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# Analysis of the effectiveness of modular training in the professional education of healthcare workers

**Abstract.** The study aimed to evaluate the effectiveness of modular training in the professional education system of healthcare workers, compared with traditional teaching methods. An experimental study was conducted involving 200 healthcare workers from various specialisations. The participants were divided into two groups: a control group (traditional training) and an experimental group (modular training). Knowledge and practical skills were assessed before and after the training using tests, surveys, and practical tasks. The findings demonstrated that participants in the experimental group, who were taught through the modular system, achieved significantly higher levels of theoretical knowledge and practical skills compared to those in the control group. Additionally, an increase in motivation for learning and independent study was observed among participants engaged in modular training. Modular training has proven to be more effective in preparing healthcare professionals compared to traditional teaching methods. The implementation of a modular approach can significantly enhance the quality of medical education and improve the professional competence of healthcare workers. The study highlighted the necessity of reforming the medical education system by adopting modular training. This approach facilitates a higher level of knowledge acquisition among healthcare professionals, which, in turn, improves the quality of medical services and contributes to the overall health of the population. The findings revealed that modular training is an essential tool in the professional education of future healthcare workers, as it ensures a deeper understanding of theoretical knowledge. This is evidenced by higher average test scores achieved in the study. The results can be utilised by lecturers in higher education institutions to improve the professional preparation of future specialists in the healthcare sector

**Keywords:** healthcare sector; future specialists; practical skills; professional development; educational technologies

## INTRODUCTION

In the modern world, medical education is continuously evolving due to the rapid advancement of medical technologies and the growing demand for the professional training of healthcare personnel. One of the innovative approaches to education is the use of modular training, which structures the learning process to make it more flexible and adaptable to students' needs. Modular training involves dividing the curriculum into distinct blocks or modules, each with its own objectives and tasks, promoting more effective material comprehension. The effectiveness of modular training in medical education lies in its ability to provide comprehensive professional preparation, focusing on

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developing practical skills and professional competencies. This approach enables students to gradually master complex medical disciplines by integrating theoretical knowledge with practical exercises. Such a method is particularly significant in medicine, where the quality of education directly impacts patients' health and lives.

A significant number of researchers have examined the effectiveness of modular training in the professional education of healthcare workers. For instance, N.O. Fedchyshyn *et al.* (2022) investigated the development of professional communicative competence among future healthcare professionals through the lens of language training. Their study emphasised the importance of communication skills for healthcare workers engaging with multicultural groups and patients from diverse cultural backgrounds. The findings demonstrated that integrating language education into professional training enhances patient understanding and improves communication in medical practice. Competency-based medical education faces numerous challenges, including resource shortages and insufficient funding. However, the adoption of new educational technologies and the integration of modern tools present opportunities for improvement. Research by L. ByrneDavis *et al.* (2024) analysed the challenges and opportunities of competency-based medical education in Bangladesh. Through interviews, observations, and mapping studies, the researchers explored ways to enhance the existing education system. The results highlighted issues such as resource scarcity, lack of funding, and limited opportunities for practical training. An innovative approach to addressing such challenges is the use of sensor-based modular training platforms to minimise vascular damage during endovascular surgery. These platforms incorporate various sensors that record and analyse surgeons' actions, refine techniques, and help prevent vascular injuries. N. Fischer *et al.* (2023) conducted a study focused on developing a modular training platform aimed at reducing vascular damage during endovascular procedures. The researchers designed and tested an advanced system that allows surgeons to practise complex operations without exposing patients to risk.

The use of 3D bioprinting in medical education opens new opportunities for training endovascular surgeons. This method enables the creation of realistic anatomical models, allowing complex procedures to be performed without posing risks to patients. R. Foresti *et al.* (2024) explored the application of 3D bioprinting in medical education, particularly in training endovascular surgeons. The researchers developed a modular system that utilises 3D bioprinting to create detailed anatomical models for educational purposes. Online modular training in eating disorder management, such as the PreparED programme, is a valuable tool for enhancing healthcare professionals' knowledge and skills in this area. This approach offers the flexibility to balance work commitments with learning, which is critical for effective material assimilation, as highlighted by O. Ruckbeil *et al.* (2022) and D.R. Glasofer *et al.* (2023).

The use of modular equipment, open-source software, and educational materials for training specialists in programmable logic controllers (PLCs) provides cost-effective and scalable learning solutions. This approach is particularly beneficial for countries and institutions with limited resources. H.P. Guntaka *et al.* (2022) analysed the use of modular hardware, open-source software, and educational content in PLC training. M. Hummel *et al.* (2024) examined the concept of stress and emotion management training for emergency service workers. The researchers reviewed existing programmes and approaches to identify the most effective training methods. Their findings indicated that implementing targeted educational programmes focused on stress and emotion management can significantly improve emergency service performance and reduce the risk of burnout.

Following a cross-sectional survey conducted among healthcare workers from 57 countries to assess their awareness and preparedness during the first wave of the COVID-19 pandemic, N.T. Huy *et al.* (2021) reported that many healthcare workers were inadequately prepared to operate effectively during a global crisis. The survey identified gaps in the knowledge and skills required for efficient pandemic response. The researchers recommended developing and implementing specialised training programmes to enhance healthcare workers' readiness for global emergencies. The modular training approach in this context has been shown to effectively improve the prevention and treatment of infectious diseases in public health facilities. Such an approach ensures that training programmes are tailored to the specific conditions and needs of each institution. E.M. Irungu *et al.* (2022) and H.D. Aleksandrenko & M.V. Shevchenko (2024) investigated the application of on-site modular training to enhance the quality of services related to infectious disease prevention and treatment in public health settings. These researchers designed and implemented programmes comprising various modules to train healthcare workers effectively. The use of mobile applications for healthcare worker training represents an innovative method that provides access to educational materials anytime, anywhere. This approach is particularly critical in primary care, where early disease detection can save lives. For instance, R. Jose *et al.* (2022) developed and implemented the M-OncoEd mobile application to train primary care physicians in cancer detection in India. This programme enables physicians to access learning resources flexibly, making training more effective. The purpose of this study was to determine the impact of modular training on the professional education outcomes of healthcare workers compared to traditional methods. To achieve this goal, the following objectives were undertaken:

- examining the theoretical foundations of modular training and its application in medical education;
- analysing existing training programmes for healthcare workers;
- conducting an empirical study to collect, analyse, and interpret data to evaluate the effectiveness of modular training in the professional preparation of healthcare workers.

## MATERIALS AND METHODS

The research findings were analysed using statistical methods, including mean values and analysis of variance. This approach provided a comprehensive assessment of the impact of modular training on the education of healthcare workers. The methods and stages of the study employed for data collection, analysis, and interpretation are outlined below. The study was conducted at several medical education institutions in Ukraine, specifically Ivano-Frankivsk National Medical University and National Pirogov Memorial Medical University, Vinnytsya. The sample consisted of medical students, with a total of 200 respondents. Of these, 46% were male and 54% female, aged 22-23 years. Participants were divided into two groups: a control group (100 participants) receiving traditional education and an experimental group (100 participants) educated using modular training methods. An experimental study was carried out, involving a comparative analysis of the results between the two groups of medical students. The study lasted one academic year (2023-2024) and adhered to ethical standards and principles. All participants were informed about the purpose of the study and its voluntary nature. Confidentiality of respondents' personal information and anonymity of the collected data were ensured.

This study involved an analysis of documents, specifically the curricula and programmes of educational institutions, to evaluate the structure and content of modular training (specialisation 222 "Medicine", educational programme "Healthcare"). This method enabled the identification of key differences in educational approaches, highlighting the strengths and weaknesses of the modular system. It also provided insights into how theoretical knowledge and practical skills are integrated within the learning process. Based on the institutions' curricula, information regarding the outcomes of modular training implementation was gathered. This facilitated conclusions about its effectiveness and suitability in specific contexts. A comparative analysis followed as the next stage of the research. The performance of students trained using the modular system was compared with those educated through traditional methods. This comparison yielded objective data on the advantages and limitations of each educational system. The evaluation focused on several key indicators: the level of theoretical knowledge acquisition, practical skills, ability for independent thinking and decision-making, and overall readiness for professional practice.

The research procedure encompassed several stages. At the initial stage, all participants underwent testing, surveys, and practical tasks to establish their baseline knowledge and skills. During the study, the control group followed traditional instructional methods, while the experimental group utilised a modular system. This modular approach involved dividing the learning material into logically coherent units, emphasising active learning methods and independent work. The study focused on core modules, including human anatomy (examining the structure of the human body, its organs, and systems), physiology (exploring the functioning of human organs and systems), biochemistry (studying chemical processes within living organisms), and pharmacology (analysing the effects of pharmaceuticals and their impact on the body). Upon completion of the training, all participants repeated the testing, surveys, and practical tasks to evaluate their acquired knowledge and skills. Assessment methods were applied at the beginning and end of the academic semester using various tools. Theoretical knowledge was measured through standardised tests comprising 50 questions on core medical disciplines. Satisfaction with the learning process and confidence in their knowledge and skills were assessed via questionnaires. Practical tasks, including specific medical procedures and simulations of clinical scenarios, were used to evaluate hands-on skills.

A variety of methods were employed to collect data, including an analysis of the curriculum for the Master's degree in "Medicine" (speciality 222) within the educational programme "Healthcare". This analysis aimed to evaluate the structure and content of modular learning. Document analysis provided insights into the organisation and content of the educational programmes, while a comparative analysis of student outcomes allowed conclusions to be drawn regarding the practical value of modular learning. These findings formed the basis for further recommendations to improve educational programmes and enhance the effectiveness of medical training. A questionnaire consisting of nine questions was utilised to assess participants' satisfaction with their education and confidence in their knowledge and skills:

1. How would you rate your overall satisfaction with the education provided at your institution?
2. How satisfied are you with the quality of learning materials and resources?
3. How would you assess the level of support provided by lecturers and administrative staff?
4. How confident are you in your knowledge of core academic disciplines?
5. Do you feel that the knowledge gained is sufficient for practical application in your future profession?
6. How would you evaluate your critical thinking and problem-solving skills?
7. Are you confident in your interpersonal communication and teamwork abilities?
8. Are you satisfied with the opportunities for practical training (internships, laboratory work, etc.)?
9. How confident are you in your ability to independently study new material and engage in self-development?

These questions facilitated the collection of detailed information about students' satisfaction with their education and confidence in their knowledge and skills, as well as identifying aspects of the educational process that require improvement. A comprehensive analysis was conducted of each aspect of the effectiveness of modular learning, particularly its impact on students' academic achievements, satisfaction with the learning process, and development of professional skills. Based on the findings,

recommendations were developed to enhance modular learning in the professional training of medical professionals. These recommendations include proposals for improving module structure, teaching methods, knowledge assessment, and feedback mechanisms.

## RESULTS

Medical education has always required a high level of knowledge, skills, and practical competencies, improving teaching approaches a critically important task. Numerous researchers have focused on modular learning, which has demonstrated its effectiveness in many countries, including Ukraine. This approach enables the educational process to be more effectively tailored to the individual needs of students while ensuring flexibility and a practical orientation. Modular learning involves dividing educational content into distinct blocks or modules, each covering a specific topic or set of topics. Typically, each module includes lectures, seminars, laboratory sessions, and independent student work. Modules are concluded with an assessment, which may take the form of tests, oral examinations, or practical tasks. This structure allows students to gain a deeper understanding of the material and immediately apply the acquired knowledge in practice. This approach incorporates essential features that make modular learning both effective and convenient for implementation across various educational institutions, particularly in higher education settings (Table 1).

**Table 1.** Functions of modular learning

| Function | Subtype | Characteristics |
|---|---|---|
| Educational | In-depth material study | Modules enable students to focus on specific topics, facilitating deeper understanding and retention of knowledge. This is particularly crucial for technical and medical fields, where comprehensive knowledge is of critical importance |
| | Sequence and structure | The modular system provides a clear structure to the learning process, where each module logically follows the previous one, promoting the systematic assimilation of material |
| Organisational | Flexibility and adaptability | Modular learning allows the educational process to be easily adapted to the individual needs of students. They can complete modules at their own pace, enhancing learning efficiency |
| | Ease of planning | The clear structure of modules enables lecturers to better plan the educational process, accommodating the needs and abilities of students |
| Evaluative | Continuous knowledge assessment | Each module concludes with an assessment, such as a test, practical task, or oral examination. This enables regular evaluation of students' knowledge and identification of gaps in their learning |
| | Feedback | Regular evaluations provide feedback that helps students understand their strengths and weaknesses, enabling them to address any shortcomings effectively |
| Motivational | Intermediate achievements | Completing each module is accompanied by an assessment, which creates a sense of accomplishment and motivates students to continue learning |
| | Individual goals | The flexibility to choose the pace and order of modules allows students to set and achieve their own learning objectives |
| Practical | Application of knowledge | Each module incorporates practical tasks, enabling students to apply their knowledge in real-world scenarios. This is particularly important for medical and technical disciplines |
| | Preparation for professional practice | The practical orientation of modules prepares students for real-world professional settings, equipping them with the necessary skills and competencies |
| Communicative | Collaboration and discussion | Modular learning fosters active discussion and collaboration among students. Group projects and discussions enhance material comprehension and teamwork skills |
| | Interaction with lecturers | Regular feedback and discussions with lecturers improve material assimilation and allow for adjustments to the learning process |

**Source:** compiled by the author based on studies by N.B. Salem *et al*. (2023) and T. Karatzias *et al*. (2023)

The advantages of modular learning include:

1. Individualised learning. Modular learning allows students to work at their own pace, which is particularly important in medical disciplines where the rate of material comprehension may vary among students. Each student has the opportunity to review and master the material fully before progressing to the next module.

2. Flexibility in the learning process. The modular approach enables students to plan their study time more effectively, allocating greater focus to topics they find challenging. This is especially beneficial for medical specialisations, where the workload is typically very high.

3. Practical orientation. Each module incorporates both theoretical and practical training. This ensures that students can apply their knowledge in practice, which is crucial for medical professionals. Laboratory work, simulations, and clinical placements enhance material retention and prepare students for real-world professional scenarios.

4. Assessment and feedback. Modular learning includes regular assessments of students' knowledge, allowing gaps to be quickly identified and the learning process adjusted accordingly. Feedback from lecturers helps students understand their mistakes and work on areas requiring improvement.

Despite its numerous advantages, modular learning presents certain challenges. Resource requirements: developing modular programmes demands substantial resources, both human and material. It is necessary to provide appropriate teaching materials, laboratory equipment, and highly qualified lecturers. Student adaptation to the new format: not all students adapt easily to the modular format. Many may struggle with the transition to self-directed learning and time management. Therefore, it is crucial to offer support during the initial stages of the programme. Quality assurance in education: ensuring a high standard of the learning process is essential so that every student attains an appropriate level of training. This requires continuous monitoring and evaluation of both student performance and lecturer effectiveness. An analysis of various aspects of modular learning in higher medical education institutions is presented in Table 2, which highlights its effectiveness and identifies opportunities for improving the learning process.

**Table 2.** Characteristics of modular learning aspects in higher medical education institutions with specific examples

| Aspect | Description | Examples |
|---|---|---|
| Learning structure | The learning process is divided into modules, each covering a specific topic or skill | The "Cardiology" module includes lectures, practical sessions, and independent research in cardiology |
| Teaching methodology | A combination of lectures, practical sessions, independent study, and interactive methods | Anatomy lectures are supplemented with laboratory work and online discussions |
| Knowledge assessment | Ongoing evaluations after each module and summative testing at the course's conclusion | Upon completing the "Pharmacology" module, students take a test and receive feedback |
| Practical sessions | Emphasis on practical skills, developed through laboratory exercises | Students practise resuscitation techniques on simulators during the "Emergency Medicine" module |
| Independent study | Students are assigned tasks for self-directed learning and preparation for classes | Students read supplementary materials and write essays on topics in the "Paediatrics" module |
| Flexibility | Modules can be adapted to individual student needs, enhancing the flexibility of learning | Students choose additional topics for in-depth study within the "Surgery" module |
| Interactive technologies | Use of electronic platforms, online courses, video lectures, and simulations | The online microbiology course features video lectures, interactive tests, and virtual laboratories |
| Student support | Consultations and guidance provided by lecturers throughout the learning process | Regular online consultations with lecturers in the "Infectious Diseases" module |
| Student motivation | Clear division of material into comprehensible modules enhances student motivation | Well-structured modules help students plan their studies and exam preparation effectively |
| Individualised approach | Tailoring learning to meet individual student needs | Students select topics for in-depth study in the "Therapy" and "Neurology" modules |
| Knowledge integration | Modules integrate theoretical knowledge with practical skills, ensuring a comprehensive approach | The "Gastroenterology" module combines lectures with clinical cases and practical tasks |
| Digital adaptation | Extensive use of digital tools and technologies to improve learning efficiency | The Moodle platform is used for real-time access to learning materials and assignments |
| Collaboration among students | Promoting teamwork and knowledge sharing among students | Group projects and discussions of clinical cases in the "Psychiatry" and "Dermatology" modules |

**Source:** compiled by the author based on studies by A.I. Sevalnev *et al*. (2021), Z. Liu *et al*. (2024) and N. Kurian *et al*. (2024)

Existing training programmes for medical professionals encompass the evaluation of the content, teaching methods, and effectiveness of educational initiatives aimed at preparing healthcare personnel. This analysis includes several key aspects, namely the theoretical component, which involves assessing the level and relevance of theoretical knowledge provided within the curricula. Disciplines such as anatomy, physiology, pathology, pharmacology, and other foundational medical sciences are included in this component. The practical component involves an analysis of practical sessions, clinical placements, and internships, which enable students to acquire the essential skills required for working in real-world settings. Teaching methods are categorised into traditional, interactive, and online approaches. Traditional methods include lectures, seminars, and laboratory work used to deliver foundational knowledge. Interactive methods incorporate simulations, roleplaying, problem-based learning, and other active techniques designed to enhance material comprehension. Online learning involves the use of digital platforms and resources to facilitate distance learning and self-directed study. This multifaceted approach ensures that medical training programmes comprehensively prepare students by combining theoretical knowledge with practical experience and diverse teaching methodologies.

The effectiveness of programs is evaluated based on several criteria. The first criterion is the assessment of knowledge and skills, which includes an analysis of assessment methods, such as tests, exams, and practical skills, such as clinical examinations and objective structured clinical examinations. The second criterion is adaptability to change, which determines how well programs adapt to the current demands of medical practice and scientific advancements. The third criterion is feedback, which includes an assessment of student and graduate feedback on the quality of education and their readiness for professional practice. Lecturers' preparation includes an evaluation of their qualifications and experience,

as well as their ability to conduct classes at a high level. Continuing professional development programmes for lecturers enable them to update their knowledge and enhance their teaching skills.

Infrastructure and resources are evaluated based on the availability of up-to-date textbooks, educational materials, and access to scientific databases. The compliance of laboratory equipment and clinical facilities with modern standards is also of critical importance. A comprehensive analysis of existing educational programmes for medical professionals highlights the strengths and weaknesses of the training process, identifying opportunities for improving the quality of education and adapting curricula to the current demands of the healthcare sector. The structure of modular components in medical education is defined by academic plans and programmes, including the allocation of study hours. For instance, the curriculum at Lviv National Medical University clearly delineates the time between theoretical and practical activities. Approximately 50% of the total study time is allocated to theoretical learning, while the remaining half is dedicated to practical activities, laboratory work, and clinical practice. The sequence of modules is structured to ensure that students begin with foundational modules in the early years of study, gradually progressing to more specialised and practice-oriented modules. This approach allows students to develop their knowledge and skills incrementally. Practical integration ensures that clinical practice is embedded within the curriculum from the third year onwards, enabling students to apply theoretical knowledge in real-world scenarios under the supervision of experienced medical professionals.

Modular learning is a contemporary approach to education that divides instructional material into distinct, logically complete modules. Each module focuses on a specific topic or skill and may include various teaching formats, such as lectures, practical sessions, independent study, and assessments. The process of modular learning is described below. The modular learning process involves the development of learning modules. Initially, the goals and learning outcomes for each module were defined. These goals were clear and specific so that students understood what was expected of them. Learning outcomes were defined in terms of specific knowledge and skills that students were expected to acquire upon completion of the module. After defining the goals and learning outcomes, the learning material was structured to provide a logical and sequential development of the topic. The content of the module was organised in the form of lectures, practical classes, independent work, and other learning resources. Lecturers prepared the necessary learning materials, such as presentations, notes, assignments, and literature for independent study. The learning process involved several stages. In the first stage, lecturers conducted lectures and seminars to introduce students to the basic concepts, theories, and information included in the module. Lectures were usually accompanied by multimedia materials that helped to better understand and remember information.

The subsequent stage involved practical sessions and laboratory work, enabling students to apply theoretical knowledge in a practical context. This stage is particularly critical in medical education, where hands-on practice is essential for preparing professionals. During practical sessions, students complete tasks simulating real-world scenarios they are likely to encounter in their professional practice. Independent study formed an integral part of modular learning. Students were assigned tasks for self-directed learning, designed to deepen their understanding of the material, develop research skills, and foster critical thinking. Lecturers provided guidance and support during this phase, ensuring a more effective learning experience. Knowledge and skills were assessed at every stage of the learning process. A variety of evaluation methods were employed, including tests, coursework, oral assessments, and practical exercises. These assessments allowed for the measurement of students' comprehension, identification of knowledge gaps, and timely adjustments to the learning process. The final stage of modular learning was the summative assessment, which involved a comprehensive evaluation of student's knowledge and skills across all completed modules. Summative assessment methods could include written exams, oral interviews, or the defence of coursework or dissertations. The outcomes of the summative assessment reflected the overall level of student preparedness and their readiness for professional practice.

The content of each module is designed to meet contemporary requirements for medical education and practice. The modules encompass both general subjects (such as anatomy and physiology) and specialised disciplines (such as surgery, internal medicine, and obstetrics and gynaecology). Universities employ a variety of teaching methods, including interactive lectures, seminars, practical sessions, simulation training, and group work, which actively engage students in the learning process. The assessment system includes regular testing, examinations, practical evaluations, and coursework. To effectively evaluate modular learning compared with traditional approaches, students were divided into two groups: a control group and an experimental group. Their knowledge and skills were assessed based on the following criteria:

1. Theoretical knowledge:

➥ The average test score in the control group before training was 60 points and 75 points after training.

➥ The average test score in the experimental group before training was 61 points and 85 points after training.

2. Level of satisfaction with learning:

➥ The percentage of satisfied students in the control group was 55% before training and 70% after training

➥ The percentage of satisfied students in the experimental group was 58% before training and 90% after training.

3. Practical skills:

➥ The average score for completing practical tasks in the control group was 65 points before training and 78 points after training.

➥ The average score for completing practical tasks in the experimental group was 66 points before training and 88 points after training.

The experimental group demonstrated significantly better results compared to the control group, highlighting the effectiveness of modular learning in enhancing theoretical knowledge. Students who followed the modular methodology achieved a higher average post-training score, surpassing the control group by 10 points. The training for the Master's programme in the speciality 222 "Medicine", under the educational program "Healthcare", at Ivano-Frankivsk National Medical University and National Pirogov Memorial Medical University, Vinnytsya, integrated theoretical and practical sessions within the modular learning framework. This approach ensured a comprehensive preparation for future doctors, emphasising the gradual development of knowledge and practical skills. The training particularly focused on foundational disciplines, including anatomy, physiology, biochemistry, and histology. These courses equipped students with essential knowledge regarding the structure and functioning of the human body.

Key disciplines included pathology, pharmacology, microbiology, and immunology. Students studied pathological processes, mechanisms of drug action, the effects of microorganisms, and immune responses. Additionally, specialised courses encompassed internal medicine, surgery, paediatrics, obstetrics and gynaecology, and psychiatry. These subjects covered a wide range of medical specialisations, deepening students' knowledge in specific areas of medicine. Practical training held a prominent role in the educational process, including laboratory work and clinical practice. Laboratory sessions involved conducting experimental studies in controlled settings to reinforce theoretical knowledge. Simulation-based training utilised simulation centres, allowing students to practise clinical skills in a safe environment. Students engaged with simulators replicating real medical scenarios. Clinical practice was conducted in hospitals and clinics under the supervision of experienced doctors. During these placements, students participated in the diagnosis, treatment, and care of patients, enabling them to apply theoretical knowledge in practical settings. Students enrolled in the modular system exhibited a higher level of satisfaction with the learning process. This could be attributed to the more interactive and practice-oriented approach of modular education, which facilitates better understanding and retention of material. The increase in satisfaction levels by 32% in the experimental group, compared to 15% in the control group, underscores the advantages of the modular approach (Table 3).

**Table 3.** Survey results for participants in the control and experimental groups

| Question | Response options | Survey responses, % | |
|---|---|---|---|
| | | Control group | Experimental group |
| 1 | - Very satisfied<br>- Satisfied<br>- Neutral<br>- Dissatisfied<br>- Very dissatisfied | - 4%<br>- 14%<br>- 50%<br>- 20%<br>- 12% | - 20%<br>- 35%<br>- 26%<br>- 14%<br>- 5% |
| 2 | - Very satisfied<br>- Satisfied<br>- Neutral<br>- Dissatisfied<br>- Very dissatisfied | - 10%<br>- 30%<br>- 50%<br>- 20%<br>- 10% | - 15%<br>- 38%<br>- 40%<br>- 7%<br>- 0% |
| 3 | - Excellent<br>- Good<br>- Satisfactory<br>- Poor<br>- Very poor | - 16%<br>- 14%<br>- 45%<br>- 10%<br>- 15% | - 45%<br>- 14%<br>- 16%<br>- 15%<br>- 10% |
| 4 | - Very confident<br>- Confident<br>- Neutral<br>- Not very confident<br>- Not at all confident | - 10%<br>- 25%<br>- 40%<br>- 15%<br>- 10% | - 40%<br>- 25%<br>- 20%<br>- 15%<br>- 0% |
| 5 | - Yes, completely<br>- Yes, partially<br>- Neutral<br>- No, insufficiently<br>- No, completely insufficient | - 20%<br>- 25%<br>- 40%<br>- 5%<br>- 10% | - 25%<br>- 35%<br>- 35%<br>- 5%<br>- 0% |

Table 3. Continued

| Question | Response options | Survey responses, % | |
|---|---|---|---|
| | | Control group | Experimental group |
| 6 | - Excellent<br>- Good<br>- Satisfactory<br>- Poor<br>- Very poor | - 15%<br>- 35%<br>- 40%<br>- 0%<br>- 10% | - 25%<br>- 35%<br>- 40%<br>- 0%<br>- 0% |
| 7 | - Very confident<br>- Confident<br>- Neutral<br>- Not very confident<br>- Not at all confident | - 10%<br>- 25%<br>- 40%<br>- 15%<br>- 10% | - 45%<br>- 14%<br>- 16%<br>- 15%<br>- 10% |
| 8 | - Very satisfied<br>- Satisfied<br>- Neutral<br>- Dissatisfied<br>- Very dissatisfied | - 4%<br>- 14%<br>- 50%<br>- 20%<br>- 12% | - 15%<br>- 38%<br>- 40%<br>- 7%<br>- 0% |
| 9 | - Very confident<br>- Confident<br>- Neutral<br>- Not very confident<br>- Not at all confident | - 10%<br>- 25%<br>- 40%<br>- 15%<br>- 10% | - 20%<br>- 35%<br>- 40%<br>- 5%<br>- 0% |

**Source:** compiled by the author based on their own research

The experimental group demonstrated significantly better performance in practical tasks, highlighting the advantages of modular learning in the development of practical skills. The 10-point difference between the control and experimental groups after training underscores the effectiveness of the modular approach in preparing students for practical applications. The findings of the study clearly indicate that modular learning is more effective than traditional methods in improving theoretical knowledge, student satisfaction, and the development of practical skills. This demonstrates the necessity of integrating modular approaches into educational processes to achieve superior outcomes in the training of medical professionals. Specifically, modular learning proves to be a more efficient method for preparing future medical specialists as it facilitates better assimilation of theoretical knowledge, enhances satisfaction with the learning process, and improves students' practical competencies. It is essential to implement modular learning in higher medical education institutions to elevate the quality of professional training. Based on the conducted research, the following recommendations can be proposed to optimise modular learning across various higher medical education institutions:

1. Integration of theoretical knowledge from various disciplines within a single module – develop integrated learning modules that combine content from anatomy, physiology, pharmacology, and clinical medicine. This approach enables students to recognise connections between different aspects of medical knowledge and practice;

2. Use of medical simulators for practical skills training – invest in modern simulation laboratories where students can practise skills on advanced mannequins replicating various clinical scenarios;

3. Problem-based learning with real clinical cases – incorporate real-world clinical cases into each module, requiring students to solve them independently or collaboratively, fostering critical thinking and clinical reasoning skills;

4. Implementation of flexible assessment methods – adopt a combination of formative assessments during the learning process (e.g., tests, mini-cases) and summative evaluations after module completion (e.g., comprehensive tests, practical exams);

5. Professional development for lecturers in innovative teaching and assessment methods – regularly conduct training sessions and workshops for lecturers to familiarise them;

6. Regular feedback provision to students on their progress – establish systems for frequent feedback where students receive detailed information on their achievements and areas for improvement through online platforms or individual meetings with lecturers;

7. Encouragement of active student involvement in research – create opportunities for studentled research by providing support and resources for their scientific projects within the modular curriculum.

An analysis of the results revealed that students trained under the modular system demonstrated a higher level of practical preparation and independence, which are critical attributes for medical professionals. At the same time, the traditional system exhibited certain advantages in the acquisition of theoretical knowledge. The use of these data collection methods facilitated a comprehensive evaluation of the effectiveness of modular learning. Enhancing modular education in higher medical institutions requires a multifaceted approach. This approach should integrate

innovative educational technologies, a combination of theoretical and practical knowledge, continuous professional development for lecturers, and active student engagement in the learning process. Such improvements are essential for preparing highly skilled medical professionals capable of working effectively in modern healthcare settings.

Modular learning stands out as one of the most promising methodologies in the professional training of medical personnel. Its effectiveness lies in the personalisation of education, allowing the creation of tailored learning pathways for each student. This is particularly important for medical professionals, as different specialisations demand varying levels of knowledge and skills. The modular system facilitates the adaptation of curricula to meet new requirements and standards, a necessity in the rapidly evolving fields of medical science and technology. Modern technologies, such as simulation training, virtual reality, and online courses, enhance student engagement and improve learning outcomes. Modules can focus on specific practical skills, ensuring that students are better prepared for real-world work in healthcare settings. Modular learning also supports the organisation of continuous professional development for medical professionals, a critical aspect of the healthcare sector. Its structure allows for interim assessments of students' knowledge and skills, enabling timely adjustments to the learning process. Key directions for the advancement of modular education include the development of new modules that incorporate recent medical advancements, the regular updating and refinement of existing modules, and the integration of innovative methods and technologies. These measures are essential for maximising the effectiveness of modular learning in the professional preparation of medical personnel.

The use of simulation training and virtual reality, alongside advanced technologies for modelling medical procedures and scenarios, enables students to practise skills in a safe and controlled environment. The integration of distance learning expands opportunities for remote education, allowing medical professionals from various regions and countries to participate in the learning process. Partnerships with medical institutions, including collaboration with clinics and hospitals, ensure students gain practical training in real healthcare settings. Regular training and professional development for lecturers working within the modular system are essential for implementing innovative methodologies and technologies. Modular learning holds significant potential for improving the quality of medical education, which, in turn, enhances the overall standard of healthcare services. To gain a clearer understanding of the topic, it is essential to compare the findings of this study with those of other researchers, evaluate the key advantages of modular learning, its impact on the professional training of healthcare workers, as well as the challenges and limitations educational institutions may face during its implementation.

Research has demonstrated that modular learning significantly enhances the efficiency of the educational process, enabling students to focus on specific topics and acquire in-depth knowledge in each area. This aligns with the findings by N. Yuniarti *et al*. (2020), who noted that the modular approach facilitates better comprehension as students can study each module in greater detail. Furthermore, modular learning promotes the development of critical thinking and analytical skills, which are vital for medical professionals. One of the primary benefits of modular learning is its capacity to integrate theoretical knowledge with practical skills. The findings indicate that higher education students engaged in modular learning have greater opportunities for practical application, enabling better preparation for real-world work environments. This is corroborated by E.S. Kay *et al.* (2024), who highlight that modular learning increases student involvement in practical activities and enhances their readiness for clinical practice.

Modular learning provides flexibility in the educational process, allowing students to learn at their own pace and tailor the program to their needs. Results confirm that this approach allows students to better balance their studies with other commitments, which is especially important for medical professionals who often work while studying. Research by Y. Kopochynska *et al*. (2020) and M. Abdel-dayem *et al*. (2021) also highlights that the flexibility of modular learning increases student motivation and contributes to better learning outcomes. It is important to ensure flexibility in the educational process, allowing students to adapt the program to their needs and learn at their own pace. Research has shown that this approach increases student motivation and contributes to better learning outcomes. Despite numerous advantages, modular learning faces certain challenges and limitations. One of the main ones is the need to develop high-quality learning modules, which require significant effort and resources from educational institutions. This study has shown that creating effective modules requires the involvement of experts from various medical fields, which can be problematic for some educational institutions. This is consistent with the findings of the study by S. Machaca *et al.* (2022), who indicate the need for significant investment in the development of modular programs.

Another challenge is the need for ongoing monitoring and evaluation of the effectiveness of learning modules. Data from the current study shows that regular evaluation helps identify weaknesses in the modules and improve them. This is supported by research from J. Sessner *et al.* (2022) and C. Strowel *et al.* (2024), who emphasise the importance of feedback from students and lecturers for the continuous improvement of modular programs. It allows for the identification of weaknesses and problems in the learning process, providing an opportunity to address them promptly. Students can provide valuable information on how well they are learning the material and which aspects require additional attention. Lecturers can make suggestions for improving teaching methods and module structure. Regular analysis of feedback contributes to adapting programs to current needs and requirements,

increasing the effectiveness of learning. The research findings indicate that to successfully implement modular learning in the professional training of medical professionals, it is necessary to develop a strategic approach that includes several key elements:

1. Development of high-quality learning modules is fundamental to successful modular education. This involves engaging experts, employing modern methods and technologies, and ensuring the integration of theoretical knowledge with practical skills.

2. Organising professional development courses for lecturers to master the modular approach and contemporary teaching methods is a crucial component. Evidence confirms that such initiatives enhance the quality of the educational process and ensure alignment with current requirements.

3. Regular evaluation of module effectiveness enables the identification and rectification of weaknesses, facilitating continuous programme improvement (Malik *et al.*, 2023; Wegner *et al.*, 2023). This process helps pinpoint areas of the curriculum that require further attention or adjustment, thereby enhancing the quality of education and ensuring compliance with current standards. Lecturers can utilise evaluation results to refine teaching methodologies and learning approaches. Additionally, such evaluations encourage students to actively engage in the learning process, boosting their motivation and academic performance.

The prospects for the development of modular learning lie in the continued integration of advanced technologies such as simulations, virtual reality, and other digital tools, which can further enhance the educational process and the training of medical professionals. It is equally important to consider feedback from students and lecturers to continuously improve modules and adapt them to the evolving demands of medical practice. The findings of this study align with conclusions drawn by other researchers in this field. For instance, the study by P. Abril-Jiménez *et al.* (2022) demonstrated that modular learning enhances the training of medical professionals by enabling a more effective integration of theoretical knowledge with practical skills. Their conclusions are consistent with the present data, highlighting the significance of integrating theory and practice in the educational process.

Other research, notably the study of K. Lorey & J.M. Fegert (2021) and Q. Mansoor *et al.* (2024), strongly supports the importance of flexibility and individualisation in modular learning. Results confirm that the flexibility of the educational process increases student motivation and contributes to better learning outcomes. This is especially important for medical professionals who often work while studying. It is important to note that implementing modular learning requires careful planning and significant resources. It is necessary to ensure the development of high-quality learning modules, the professional development of lecturers, and the regular evaluation of program effectiveness. Collaboration between educational institutions, medical establishments, and other stakeholders is a crucial factor for success. Modular learning is an effective method of professional training for medical professionals, allowing for the integration of theoretical knowledge with practical skills, providing flexibility and adaptability in the learning process. The results of this research, as well as other scientific studies, have shown that the modular approach contributes to better learning outcomes, increased student motivation, and their readiness for real-world work. However, to successfully implement modular learning, certain challenges must be overcome, including ensuring the development of high-quality learning modules, the professional development of lecturers, and the regular evaluation of program effectiveness. A strategic approach that includes developing high-quality modules, professional development, regular monitoring, and ensuring flexibility in the learning process is the key to the successful implementation of modular learning in the professional training of medical professionals.

In summary, modular learning offers many advantages for the professional training of medical professionals. It promotes a deeper understanding of the material, integrates theoretical knowledge with practical skills, and provides flexibility and individualisation in the learning process. This research, along with other scientific studies, confirms that modular learning increases the effectiveness and quality of training for future medical professionals, making them better prepared for real-world work.

## CONCLUSIONS

Modular learning in higher education medical institutions provides a structured and effective approach to training medical professionals. The clear organisation of the learning process, integration of theoretical and practical classes, utilisation of modern teaching methods, and regular assessment contribute to a high quality of education. The modular learning system allows students to acquire in-depth knowledge and skills necessary for successful professional activity in the medical field. Modular learning ensures a deeper understanding of theoretical knowledge, as evidenced by higher average test scores. Students who study using modular methods demonstrate a higher level of satisfaction with the learning process, which may be attributed to the greater interactivity and practical orientation of the methodology. The modular approach significantly improves students' practical skills, which is critical for their future professional activities.

Overall, the research results confirm that modular learning is a more effective approach in the professional training of medical professionals compared to the traditional methodology. This indicates the need to implement modular approaches in the curricula of medical faculties to improve the quality of training for future healthcare professionals. Further research is needed to assess the long-term impact of modular learning on the professional activities of graduates of medical specialities. This will help determine the extent to which the acquired theoretical knowledge and practical skills contribute to the successful careers of medical professionals.

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## CONFLICT OF INTEREST

None.

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# Аналіз ефективності модульного навчання у професійній підготовці медичних працівників

**Анотація.** Метою дослідження була оцінка ефективності модульного навчання в системі професійної підготовки медичних працівників, у порівнянні з традиційними методами навчання. Було проведено експериментальне дослідження, в якому взяли участь 200 медичних працівників різних спеціальностей. Учасники були поділені на дві групи: контрольну (традиційне навчання) та експериментальну (модульне навчання). Оцінювання знань і практичних навичок проводилося до та після навчання за допомогою тестів, опитувань і практичних завдань. Результати дослідження показали, що учасники експериментальної групи, які навчалися за модульною системою, продемонстрували значно вищі показники засвоєння теоретичних знань і практичних навичок у порівнянні з контрольної групою. Також було відзначено підвищення мотивації до навчання та самостійного опрацювання матеріалу серед учасників модульного навчання. Модульне навчання виявилося більш ефективним у підготовці медичних працівників порівняно з традиційними методами навчання. Запровадження модульного підходу може суттєво покращити якість медичної освіти та підвищити рівень професійної підготовки медичних працівників. Дослідження підкреслило необхідність реформування системи медичної освіти з впровадженням модульного навчання. Це дає змогу підвищувати рівень знань медичних працівників, що в свою чергу покращить якість медичних послуг і сприятиме загальному покращенню здоров'я населення. Отримані результати дозволили виявити, що модульне навчання є необхідним інструментом у професійній підготовці майбутніх медичних працівників, бо забезпечує більш глибоке засвоєння теоретичних знань, що підтверджується вищими середніми балами тестів у дослідженні. Результати дослідження можуть бути використані викладачами закладів вищої освіти з метою удосконалення професійної підготовки майбутніх фахівців у сфері охорони здоров'я

**Ключові слова:** сфера охорони здоров'я; майбутні фахівці; практичні навички; підвищення кваліфікації; освітні технології