital role in guiding and facilitating the learning process and have the responsibility to support trainees in the effective application of their knowledge and skills in real-world clinical practice. The most relevant missions and key responsibilities of the educator in promoting learning transfer

include curriculum design and implementation, facilitating active learning, clinical supervision and feedback provision, encouraging reflection and self-assessment, promoting inter-professional collaboration, professional development, evaluation and assessment, promoting a lifelong learning culture, and more. By fulfilling these roles and responsibilities, medical educators significantly contribute to the successful transfer of medical preparation, ensuring that trainees are well-prepared to deliver high-quality patient care in real clinical settings [9–14].

While medical educators play a significant role, trainees themselves have responsibilities and actions they can undertake to enhance the effectiveness of the transfer. By actively engaging in the training process, self-directed learning, reflecting on experiences, collaborating and working in teams, seeking feedback, and applying knowledge in diverse contexts, trainees contribute to their own development and play a vital role in ensuring the successful transfer of medical preparation [15–19].

Challenges in learning transfer

The greatest difficulties related to learning transfer in medical education arise from the disparity between theoretical and practical learning, fragmentation and lack of context in educational programs, the lack of connection between theory and practice, rapid changes in medical practice, and more. Students may struggle with applying theoretical knowledge and skills in practical and real-life situations. There is a need for practical implementation and integration of clinical experience to facilitate learning transfer. Sometimes, medical education programs focus more on teaching isolated knowledge and skills without providing a global and integrated perspective on the medical field. This can hinder the transfer of learning in complex practical situations. Additionally, there may be a lack of connection between theoretical knowledge and practical healthcare situations. Students may face difficulties in understanding how to apply knowledge in clinical contexts, requiring appropriate support and guidance.

In the medical field, practice and technologies evolve rapidly. This can pose challenges to learning transfer as new knowledge and skills need to be constantly updated to remain relevant in clinical practice. To address these issues, an integrated approach in medical education is necessary to facilitate learning transfer. This can include active learning methods, practical internships, clinical simulations, and authentic assessment of practical competencies. Furthermore, it is important for medical educational institutions to collaborate with hospitals and clinics to bridge the gap between learning and clinical practice.

Standardization

The standardization of medical education globally is a complex and constantly evolving subject. There are considerable efforts to promote common standards and coherent approaches in medical education worldwide. Organizations such as the World Health Organization (WHO) and the World Federation of Medical Education Associations (WFME) play an important role in promoting global standards in medical education. These organizations develop and publish guidelines, standards, and resources to guide medical education programs. WFME in order to make medical education more efficient and to ensure the applicability of recommendations in all cultures and circumstances, has changed the standardization paradigm, replacing prescriptive, process-based requirements with a principles-based approach [20]. Through this new concept each agency or institution makes its own version of the basic standards, which is appropriate to the regional and local context [21]. WHO also makes considerable efforts through its recommendations which are a culmination of evidence-informed decision interventions to guide a focused transformational process of and for scaling up health professionals' education and training globally [22]. Similarly, Association for Medical Education in Europe (AMEE) being the European regional association of the WFME and a member of its Executive Council have contributed enormously to increasing the level of medical education through the development of syn-

theses of scientific evidence, such as the Best Evidence Medical Education (BEME) collection, resulting in "the transition from education based on opinion to education based on evidence" [23].

Strategies

The implementation of faculty development strategies, curriculum development, and the utilization of simulation methods are crucial aspects for improving the medical education system in enhancing transfer of learning. By investing in the development of medical faculty's competencies, it promotes effective teaching and evaluation skills, as well as a stimulating and up-to-date learning environment. Providing training opportunities and support for medical faculty contributes to enhancing the quality of instruction and improving communication and interaction skills with students and residents [22].

The use of simulation methods, such as high-fidelity simulation and virtual simulation, represents an effective way to provide practical and realistic experiences in a controlled and safe environment. These methods allow students, residents, and physicians to practice clinical skills, develop decision-making competencies, and become familiar with complex clinical situations. Through simulation, opportunities for active learning, repetition, and feedback are created, which contribute to strengthening learning transfer and improving practical performance [24–28].

Good practices

Progress in the field of learning transfer in medical education can be observed in several countries worldwide. Universities and medical institutions in the United States have developed innovative medical education programs that place special emphasis on learning transfer. These programs include active learning methods, advanced medical simulations, and extensive clinical rotations. Canadian medical institutions have made efforts to integrate practical learning into their medical education programs. Additionally, collaboration between universities and healthcare institutions is promoted to ensure a strong connection between theory and practice. In the United Kingdom, progress has been made in creating and developing integrated clinical learning programs that encourage learning transfer. Medical simulations and clinical rotations are used to facilitate the development of practical skills and the application of knowledge in a clinical context. Australian medical institutions have implemented innovative learning and assessment methods that focus on learning transfer. For example, advanced simulation and case studies are used to develop practical skills and bridge the gap between theory and practice. The Scandinavian countries (Norway, Sweden, Denmark) are recognized for their medical education systems and innovative approaches to learning transfer. These include problem-based learning, extended clinical rotations, and the use of modern technologies in medical education. It is important to note that progress in the field of learning transfer can be observed to varying degrees in other countries and regions around the world. Each country has specific initiatives and projects aimed at improving learning transfer in medical education, tailored to the needs and specific context of each country.

Outcome evaluation

Transitioning to outcome-based medical education raises the question of how we measure the deliverables of professional learning transfer. Many evaluation results of short-term training, such as courses in continuing professional education, are published. However, how should we proceed with evaluating the entire undergraduate medical education program? How do we know if we are on the right track in medical education and what reserves can be leveraged for future continuous improvement?

Several evaluation methodologies have been developed and used so far, such as the Kirkpatrick model and the Phillips ROI, Anderson, and Kaufman CIRO models, derived from it, mostly used by companies and organizations to analyze the outcomes of training provided to their employees. Other methodologies include the objective-based model or the Tyler model, which assesses the

extent to which training objectives have been met. The classic method of evaluating learning transfer is based on comparison with control groups. Additionally, there are methodologies like pre-/post-testing, also known as pre-then-post testing, 3-test approach, time series analysis, etc. However, one of the most widespread and comprehensive methods for evaluating learning transfer is the Kirkpatrick model. It involves quantifying the outcomes and categorizing them into four levels: reaction, learning, behavior, and results.

In medical education context, one can expound upon an outcome-based education (OBE) implementation assessment tool, designed to enable educational institutions to gauge the extent of their integration of an OBE approach within their organizational framework. This assessment tool empowers institutions to evaluate their level of OBE assimilation across nine distinct dimensions, each evaluated on a five-point scale. These dimensions encompass the articulation of explicit learning outcomes, the effectiveness of communication regarding these outcomes among faculty and students, the pedagogical strategies implemented, the breadth of learning opportunities offered, the alignment of course content with predefined outcomes, the progression of students throughout the academic journey, the methodologies employed for student assessment, the overall educational milieu, and the procedures for student selection. The comprehensive analysis of these dimensions culminates in the creation of an institution-specific OBE implementation profile [29].

For a more comprehensive evaluation of the quality of undergraduate medical education, it would be ideal to assess the individual performance of graduates in a real clinical setting. When measuring the outcomes of professional training through residency, this assessment should be conducted by evaluating the individual performance of young graduates or by evaluating organizational performance using specific indicators of the institutions where these young specialists have been subsequently employed. However, this task is quite challenging.

In recent years, universities in the USA and other countries have been implementing so-called “entrustable professional activities” (EPAs) as a means of evaluating the transfer of professional competencies in clinical practice [30]. The Association of American Medical Colleges defines EPAs as units of professional practice, tasks, or responsibilities that trainees are entrusted to perform unsupervised once they have acquired a sufficient level of specific competence. In other words, EPAs represent the clinical expression of competencies or specific performance units. They are executable, observable, and independently measurable, making them suitable for decisions of subsequent entrustment without supervision. A pilot project using EPAs as an assessment tool in the residency admission process in the USA was recently completed in 2021 and is now set to be implemented nationwide.

Medical education in post-Soviet countries

A particular discussion arises when considering the situation in the post-Soviet space. The effectiveness of medical education varies greatly from country to country and depends on the particular medical education system in place. However, there are several common features and challenges in this region. Judging from the situation in the Republic of Moldova, we can assume that some low and middle-income countries in the post-Soviet space have limited resources in terms of advanced medical equipment and educational technologies, which in turn can affect the ability to develop innovative medical education programs that facilitate efficient learning transfer. In a number of medical education institutions in the region, the focus can be still primarily on theoretical knowledge, and clinical practice may be limited and not standardized, which can create difficulties in learning transfer and the development of practical skills necessary for future professional practice. In accordance with the author’s assertion, as inferred from global university and medical school rankings across the world, numerous medical universities situated within the post-Soviet region confront a substantial challenge concerning

their academic performance. In the academic context of the 15 former Soviet states, only four of them host medical education institutions that are featured in global university rankings based on their academic performance. Among these four countries, three of them, namely Estonia, Latvia, and Lithuania, are currently members of the European Union, which explains their notable achievements [31]. It cannot be excluded that one contributing factor to this challenge may be their continued dependence on conventional pedagogical techniques, such as didactic lectures and passive modes of learning.

After the collapse of the Soviet Union, many countries in the region revised their medical education systems. This process of transition can bring both opportunities and challenges in terms of learning transfer and curriculum development in line with international standards. However, it is important to note that some initiatives and projects in the post-Soviet space aim to improve learning transfer in medical education. Some universities and medical institutions have introduced active learning methods, medical simulations, and clinical rotations to support the application of knowledge in clinical practice. There are also efforts of collaboration and exchange of best practices among institutions in the region to promote the development of medical education and efficient learning transfer.

The evaluation of the professional competence of graduates from medical programs in the post-Soviet space involves several common methods. Medical graduates are often assessed through licensing examinations that test their theoretical knowledge and practical skills, as well as through state clinical examinations (also known as final clinical examinations) that assess the clinical competencies of graduates.

Our experience

In the Republic of Moldova, there is only one Medical University that prepares specialized healthcare professionals for the entire country and for other countries around the world. At the time of writing this manuscript, *Nicolae Testemițanu* State University of Medicine and Pharmacy had 4 109 domestic students and 1 992 international students enrolled, along with 1 351 resident doctors, 450 doctoral candidates, and 5 732 practicing physicians participating in continuing medical education [32].

In order to align with international standards, in 2009 the University implemented a Quality Management System according to ISO 9001:2008 standard and obtained, for the first time, a Quality Certificate, which is subsequently reaffirmed annually. In 2011, it became a member of the Association of Medical Schools in Europe, and in 2012, it affiliated with the International Association of Universities. In 2019, the University received institutional accreditation at the international level according to the standards of the World Federation for Medical Education [33].

One of the major achievements in strengthening medical education has been the implementation of high-fidelity and virtual medical simulation methods. In Moldova, simulation-based training in medicine has been officially available for over 20 years. In 2003, the Center for Training and Testing Practical Skills (CITDP) was established as part of a project developed through a partnership between the American International Health Alliance (AIHA), the Eastern Virginia Medical School Norfolk/Portsmouth, USA, and the *Nicolae Testemițanu* State University of Medicine and Pharmacy, within the framework of the University Primary Care Clinic. With the primary goal of training students and family physicians in the field of internal medicine, the Center implemented the standardized patient method, becoming one of the first higher medical education institutions in the Eastern European region to mandate training for all medical students using the standardized patient method.

In 2013, in line with the "Program for the Development of Medical and Pharmaceutical Education in the Republic of Moldova for the years 2011-2020," the *Nicolae Testemițanu* State University of Medicine and Pharmacy inaugurated the University Center for Simulation in Medical Education (CUSIM) by absorbing CITDP [34]. CUSIM is established with the financial support of the European Union,

aiming to build and establish a European space of knowledge and ensure the quality of modern medical education and practice. Among the various simulation techniques and methods known worldwide, CUSIM implements the majority, ranging from the use of task-trainers and mannequins for basic practical skill training to the development of complex competencies through the imitation of clinical situations in high-fidelity simulation environments. Thus, from the second year until the final year of study, medical students acquire professional competencies according to current requirements based on modern simulation-based training methods. The training approach applied at CUSIM is interdisciplinary and innovative, and the beneficiaries of the training programs express enthusiasm for the teaching-learning-evaluation methods.

Discussion

This article reflects an initial standpoint with subsequent research intentions. A team of researchers hailing from Nicolae Testemițanu State University of Medicine and Pharmacy is poised to undertake an analysis of learning transfer employing a mixed research methodology. In the initial phase, the authors have outlined a two-stage study aimed at dissecting prevailing didactic methodologies and the developmental requirements of medical educators. This comprehensive approach seeks to enhance the transmission of knowledge and competencies. The methodology involves interviews and an anonymous questionnaire meticulously crafted by researchers, drawing upon experiences and scientific insights garnered from various universities. The subsequent phase will delve into the perspectives of graduate clinicians (post-residency) regarding the efficacy of knowledge transfer and the necessity for professional development in clinical skills post-graduation. This phase will employ interviews and questionnaires as data collection instruments. The culmination of this research endeavor will be the presentation of findings in the form of a final report, replete with recommendations designed to perpetuate advancements in the realm of clinical specialist training.

The ensuing discourse deliberates the multifaceted challenges associated with learning transfer in medical education. It elucidates the factors that influence learning transfer, including the characteristics of trainees, the design of interventions, and workplace dynamics. This discussion incorporates an exploration of evidence drawn from other domains pertaining to learning transfer in medical education and spotlights international initiatives and projects aimed at enhancing the efficacy of learning transfer. Furthermore, it underscores the pivotal roles played by medical educators and trainees in the facilitation of effective learning transfer. The critical responsibilities of medical educators in guiding the learning process, designing and implementing curricula, and nurturing the application of knowledge and skills in clinical practice are highlighted. Simultaneously, it underscores the active involvement of trainees in the educational process, encouraging self-directed learning, reflective practice, and collaborative teamwork.

Conclusions

In summation, learning transfer within the sphere of medical education assumes paramount importance, serving as the conduit for students and medical practitioners to translate their acquired knowledge and competencies into real-world healthcare contexts. The manuscript underscores the imperative of striking a harmonious balance between theoretical and practical education, promoting the seamless integration of clinical experiences, and fostering robust collaborations between educational institutions and healthcare settings. The article concludes by advocating for the adoption of a mixed research approach to delve deeper into the intricacies of learning transfer in medical education and subsequently offering recommendations to drive continuous improvement in this crucial domain.

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TEACHING OPPORTUNITY AND KNOWLEDGE MANAGEMENT BY ASSESSING THE BENEFITS AND HEALTH RISKS OF NANOTECHNOLOGIES IN THE REPUBLIC OF MOLDOVA

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Abstract. The application of nanotechnologies in various fields of contemporary life raises questions about their harmlessness to humans and the environment. The progressive use of nanotechnologies in medicine, pharmaceuticals, medical bioengineering, etc. requires a risk assessment of the use of nanotechnologies. We find that the risks and, as a consequence, the ethical and social problems resulting from the use of nanotechnology are still not sufficiently understood at the level of regulation, research, and education. As nanotechnologies advance, the role of teaching and management of knowledge in the field acquires a dominant importance in realizing the benefits and, at the same time mitigating the related risks. We conclude the importance of including in the educational programs in universities. This will also make researchers responsible for drawing the necessary attention to the risk assessment of their own research in nanotechnologies or biomedical engineering and will contribute to the development of education courses for students and doctoral students in specialities related to the field. The paper presents a brief analysis of international efforts regarding the assessment of the risk associated with nanotechnologies necessary for promotion for the progress of society. The analysis also refers to the current state of the problem in the Republic of Moldova. We believe that the lack of subjects related to nanotechnology risk assessment in courses taught to undergraduates, masters and PhD students in biomedical engineering and nanotechnology will cause undesirable ethical and social consequences.

Key Words: Knowledge management, nanotechnology risk assessment, biomedical engineering, Republic of Moldova.

Introduction

After almost half a century of fundamental research in nanosciences and about 20 years of focus on nanotechnologies, we see achievements in both predicted and unexpected areas, but with promising benefits for society and the environment [1, 2]. The penetration of nanomaterials into all areas of life raises several questions, especially regarding their harmlessness. We note that the scientific community still does not have a complete picture of understanding all the health effects that would result from exposure to nanomaterials. There are knowledge gaps in critical areas for health risk assessment. The questions addressed are extremely complex, with many unknown variables and cannot be solved up to date. From these considerations, it is imperative to establish in universities a favorable environment for the transfer of knowledge to the new generation for the assessment of the risks and benefits of new technologies.

Current Status

Nanotechnology is part of a complex of essential technologies, and will become so ubiquitous naturally that its existence will be understood.

As with any new technology, the question of necessity and usefulness arises. A concern,

we admit with sufficient argumentation, of the sceptics of the utility of nanotechnology is based on the insufficiency of knowledge regarding the toxicity on humans and the environment. It is found by research, that we cannot deduce the toxicity of a nanomaterial based on the exclusive knowledge of the toxicity of the macro form.

New technologies have initiated an increased interest in the dangers of nanomaterials, reflected yearly thousand of articles. The difficulty of reviewing all publications caused a hazard categorization for 11 nanomaterials (fullerenes, single-walled C nanotubes, multi-walled C nanotubes, dendrimers, nano clays/nanocomposites, as well as nanoscale materials as Ag, Au, SiO_2, TiO_2, CeO_2, and ZnO)) performed by an OECD working group [3]. These 11 nanoforms of the substances were identified as a priority based on the quantities traded, increasing use and potential human and environmental exposure. The explosive expansion of the use of ZnO and TiO_2 nanomaterials has recently required the Government of Canada to initiate a further study on the degree of toxicity of them in different nanoforms.

The main causes of the risk of hazards associated with the use of nanomaterials are related to the following 2 factors:

- the extra small dimensions, which determine a specific surface or volumetric capacity (Commission Recommendation 2022/C/229/01 for the identification of nanomaterials);
- the complexity of the dependence of the properties of nanomaterials on their shape, phase composition, dimensions, etc. and frequently exhibits physicochemical properties extremely different from its macro form. As mentioned [4–6], the toxicity can be dictated by environmental factors, NP's size, shape, and surface area which play an important role, determining largely the unique mechanism of their interaction with living systems.

Another risk associated with nanotechnologies is uncontrolled exposure to NP, which occurs through various ways such as inhalation, ingestion, skin penetration, and injection [7–8]. NP reaching the extracellular fluid are conjugated with biomolecules present in the environment, which allows them to internalize into cells by direct or indirect penetration. The NP's small size in conjunction with the diversity of shapes gives a differentiated penetration of the epithelial and endothelial barriers thus reaching the lymph and the blood circuits. Subsequently, the blood and lymphatic flow ensure the transport of NP to all organs and tissues with potentially harmful results. The penetration of NP into the bloodstream paves the way for the possible non-invasive penetration of the blood-brain barrier with serious consequences that are difficult to underestimate.

The modelling of the toxicity of NP on the living organism shows that they can generate thrombosis, inflammation of the respiratory tract, neurodegenerative disorders, cerebrovascular accidents, etc. So, public concerns about the increased toxicity of NP have had a legitimate experimental basis for many years (silicosis, asbestosis, "black lung"). So, the lack of knowledge of the interaction of the human body with the entire spectrum of NP used in the different industries does not allow us to state with certainty a total success story of nanotechnology.

Assessing the risk from the use of nanomaterials needed to have a decision-making framework, agreed by researchers, for nanomaterials categorization and testing with respective conclusions. For these reasons, the European Center for Ecotoxicology and Toxicology of Substances proposed a so-called DF4nanoGrouping decision framework [9]. DF4nanoGrouping consists of three levels of assigning nanomaterials to four groups. If necessary, these four groups can in turn be divided into subgroups as needed. The aim of the DF4nanoGrouping model is to maximally encompass the life cycle aspects of nanomaterials, with the reflection and participation/contribution of their biological pathways. Thus, in addition to reflecting the intrinsic physical-chemical-biological properties, the properties manifested in the system (respective environment) are also elucidated.

This model may exempt a nanomaterial from further testing if the initial qualification

determines that it cannot be released from the product (e.g. it may refer to many nanomaterials used in nanoelectronics, solid nanosensors).

The four main classification groups proposed by the DF4nanoGrouping model refer to: (a) soluble nanomaterials, (b) bio-persistent nanomaterials, (c) passive nanomaterials, and (d) active nanomaterials. A close classification of nanomaterials was also proposed by the Government of Canada [10].

The evaluation of the DF4nanoGrouping model by several researchers has confirmed its usefulness, providing sufficient data for the hazard assessment of nanomaterials and facilitating, thanks to the proposed grouping, the targeted testing of nanomaterials [11].

But the risk is generated by the summation of hazard and exposure, and the exact correlation between the intrinsic properties of a nanomaterial and the effect of the environment may not be obvious and conclusive.

Although the DF4nanoGrouping model is quite comprehensive, less discussed in the literature is the exposure-response dose of NP. Similar to the dose of exposure to ionizing radiation, the effect will depend on the dose and method of delivery to the target organ. And, it should be noted that the body's reaction is not fully studied, there are several response models to the assigned dose, including the hormesis effect also valid in toxicology. Let's not forget the bystander effect studied more deeply as a result of treatment with ionizing radiation, but it is not lacking in other methods of therapy. These are already the first results that show that photodynamic stress agents and chemotherapeutic drugs respond with effects similar to the bystander effect [12, 13]. Therefore, a careful assessment of exposure-dose-response relationships is essential for the final toxicological assessment of nanoparticles.

The ancient paradigm attributed to Paracelsus "dosis sola facit venenum" is valid in toxicology and must be taken into account in medical treatment or diagnosis. This includes not only dosimetric questions (mass, number, electronegativity, shape of particles) but also the form of delivery, the pathways, and the environment with which they interact – which all contribute to the relevance of dose levels.

Thus, we again note that much is not yet known about the interaction of NP with the human body, but also with the environment. When we talk about nanotechnologies vs the environment, two factors are relevant:

a) NP existing in free form, can be released into the environment accidentally during production, or as secondary production waste,
b) NP existing in a fixed form, as part of a substance or manufactured product, are released into the environment without recycling, extraction or transformation into waste.

In order to objectively evaluate the dangers to human health and the environment, the entire NP's life cycle must be evaluated until their total elimination as non-toxic waste.

But the environmental factor cannot be considered without human interaction. Let's admit that many pharmaceutical preparations in their nanoform form are thrown away as household waste (inadvertently, expired, etc.). Enduring in the environment, their chemical and biological degradation takes place, transforming into various forms. Some of them are toxic after decomposition, others psychotropic, etc they are carried through the already known exchange cycles in the environment: soil – water – air – flora – fauna, etc. Later they enter the human body in all possible ways. As unfortunate consequences, the body's reactions may appear, difficult to detect and difficult to treat, because the cause and time of the initiation of the disease are not initially known.

We find that other risks may appear that we do not yet intuit, which confirms the need for continuous risk analyses. We risk saying that most of the safety issues addressed about nanotechnologies are related to the uncontrolled "free" nanostates and less to the embedded, "fixed/immobilized" states of the already designed NP. Of course, there are also exceptions, when the human factor is imposed by not complying with the security and safety requirements for storage, transportation, administration, processing, use, etc. of

products or materials with incorporated nanoparticles, as mentioned above.

However, the precautionary principle cannot be used to stop nano state research, as such research allows us to expand our fundamental knowledge of matter, and to identify the potential dangers of nanotechnologies. This would also allow the establishment of a scientifically susceptible database for the purpose of risk assessment, with subsequent justified procedures for risk management.

The emphasis on the type of risks to be considered depends on the perspective of the implication of nanotechnology or nanoengineering. Thus, the possible risks from the application of nanotechnology are:

- military – the proliferation of new conventional and non-conventional weapons, their delivery methods, terrorism;
- regarding the societal impact;
- regarding the environmental impact;
- the professional environment dictated by NP harmfulness;
- due to insufficient final knowledge regarding NP interaction with the biological environment or with other NPs;
- unpredictable innovations, through the prism of artificial intelligence.

We make an exception to the first risk noted because it is usually regulated by rules specific to the military field. The other forms of risk associated with nanotechnology belong to the consumer, but it is also part of the research field. Research is the first to deal with nanotechnologies and is largely responsible for the reasoned risk assessment associated with nanotechnology. For these reasons, researchers through their professional environment are the first exposed to the risk associated with nanotechnology. Thus, a responsible attitude is necessary in the regulation of this field in order to provide the maximum possible safety of the activities in the field. This responsibility must be taught to the young generation by teaching specialized courses related not only to the benefits of new technologies, but also to their risks, ethical and social repercussions.

A responsible attitude towards the future of nanotechnologies and the associated risks, towards the knowledge management, can be seen in the example of Germany. As one of the world leaders in nanoscience (40% of EU research), Germany is among the leaders in promoting research into the potential risk and safety issues associated with nanotechnology. We would like to mention the NanoCare project carried out by 13 partners from industry, universities, and research centers focuses on studying the possible risks of NP used or recommended for the economy. The project agenda is composed of three different but overlap areas [14]:

1. knowledge generation through in vitro NP influence studies supplemented with in vivo ones;
2. adequate knowledge management, and
3. the transfer of knowledge, including to the general public, after a common interpretation of the data within the consortium, which contributed to the standardization of analytical procedures.

We note that three German Agencies (for occupational safety, environment and risk assessment) have a joint research strategy addressing the health and environmental risks of NP. The results of the implementation of the Strategy [15] identified the imperfection of the EU legislation regarding e. g. chemicals (REACH). Another important conclusion was, that the toxicological properties and risks regarding the exposure of humans and the environment to NP cannot yet be exhaustively evaluated. The conclusion is the recommendation of research and risk assessments, taking into account the continuation of the deepening of toxicological and ecotoxicological knowledge. In order to achieve coordinated and effective research the following strategic objectives are also recommended [15]:

- a risk-oriented approach;
- comprehensive risk characterizations and assessments with ongoing consideration of new knowledge;
- evaluation of the novelty of nanomaterials;
- application-oriented and regulatory-relevant research;
- sustainability and the precautionary principle;
- public transparency and consultancy;

- efficient management of knowledge through information exchange with universities, regulators, entrepreneurs in the country and abroad.

We talk all the time about the potential safety risks of those nanotechnology products to consumers (to large public), but what about the personnel who directly contribute to their production, or about researchers, students and PhD students involved in research?

Those working on state-of-the-art products are potentially exposed to higher levels of NPs, unlike traditional chemical engineering and microelectronics industries where worker exposure to various chemicals has regulatory and safety measures traditions.

It would be fair to mention, that it is not yet known whether the existing protective measures, filters and ventilation systems in the respective industries are sufficient to prevent harmful exposure to new nanostates. From the mentioned, we noted that the safety problems derived from the entryways of NPs and their potential bio-distribution are managed by many characteristics of NP such as surface, shape, agglomeration, solubility in aggregation, size, electric charge, form of aggregation, pathway, type of interaction with the potential host. NP sizes dictate chemical and biological reactivity which is not always a function of the chemical formula of the macroform substance. With these characterizations, still unknown in the end, possible paths of migration, and penetration of NPs research in nanotechnology and nanoengineering should be carried out with utmost caution.

Added to this is the lack of knowledge regarding the risk associated with nanotechnologies, delivered to young researchers during their studies at the university.

Considering that nanotechnologies are relatively new technologies, they are not regulated by special normative acts. Thus, the safe handling of nanotechnologies at the workplace is mostly reflected by the national and European normative framework that refers to chemical substances (Directive 98/24/EC).

There are regulations in force in the EU to protect workers from the effects of harmful chemical, biological and other substances used in microelectronics, but they cannot ensure their complete harmlessness at the nano state level. There are WHO Guidelines on the protection of workers from potential risks from manufactured nanomaterials [20]. They were developed by the OECD group on the analysis of researchers' results and based on two principles [3]:

- *Precautionary approach*: In cases where health concern is identified, but scientific data do not allow assessment of the magnitude of the risk based on human studies, the precautionary principle should be used to reduce or prevent exposure as much as possible.
- *Administrative controls approach*: whereby the implementation of controls to reduce worker exposure will be considered the objective of a successful industrial hygiene program. Research staff education is considered an indispensable measure which should be upgraded periodically to take into consideration news in science and technology.

WHO's increased attention to the consequences of nanotechnology is due to:

- novelty, but in the continuous progress of expansion on the world map;
- the need for full risk assessment;
- the unavailability of correct and uniform information on the globe;
- the need to ensure a fair level of protection for workers in the field;
- developing and approving guidelines based on research with relevant results for health protection activities.

The European Agency for Safety and Health at Work also draws increased attention to the need to ensure the harmlessness of activity in nanotechnology. There are a number of analyzes of the works of researchers [16, 17], which contribute to the development, and updating of normative acts in the EU, as well as in Great Britain.

The U.S. National Institute for Occupational Safety and Health has developed recommendations for controlling worker exposure to the effects of technological nanomaterials and their industrial use. The recommendations are

updated on technologies that are applied in industries that use nanomaterials and on the basis of control methods that have been proven to be effective in reducing workplace exposure in other types of industries.

The above denotes increasing attention of the WHO, and EU attributed to the assessment of the risk associated with nanotechnology, both for the final consumer and for the workers, researchers directly involved in the production or research of nanomaterials.

We note a different situation in the Republic of Moldova. Although with traditions in research, recognized by the number of publications with an impact factor in nanotechnologies, there are no publications on the identification, management of hazards and risk assessment of the use of nanomaterials and nanotechnologies, nanoengineering. The analysis of the curricula of the subjects for the students, master's and doctoral students of the Nanoengineering and Biomedical Engineering specialties shows the lack of the relevant discipline to the risk associated with new technologies, and to the possible social and ethical repercussions.

We note that there is no domestic institutional normative framework (Codes of conduct, regulations, guidelines or requirements for conducting research with nanomaterials, promoting good practices, e.g. GoodNanoGuide). The protection of Moldovan workers (researchers) is ensured by previously adopted rules on working with macro form materials. If we refer to the legislative framework relevant to the industrial application of nanomaterials, we note the delay in the adoption of the process being limited exclusively to the recognition or transposition of the European directives or Regulation into the national legislative framework.

The current problem with nanotechnology remains the existence of health and environmental risks, social and ethical impact. This topic has not been addressed in the Republic of Moldova, neither at the level of state reserch programme nor at the level of research authorities, although we recognize that only certain nanomaterials are potentially dangerous, which still needs to be demonstrated. The absence of systematic studies, followed by lack on national regulations, constitutes an argument for "anti-nano" public campaigns, similar to e.g. "anti-nuclear power plants", "anti-genetically modified organisms", etc.

The promotion of nanotechnologies is not possible if there is distrust among the consumer and the general public, and the lack of structured information and a correct picture of the associated risks for health, the environment and the future maintain this distrust. The most important aspect, however, remains knowledge management, including risk assessment of new technologies through their efficient transfer to the new generation of students, master's and doctoral students [18]. This also will contribute to remove the administrative and regulatory barriers, as well as the reluctance of the private sector to invest in new technologies and products.

Conclusions

In the Republic of Moldova, there are no research works that develop the topic of nanotechnology risk assessment, at least for the nanomaterials they work with. For these reasons, research does not contribute to the development of the national and institutional normative framework, including ensuring one's own security in scientific activity, and ensuring a positive public perception of society towards nanotechnologies.

In the Republic of Moldova, it is imperative to develop a national regulatory framework for assessing potential hazards and estimating potential exposure to nanomaterials in the workplace, integrating health and safety issues from nanotechnology into existing methods of learning, monitoring hazards and establishing the need for new methods of additional screening.

We realize that nanotechnology with immeasurable societal potential is not without associated risks. This denoted the critical importance of teaching and transferring knowledge to the younger generation. When solving this problem, we will note the following, the main requests caused by:

- the complexity of the subject, which requires a balanced proportion of knowledge transfer from different exact and socio-human disciplines to ensure an adequate background of the knowledge of the young generation;
- the safety of nanotechnologies denotes the need for knowledge and appropriate behavior, socially and ethically responsible, indispensable for education and research;
- knowledge gaps due to ultra-fast progression, which requires the teacher to refine his curriculum to keep up with the evolution of nanotechnologies, giving students real insights;
- responsible dissemination and technology transfer related to the dual use of nanotechnologies.

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Conflict of Interest

The author declares that they have no conflict of interest.

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