MEDICAL SIMULATION

an international training ground
for teaching and scientific
experiences

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Contents

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Foreword

In the nineteenth century, there was a rapid development of technology and industry, which significantly changed our civilization. This development continues and is gaining momentum. Not only technology is developing, but also knowledge, with almost unlimited access. The development of technology influences and even forces changes in various fields, including medicine and health care. An indispensable element of civilizational progress is also a change in education systems, in which the benefits of technical development are taken into account and innovative solutions are introduced, mainly to improve the quality of education, but also to make this process more attractive. An effect of these changes is the currently flourishing method of teaching in medical professions, such as medical simulation.

Although this method has been present in healthcare since the beginning of the twentieth century, it has recently gained in popularity. Simulation is one of the most modern teaching methods that allows you to gain knowledge and experience by participating in realistic scenarios of hospital cases, enabling the reconstruction of a clinical situation in laboratory conditions. This method uses virtually created reality, advanced ICT technologies, trainers, phantoms and patient simulators that faithfully reproduce a person, their physiological parameters and selected pathologies. In addition, by making the teaching process more attractive, it is possible to introduce a simulated or standardized patient scenario. In the context of educating medical staff, not only the quality of education is important, but also the broadly understood safety of patients, by shaping skills in a controlled and safe environment. The teaching process, based on gaining experience, takes place in safe and repeatable conditions. The participant has the opportunity to learn and improve various procedures, has the opportunity to make mistakes, without the real consequences of causing harm to the patient. Education based on simulation (SBE) has great potential both to improve technical and manual skills, together with a teamwork and communication. It provides a unique opportunity for interprofessional training in a safe learning environment, as well as the opportunity to receive immediate feedback from specialists/instructors, which enables the evaluation of the learning process. Medical simulation is a key element of the education process for medical students, it is a bridge connecting theoretical knowledge with practical knowledge, as well as a preparatory stage for the final phase of preparation for the medical profession, i.e. teaching in direct contact with the patient and the clinical world. It is worth noting, however, that this method is used in both pre-graduate and postgraduate education. Medical errors committed by staff during their work

cause a real risk to the health or life of patients. Therefore, simulation-based CPD is an excellent initiative to improve patient safety and provide the highest possible level of care.

Medical simulation is not only a didactic method, it is also a broad issue for insightful scientific analysis, which allows for the development and improvement of this method. The dynamics of improving medical simulation in the teaching process, based on scientific evidence, will significantly create the quality of education, which at a later stage will translate into professionalism in the provision of health care and the safety of the patient/ward. Therefore, in this publication, the authors want to present a certain range of international experiences related to medical simulation, both in the didactic and scientific aspects. The authors hope that this book will be an inspiration for the implementation and development of medical simulation as a creative educational method and an area of scientific inquiry.

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Potential applications of medical simulation in the teaching process within the field of wound prevention and treatment. Literature review and personal experiences analysis

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Abstract

Introduction: The dynamic advancement of simulation techniques in medical universities opens a new chapter in medical education in its broad sense. Education in the field of wound prevention and treatment can enhance and enrich the training opportunities for nurses.

Aim: The aim of this study was to analyze available literature on medical simulation as a practical tool in educating nurses in wound prevention and treatment.

Material and methods: A literature review was conducted regarding medical simulation in the nursing education process. National (Termedia) and English-language (PubMed, Cochrane) databases were searched from 2015 to 2023 using the key words "nurse", "medical simulation," "wound treatment."

Conclusions: Education utilizing medical simulation in the area of wound treatment can be an effective tool in enhancing practical skills among nursing students. Data regarding the utilization of this teaching method in practice are still too limited to draw definitive conclusions. Implementing simulation models in the teaching process is necessary to enhance skills, foster attitudes, satisfaction, and alter perceptions of this issue among nursing students.

Key words: medical simulation; education; wounds; nurse

Introduction

The education of nurses throughout its history has been and continues to be focused on systematically improving the quality of education based on prevailing standards and recommendations. The increase in prerequisite requirements for candidates, adjustment of the number of hours, and duration of education to meet European Union requirements are some of the elements aimed at enhancing the quality of education. In Poland, the utilization of medical simulation in pre-diploma teaching is conditioned by the regulation of the Minister of Science and Higher Education. It is mandatory for higher education institutions, universities, and academies to incorporate medical simulation techniques into the educational process [1].

In the Slovak Republic simulation education is relatively underexplored. This may be particularly related to financial issues associated with providing high-fidelity models for the education of health professions students. Investment in this type of education should be prioritized, as the prosperity of society is closely linked to the quality of healthcare provided by well-educated and trained professionals. Simulation-based education is one of the key factors influencing the evaluation of the educational process. It enables the standardization of clinical situations and supports students' abilities to apply their knowledge in various scenarios, enhance their practical skills, develop their critical thinking and clinical decision-making, improve communication and multidisciplinary collaboration, and increase their satisfaction with education [2].

The implementation of simulation methods in the education process of nurses is an effective approach in undergraduate and postgraduate education. Simulation-based clinical education is an innovative pedagogical approach that provides nursing students with opportunities to improve their clinical and decision-making skills through various real-life situations without compromising patients' health. Simulations allow students to work together on scenarios with clear learning outcomes [3].

The aim of the study was to analyze the available literature on medical simulation as a practical tool in nursing education in the field of wound prevention and treatment.

Material and methods

A literature review was conducted regarding medical simulation in the nursing education process. National (Termedia) and English-language (PubMed, Cochrane) databases were searched from 2015 to 2023 using the key words "nurse," "medical simulation," "wound treatment." Additionally, relevant book publications

were utilized. Studies focusing solely on wound treatment education through lecture materials were excluded, regardless of whether these materials were personal, virtual, or simulation-based interventions that did not primarily focus on wound treatment. Based on the analyzed literature, our own experiences related to conducting simulations in the field of wound prevention and treatment are presented.

Types of medical simulation and their potential applications in the teaching process in the field of wound prevention and treatment

The training system for medical professions (nurses, midwives, physicians, paramedics, pharmacists, etc.) in Poland is regulated by law and supervised by designated institutions [1]. Changes in the education system enable students to delve into practical skills in the context of holistic care based on real-life scenarios. Training based on competencies (Competency-Based Medical Education) is designed with future professional tasks and roles in mind, which graduates will fulfill in a social environment. Competencies are understood as the ability to apply acquired knowledge and skills in specific situations while adhering to principles of professional ethics. An essential aspect of competency-based or outcome-based education is the credible assessment of the degree to which students achieve these outcomes/competencies, enabling them to obtain diplomas and professional qualifications. As competencies encompass various areas (knowledge, skills, and attitudes, also known as social competencies), their assessment requires the use of appropriate and often entirely new methods. This necessitates the continuous updating of knowledge among academic teachers. Simulation is an active learning strategy in which participants engage in practical actions that resemble training conducted in natural conditions, based on feedback between the trainees and simulated patients. Medical simulation is a dynamically evolving branch of medical education closely related to medical technology. It is a teaching method and an educational process that utilizes a range of educational equipment, from simple trainers for learning individual tasks to advanced manikins, also known as patient simulators, which faithfully mimic human anatomy and physiology [4].

This review focuses on the potential of simulation in the field of health sciences, specifically within undergraduate and graduate nursing studies, for wound prevention and treatment. Clinical nursing education conducted by professional teachers and clinicians using simulation is not limited to the use of manikins and simulators alone but is highly creative and dependent on the instructors and their level of engagement. It may involve various activities, including the use of electronic

and audiovisual systems, realistic virtual environments, and role-playing by actors prepared for such activities or by the students themselves [5]. The cornerstone of simulation work is the scenario. A detailed description of the conducted exercise is essential for both low-fidelity and high-fidelity technology-based sessions. Considering the method's universality as a form of medical education, a classification based on its fidelity into low, medium, and high-fidelity simulations has been made.

Low-fidelity medical simulation is used in the teaching of technical-manual skills and isolated clinical procedures, without an extensive clinical context. Low-fidelity simulation utilizes equipment that allows for the repeated practice of a given task. Through the repetition of performed procedures, students gain confidence and develop desired behaviors and habits, enabling them to perform tasks freely and safely, in accordance with aseptic and antiseptic principles. The advantages of this method include simplicity, repeatability, minimizing the risk of error, and exposure of potential patients in clinical reality. Exercises should be conducted under the constant supervision of a teacher who demonstrates the correct execution of each procedure, and then monitors and promptly corrects any errors that occur. The equipment used in low-fidelity simulation mainly consists of trainers and simulators reflecting specific areas of the human body. Exercises utilizing low-fidelity simulation can also be conducted on more advanced simulators. In the field of wound prevention and treatment, within this form of education, one can consider learning simple procedures related to wound assessment and management: describing the depth of injuries, type of tissue in the wound, wound edges, for which clinical scales, trainers, and wound photos can be utilized. Shipton et al. emphasize that to stimulate students' creativity, the replication of wounds on the skin through makeup can be used, which is a very interesting approach given its ability to recreate wounds for subsequent description [6]. Performing the procedure should be concluded with a description of the wound's appearance. Teaching involves conveying knowledge, practical skills, and interpersonal communication. Collecting microbiological material, removing sutures from a wound, and administering injections within the wound area (e.g., local infiltration anesthesia currently performed on a physician's order) are simple procedures commonly used in practice. Many authors emphasize the correctness of performing these procedures, which should involve obtaining tissue scrapings or biopsies, rather than just swabbing the wound [7]. Performing compression therapy using the Kikuhime device to measure pressure under the bandage is another procedure commonly used in the wound healing process. The ability to apply compression therapy should be a mandatory activity in conducting basic nursing classes. The individual procedures are depicted in Figure 1, and their implementation can be conducted in basic nursing classes as well as during physical examination sessions in the first year of diploma training.

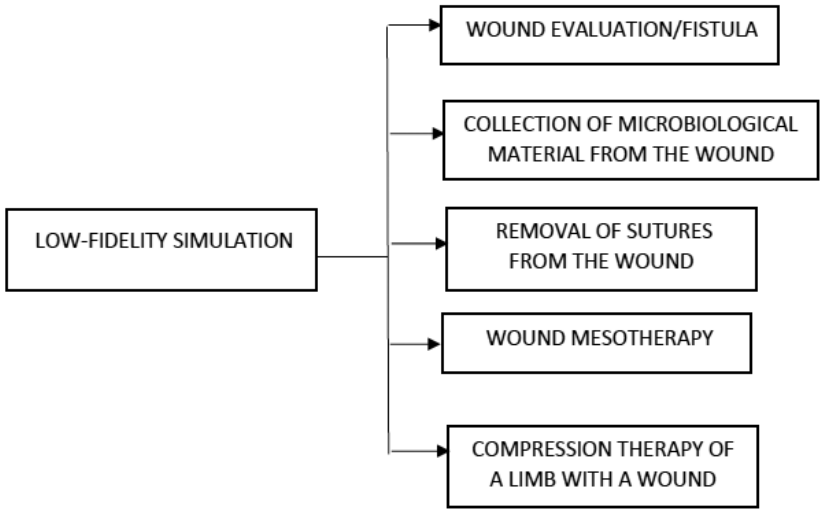

Figure 1. Possibilities for implementing preventive and therapeutic procedures in low-fidelity simulation in undergraduate studies (own elaboration)

The concept of intermediate-fidelity medical simulation is based on gradually introducing clinical context. While performing procedures, students must pay attention not only to the correctness of each task element but also to the patient's situation. Attitude, interdisciplinary communication, and the quality of tasks performed are considered in the assessment process. In this form of education, practical attitudes and behaviors are emphasized using both trainers and more advanced simulators [8]. Intermediate-fidelity simulation involves creating an environment and context through the instructor's creativity, rather than relying solely on equipment. In the teaching process of wound care and management, intermediate-fidelity simulation can be used for diagnostic procedures (evaluation, lower limb examination in diabetic patients, Doppler ultrasound examination, ankle-brachial index assessment) as well as therapeutic procedures (wound debridement through scraping, removal of devitalized tissues, suture removal, wound dressing using specialized dressings, application of negative pressure wound therapy, larval therapy, management of stomas with wounds). Classes suitable for implementing these procedures include basic nursing, physical examination, and modules focusing on wound management in graduate studies. The possibilities of using simulation are presented in Figure 2.

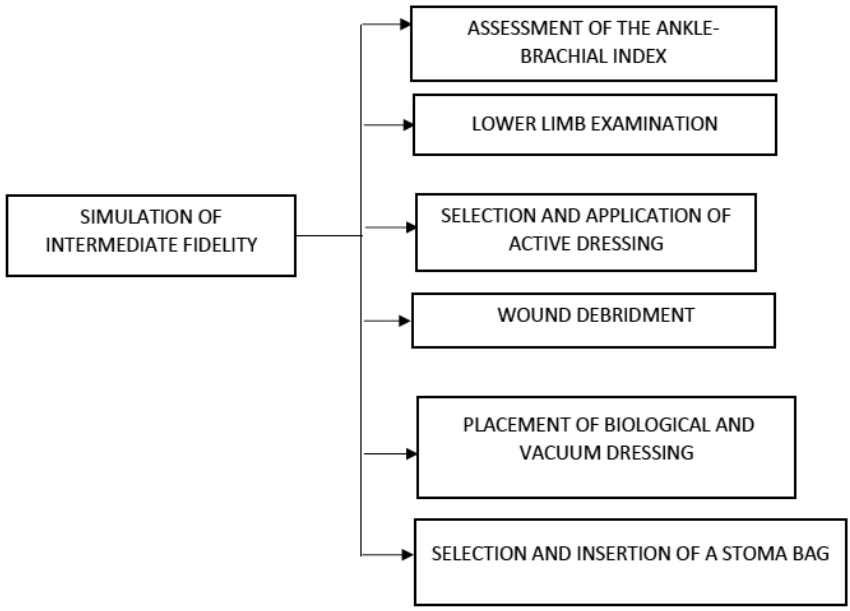

Figure 2. Possibilities for implementing preventive and therapeutic procedures in intermediate-fidelity simulation in undergraduate and graduate studies (own elaboration)

High-fidelity simulation is used for an integrated educational process, which includes theoretical knowledge, practical skills, and attitudes such as patient approach and communication. The main goal of this form of education is to integrate previously acquired knowledge and practical skills into independent or team actions. Implementing complex simulation scenarios involving multiple procedures can engage individual participants or interdisciplinary teams. At this stage, students make decisions independently, based on their knowledge and analysis of the clinical situation. High-fidelity simulations require instructors to pay close attention to technical and substantive training details, which have a comprehensive character. Experiential learning is one of the most effective teaching methods. Students, as simulation participants, solve prepared clinical problems in the form of simulation scenarios, which include numerous tasks to be performed. The student takes responsibility for performing the entire therapeutic-diagnostic process from start to finish. High-fidelity scenarios are conducted in rooms that reflect clinical reality, with audio and video monitoring capabilities, recording, and transmission options. The instructor is located in a separate room behind a one-way mirror (control room) (Photographs 1a and 1b).

Photograph 1a. High-fidelity simulation in the nursing student teaching process at the Center for Medical Simulation, University of Rzeszów (personal material)

Photograph 1b. High-fidelity simulation in the nursing student teaching process at the Center for Medical Simulation, University of Rzeszów (personal material)

Therefore, students should be well-prepared in terms of knowledge and basic skills already mastered. High-fidelity simulation aims to maximize the resemblance of the learning environment to the work environment by faithfully reproducing it, often

including the work subject as well. Typical high-fidelity simulation rooms resemble or closely resemble real hospital emergency departments, intensive care units, or settings resembling apartments for elderly individuals. An important element of high-fidelity simulation room equipment is debriefing systems, including cameras, recording equipment, and appropriate software, allowing for training support and, particularly, conducting debriefing sessions with the trained team based on the audio-video recording of the conducted exercise (simulation scenario). The area of wound prevention and treatment can be addressed in medical simulation at every level; possible clinical situations that can be implemented are presented in Figure 3.

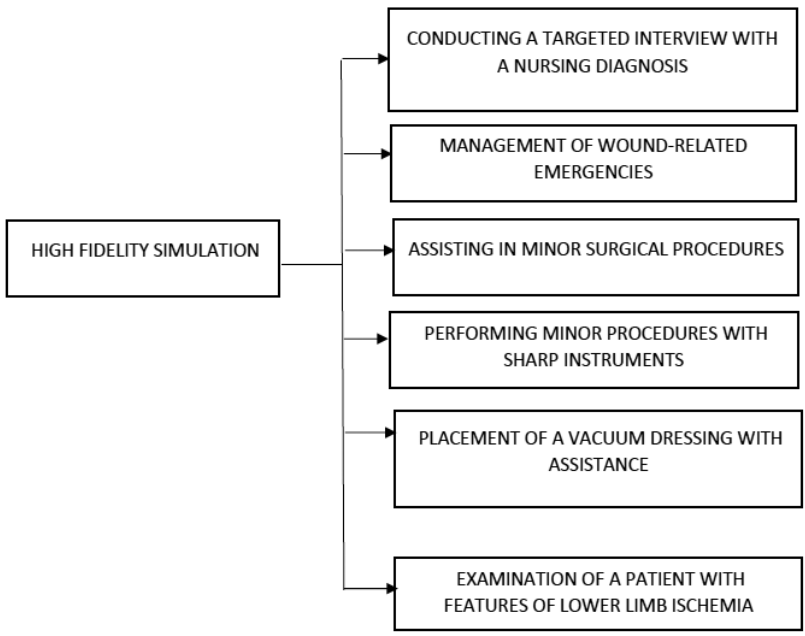

Figure 3. Possibilities for implementing preventive and therapeutic procedures in high-fidelity simulation in undergraduate and graduate studies (own elaboration)

In the teaching process, scenarios can be created in various settings, such as a home environment (long-term care or hospice patient), surgical outpatient clinic (assisting in changing negative pressure wound dressings, obtaining histopathological tissue samples, managing abscesses), and even in emergency nursing scenarios (e.g., hemorrhage from a damaged vessel within a wound or a wound at a metastatic site). The most creative sessions involve actors who are equipped and prepared to portray the roles of elderly individuals, providing a realistic representation of the environment and stereotypes associated with diabetic foot disease [9]. In Photograph 2, the

various stages of teaching wound management with a negative pressure dressing are depicted, from simple procedures to scenarios involving actors. A challenge for contemporary clinical nursing is the development and implementation of new competencies. In anticipation of new teaching standards in nursing education, it is necessary to prepare educators to teach the use of surgical tools, management of necrotic and devitalized tissues, and techniques of modern therapeutic systems such as controlled negative pressure with irrigation capabilities.

Photograph 2. Intermediate and high-fidelity simulation in the nursing student teaching process at the Center for Medical Simulation, University of Rzeszów (personal material)

Both in Poland and in Slovakia, there are various types of models that may include various aspects of wound management, such as moist wound healing, surgical wound management, and nursing aspects. When choosing a model, it is important

to consider its quality, realism, and ability to simulate various stages and types of wounds to provide the best possible preparation for practice. The models are made of materials that are resistant to repeated use and allow the application of various types of treatment. Some models are even equipped with technology that allows monitoring of healing processes and provides feedback for the user. Furthermore, it is important to consider service and operational support [10]. Standardization of certain procedures arises from the influence of both local and global scientific societies, whose representatives recommend procedural models based on scientific guidelines [11, 12, 13]. Chronic wound models are an important tool for education and training, particularly for students of nursing and other health professions. They are constantly updated to reflect the newest scientific knowledge and clinical experience in wound management [14].

In simulation, standard procedures for chronic wound treatment are used and developed based on expert analyses and verified experience. Therapeutic and care procedures may result from educational standards or ministerial recommendations [1]. For example, the standard procedure "Comprehensive Nursing Management of Patients with Chronic Wounds" provides detailed guidance for nurses on how to effectively treat chronic wounds using the latest knowledge and technology [15]. Another important document is "Wound Management," which contains comprehensive information on the epidemiology of patients with wounds, wound classification, clinical presentation, diagnosis, treatment, and care [16].

The use of simulation methods can be considered an important factor in the evaluation of educational settings. The use of various types of simulation methods in the training of health profession students enhances the practical acquisition of skills. This is achieved through multiple repetitions, visualization, precise execution, and coordination of individual actions, making the learning process much more effective [17, 18]. The educational process, atmosphere, and students' perceptions and opinions about their own performance have become very important for optimal teaching and affect the evaluation of the educational environment [19].

Discussion

As technology advances, innovative educational methods are preferred alongside traditional ones to develop students' cognitive, emotional, and psychomotor skills. Conducting theoretical education in practical professions aimed at preparing professionals for patient care is insufficient and does not provide the desired level of knowledge and outcomes, especially in critical situations (e.g., cardiac arrest,

acute life-threatening conditions) burdened with high responsibility, where students cannot practically participate as members of interdisciplinary teams. Simulation provides opportunities to practically deepen highly specialized skills and is one of the breakthrough techniques in the array of methods for assessing experimental learning, offering broad opportunities for practice while ensuring safety and high teaching standards [20].

The dynamic development of simulation techniques in medical universities opens a new chapter in medical education in the broadest sense. Education in the field of wound prevention and treatment can expand and enrich the training opportunities for nurses in this area. The results of research conducted by Silva et al. indicate that simulation enables the acquisition of practical skills for assessing and treating wounds [21, 22]. The obtained results unequivocally indicate that clinical simulation can be an effective strategy for improving clinical outcomes but has a lesser impact on acquiring theoretical knowledge compared to other educational methods [23, 24]. Studies confirming the effectiveness of simulation in knowledge acquisition have combined this method with other teaching strategies, such as lectures, video presentations, and traditional clinical experiences [25].

The authors indicate that learning outcomes may include perceived or distinctly measured gains in knowledge as a result of simulation interventions [26, 27]. Redmond et al. highlight the potential use of virtual patients (VP) to supplement knowledge on wound management in undergraduate studies. The majority of students highly rated the educational value of virtual patients and their support in learning. They reported a noticeable increase in confidence and ability to achieve competency outcomes in wound management. Virtual patients also provided an opportunity to develop clinical reasoning skills. This study provides evidence that virtual patient simulation is an effective pedagogical method for enhancing clinical competencies in wound management. It gives nursing students the opportunity to practice skills and repeatedly apply theory in a safe environment, unconstrained by resource limitations such as access to clinical placements and decreasing faculty [28]. Virtual patient (VP) is defined as a specific type of computer program simulating real clinical scenarios: students take on the roles of healthcare workers to gather history, conduct physical examinations, and make diagnostic and therapeutic decisions.

Additionally, students can receive immediate and timely feedback on their decisions and practitioner skills, which is a significant enhancement to learning. Other advantages of VPs include flexibility in scheduling without time constraints, repeatability, simultaneous use by all students, and minimal cost after the initial investment [29]. Employees at University of Rzeszów's Medical Simulation Center

(Centrum Symulacji Medycznej Uniwersytetu Rzeszowskiego – CSM) have had positive experiences in conducting training sessions using virtual patients, especially in the areas of physical examination and emergency situations. Collaboration with a Portuguese team [30] has provided a framework for evaluating actions in this regard. Literature analysis provides broader insights into the issues of prevention and wound care in nursing. Particularly noteworthy are the studies conducted by Yilimazer et al. among nursing students regarding the prevention and treatment of pressure ulcers. The authors confirmed that the obtained results of the participants were at a high level after comprehensive training involving standardized patients. This study reaffirmed that standardized patient interactions are an effective learning method for nursing students. Furthermore, it was established that knowledge and outcomes may be more enduring through comprehensive training encompassing both summary sessions and theoretical and demonstrative education [27].

Each teaching process should undergo evaluation and final assessment. The use of OSCE (Objective Structured Clinical Examination) to assess the cognitive knowledge and clinical reasoning of participants aims to objectively evaluate acquired skills as well as behaviors in simulated work environments and medical events. Preparing nursing students and training nursing staff in the prevention and treatment of wounds remains a challenge for the education system. Staff shortages and inadequate interest among practitioners continue to present practical problems associated with advanced professional practice in this area [31]. In Poland, nurses acquire qualifications for wound care during the diploma-level education in second-degree nursing studies. These qualifications can also be obtained through specialization or specialized courses in wound care. Continuing education programs offer the opportunity to utilize high-fidelity simulation in the teaching process of applying larval therapy (MDT), negative pressure wound therapy (NPWT), or wound debridement. The primary objective of nursing education programs is the acquisition of clinical competencies. Nursing professional organizations define competencies as a combination of knowledge, abilities, skills, attitudes, and decision-making abilities. Concerns have arisen, both domestically and abroad, regarding the adequacy of the preparation of undergraduate nurses for competencies in wound care. Authors point out issues such as the lack of evidence-based practice, the need for greater education in the biological sciences, and the necessity for significantly improved, structured wound assessment, as well as post-care and education in clinical reasoning skills [32, 33].

Unprofessional wound management and treatment have consequences for patients and the healthcare system, including increased risk of amputation, more frequent hospitalizations, antibiotic overuse, pain leading to decreased mobility, and

predisposition to social isolation. Concerns regarding the competency of nursing students in wound management and treatment may be justified in the context of professional preparation. The global shortage of nursing staff and limited opportunities for clinical practice in wound care are considered contributing factors. Virtual simulation offers potential solutions and enables the evaluation of practical training outcomes.

An important aspect is also the multidisciplinary approach that emphasizes collaboration between various healthcare professionals to achieve the best care possible. In Slovakia, there are educational programs that focus on chronic wound management and use simulations as a key part of the educational process. The programs have been designed to provide comprehensive theoretical information along with practical skills necessary for providing successful treatment. As a result, nurses are better trained to deal with complications associated with chronic wounds and overall treatment outcomes improve. Thus, simulation is an important tool to increase the effectiveness and quality of nursing practice in Slovakia, which has direct positive effects on patients suffering from chronic wounds [34]. Establishing collaboration with foreign institutions offers opportunities for expanding knowledge and horizons related to research design, as well as enhancing the utilization of teaching methods from partners with greater experience.

Conclusions

Education utilizing medical simulation in the area of wound treatment can be an effective tool in enhancing practical skills among groups of nursing students. Data regarding the utilization of this teaching method in practice are still too scarce to draw unequivocal conclusions. It is necessary to implement simulation models in the teaching process to enhance skills, build attitudes, satisfaction, and change perceptions of this issue among groups of nursing students. Thorough research and comparisons of various models and procedures help to identify the most suitable methods for treating chronic wounds according to specific needs. Therefore, high-quality simulations are essential for nurses with varying levels of experience.

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Preparation of the reliability and validity test of the Hungarian adaptation of the modified Simulation Effectiveness Tool (SET-M HU)

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Abstract

Introduction: The Simulation Effectiveness Tool-Modified (SET-M) questionnaire aims to assess students' perceptions of the effectiveness of teaching and learning in a simulation environment.

Aim: The aim of our research group was to develop a Hungarian version of the questionnaire (SET-M HU) and to test the reliability and validity of the psychometric characteristics of the questionnaire. In the preparatory phase of this process, a pilot study was conducted, and the results of which will serve as a basis for the development of the final Hungarian version and for further validity tests.

Material and methods: Data were collected from 91 students who participated in the simulation-based learning experience in the Faculty of Health Sciences at the University of Debrecen, between September 2023 and March 2024. The methods used for data analysis were descriptive statistics, exploratory factor analysis, correlation analysis, calculation of Cronbach alphas, Item-Total analysis, Split-Half reliability, and Rough Set analysis. The data analysis used Microsoft Excel 2016 and SPSS v24 software.

Result: As a result of the factor analysis, three factors accounted for 69.8% of the total variance. The correlations of the Hungarian version of the instrument ranged from r = 0.918 to r = 0.894. The overall Cronbach's alpha coefficient of the instrument was found to be 0.950. The correlations were statistically significant for the full instrument and the subscales. Rough Set analysis showed similar results for the Gauge test.

Conclusions: Based on the results of our research, the feasibility of the questionnaire in Hungary has been confirmed, so it is relevant to continue the validation process. The Hungarian version of the questionnaire can be a reliable and valid measurement tool to assess the effectiveness of learning in simulation environments.

Key words: simulation training; validation study; effectiveness; SET-M

Introduction

Health simulation education has developed significantly in the world and in Hungary in recent decades. Simulation as an educational tool and learning methodology is increasingly emphasized in the training of health professionals [1]. Simulation education is also supported by national and international professional bodies in the nursing profession. The International Nursing Association for Clinical Simulation and Learning (INACSL) includes more than 2400 members from around the world.

However, when using simulation in education, it is important to emphasise that simulation is an educational strategy and not a technology [2]. The goals of simulation in education are related to learning and assessment. Simulation is not a substitute for learning throughout the clinical practice, but allows the student to develop professional skills, assessment, critical thinking and decision-making in a safe and supportive environment [3].

Simulation training involves the modelling of clinical situations using simulators and possibly human actors. This solution provides students with the opportunity to practice their clinical skills through real-life situational experience, without endangering the patient's life, in the interest of patient safety. By providing conditions as close to reality as possible, the simulation environment gives the opportunity to practice certain activities in a targeted way by controlling specific factors, and minimising the possibility of manipulation, while using motivational experiential factors [4]. Patient care is highly influenced by the innovative modern education of future professionals, especially in the critical patient care environment where the patient's condition is highly dependent on timely, complex care [5, 6, 7, 8]. In addition, simulation education has a motivational effect on students, increases their ambition, self-confidence, and enhances their sense of profession [8, 9, 10]. It also supports competencies that are often neglected in traditional teaching methods, such as teamwork, explanation, collaboration, and also develops their communication skills [11, 12, 13, 14].

To provide effective, high quality simulation education, it is necessary to have an adequate pool of professionals who are well prepared for being able to train in a simulation environment, have adequate knowledge of the use of modern simulation tools, and therefore the organisation of professional training programmes and the development of simulation units are of great importance [7].

Pre-briefing and debriefing are important elements of effective teaching. The latter is an important feedback to the student. Debriefing provides an opportunity for the student to repeat the task until he or she has mastered it properly [15, 16]. In a survey, conducted at a university in the West of Ireland in 2020, researchers found that all students found debriefing to be a very valuable component of the learning experience through simulation. It was also reported that learning about students' opinions was a valuable component of the simulation-based learning experience since it allowed them to express their feelings and apply self-reflection [16]. This is why it is important to explore the views of students preparing for a health career to understand the impact of simulation education on training [17]. Evaluation ensures that simulations undergo consistent, continuous, quality process improvement. Evaluation processes and methods are designed during the simulation development phase. An assessment method should be incorporated to measure students' knowledge acquisition and their learning outcome achievement. Other components to be evaluated are the facilitators and the simulation environment [18].

The Modified Simulation Effectiveness Tool (SET-M) included in the study is a measurement tool that has been shown to be effective from a variety of approaches in research [19, 17] and has been used in relation to simulation-based learning experiences in a number of fields, for instance, among nursing and midwifery students. The research team aims to develop a range of valid and usable measurement tools that can be used in simulation-based teaching practice and are excellent for measuring the effectiveness of teaching, which includes the SET-M questionnaire. This paper summarises the results of a pilot study conducted in the preparatory phase of the validation process of the SET-M instrument. The purpose of this study is to prepare the Hungarian adaptation of the SET-M HU, to examine the validity of content, construct, and criterion reliability.

Material and methods

The SET-M questionnaire was developed in 2015 by Leighton and colleagues from the work of Elfrink-Cordi and colleagues in 2012 [18, 19]. The aim of the instrument is to assess the effectiveness of teaching in a simulation environment based on students' perceptions. The 19 questions of the SET-M questionnaire are usually analysed by the researchers in three or four parts. The first part (questions 1 and 2)

measures the PREBRIEFING phase. The SCENARIO phase can be divided into two major parts (LEARNING sub-phase, questions 3 to 8, and CONFIDENCE sub-phase, questions 9 to 14) which measure students' self-perceptions of their learning and the development of their confidence. The DEBRIEFING phase examines the discussion and analysis phase (questions 15–19), see Table 1. Question 20 is an open question where respondents were asked to express their opinions in their own words.

Students can rate their opinion on the statements on a 3-point Likert-type scale (1–strongly disagree; 2–somewhat agree; 3–totally agree).

Based on previous measurements, the Cronbach's alpha coefficient of the instrument was 0.93, while the Cronbach's alpha coefficients of the subscales were 0.83 (pre-discussion), 0.85 (learning), 0.91 (confidence) and 0.90 (post-discussion). There were no items for which a reverse assessment was required. The total score is obtained by adding up the scores of all subscales [19, 17].

Language Validity of the SET-M HU Tool: In order to ensure the language validity of the SET-M HU, the tool was translated from English into Hungarian by two members of the research team and two English specialist translators, who were proficient in both languages. The Hungarian version was then translated again into English. The translations were reviewed again by the researchers before the final version was developed.

Ethical consideration: We have obtained the permission of the original authors (Kim Leighton) to adapt the questionnaire into Hungarian, and our team has ethical permission to conduct the research (BM/15069-1/2023).

Data Collection: The sampling took place at the Faculty of Health Sciences of the University of Debrecen. A subset of students who participated in a simulation practical class in the Faculty Skill Lab between September 2023 and March 2024 completed the questionnaire. The sample size was 91 students. The students completed a paper questionnaire at the beginning of the research and later the questionnaire was made available through the Google Forms application. The teachers leading the simulation exercise and the members of the Simulation Working Group participated in data collection.

Statistical Analysis: For data analysis Excel 2016 and SPSSv24 software were used. Results were evaluated with 85% confidence, and the significance level was $p < 0.05$. Descriptive statistics, factor analysis with varimax rotation, correlation examinations, Cronbach's alpha coefficients, Split-half correlations were used for data analysis. In addition, rough set analysis was used, which measured the interdependence of variables (attributes) based on the Polish Pawlak's theory [20].

Table 1. Distribution of responses to the SET-M HU questionnaire

	A (%)	B (%)	C (%)	NA (%)
PREBRIEFING				
1. Prebriefing increased my confidence	53 (58.2)	33 (36.3)	5 (5.5)	–
2. Prebriefing was beneficial to my learning.	64 (70.3)	24 (26.4)	3 (3.3)	–
SCENARIO (LEARNING)				
3. I am better prepared to respond to changes in my patient's condition.	58 (63.7)	31 (34.1)	2 (2.2)	–
4. I developed a better understanding of pathophysiology.	49 (53.8)	33 (36.3)	9 (9.9)	–
5. I am more confident in my assessment skills.	43 (47.3)	38 (41.8)	10 (11.0)	–
6. I felt empowered to make clinical decisions.	41 (45.1)	39 (42.9)	11 (12.1)	-
7. I developed a better understanding of medications.	46 (50.5)	29 (31.9)	7 (7.7)	9 (9.9)
8. I had the opportunity to practice my clinical decision making skills.	57 (62.6)	28 (30.8)	6 (6.6)	–
SCENARIO (CONFIDENCE)				
9. I am more confident in my ability to prioritise care and interventions.	52 (57.1)	28 (30.8)	10 (11.0)	1 (1.1)
10. I am more confident in communicating with my patient.	55 (60.4)	27 (29.7)	9 (9.9)	–
11. I am more confident in my ability to teach patients about their illness and interventions.	49 (53.8)	32 (35.2)	10 (11.0)	–
12. I am more confident in my ability to report information to health care team.	49 (53.8)	34 (37.4)	8 (8.8)	–
13. I am more confident in providing interventions that promote patient safety.	48 (52.7)	30 (33.0)	10 (11.0)	3 (3.3)
14. I am more confident in using evidence-based practice to provide care.	43 (47.3)	38 (41.8)	7 (7.7)	3 (3.3)
DEBRIEFING				
15. Debriefing contributed to my learning.	66 (72.5)	19 (20.9)	3 (3.3)	3 (3.3)
16. Debriefing allowed me to communicate my feelings before focusing on the scenario.	54 (59.3)	22 (24.2)	12 (13.2)	3 (3.3)
17. Debriefing was valuable in helping me improve my clinical judgment.	58 (63.7)	27 (29.7)	3 (3.3)	3 (3.3)
18. Debriefing provided opportunities to self-reflect on my performance during simulation.	66 (72.5)	20 (22.0)	2 (2.2)	3 (3.3)
19. Debriefing was a constructive evaluation of the simulation.	65 (71.4)	20 (22.0)	3 (3.3)	3 (3.3)

Results

Table 1 shows the responses to the questions of the questionnaire in aggregated form. For each question, the highest level of agreement received the most marks. It is noteworthy that in the Debriefing questionnaire, with two exceptions, at least

70% of respondents indicated the highest level of agreement. The two exceptions also had response rates of around sixty percent. The Prebriefing section got a similarly high rating. The two sections of the Scenario question set scored slightly lower, but here too the highest rating was the most typical (column A). Question seven showed the highest level of uncertainty with a non-response rate of nearly 10%.

The columns show the number of cases for each response option and the percentage distribution in brackets. Column A indicates the 'Strongly Agree' response (3 points); column B indicates the 'Somewhat Agree' response (2 points); column C indicates the 'Do Not Agree' response (1 point). Column NA indicates the 'No Answer' response.

To the 20-question open questionnaire, *What else would you like to say about today's simulated clinical experience?*, 42 responses were received. These were typically positive, complimentary comments. Negative comments were reported by one respondent. Some asked for the use of more modern equipment and others asked for a greater proportion of simulation lessons in the curriculum.

The aggregated descriptive characteristics of each question group and the overall questionnaire are presented in Table 2. For all questions, the answers were crowded towards higher values. This is also reflected in the point averages of the individual questions (Mean/Number of questions row). All averages are above two. What was observed during the evaluation of Table 1, that the Prebriefing and Debriefing groups of questions were rated more highly, is also observed here with averages of around 2.6 compared to averages of around 2.4.

Table 2. Summary characteristics for the full questionnaire and for each group of questions

		All	Prebriefing	(Scenario) learning	(Scenario) confidence	Scenario	Debriefing
Mean		48,0253	5,1978	14,8659	14,7011	29,6203	13,2500
Mean/Number of questions		2,5277	2,5989	2,4777	2,4502	2,4684	2,6500
95% Confidence Interval for Mean	Lower	46,0988	4,9713	14,2037	13,9912	28,2487	12,7647
	Upper	49,9518	5,4243	15,5280	15,4111	30,9918	13,7353
5% Trimmed Mean		48,6280	5,3120	15,0854	14,9368	29,9958	13,4899
Median		49,0000	6,0000	15,0000	16,0000	30,0000	14,0000
Variance		73,974	1,183	9,081	11,096	37,495	5,247
Std. deviation		8,60080	1,08750	3,01339	3,33102	6,12331	2,29066
Minimum		24,00	2,00	7,00	6,00	14,00	5,00
Maximum		57,00	6,00	18,00	18,00	36,00	15,00
Range		33,00	4,00	11,00	12,00	22,00	10,00
Interquartile Range		14,00	2,00	5,00	6,00	11,00	3,00
Skewness		–,743	–1,147	–,662	–,760	–,649	–1,372
Kurtosis		–,294	,529	–,342	–,409	–,624	1,386

The strength of the relationship between each subgroup is indicated by Spearman's rho coefficient (see Table 3). The value of the smallest correlation coefficient is 0.556 (PREBRIEFING and DEBRIEFING). All coefficients indicate a moderately strong or strong significant relationship.

Table 3. Correlation values for the response scores of the question groups

		All	Prebriefing	Learning	Confidence	Scenario	Debriefing
ALL	Correlation Coeff.	1,000	,727**	,938**	,929**	,964**	,789**
	Sig. (2-tailed)	.	,000	,000	,000	,000	,000
	N	79	79	79	79	79	79
PREBRIEFING	Correlation Coeff.	,727**	1,000	,589**	,592**	,613**	,556**
	Sig. (2-tailed)	,000	.	,000	,000	,000	,000
	N	79	91	82	87	79	88
LEARNING	Correlation Coeff.	,938**	,589**	1,000	,868**	,960**	,678**
	Sig. (2-tailed)	,000	,000	.	,000	,000	,000
	N	79	82	82	79	79	79
CONFI-DENCE	Correlation Coeff.	,929**	,592**	,868**	1,000	,965**	,630**
	Sig. (2-tailed)	,000	,000	,000	.	,000	,000
	N	79	87	79	87	79	87
SCENARIO	Correlation Coeff.	,964**	,613**	,960**	,965**	1,000	,672**
	Sig. (2-tailed)	,000	,000	,000	,000	.	,000
	N	79	79	79	79	79	79
DEBRIEF-ING	Correlation Coeff.	,789**	,556**	,678**	,630**	,672**	1,000
	Sig. (2-tailed)	,000	,000	,000	,000	,000	.
	N	79	88	79	87	79	88

Legend: Spearman's rho coefficient, ** sign correlation is significant at the 0.01 level (2-tailed)

Principal Component Analysis (Factor Analysis, Varimax Rotation, listwise) was carried out to analyse the answers to the questions in more depth. The resulting components revealed relevant correlations (KMO = 0.886; Bartlett's Test of Sphericity Approx. Chi-Square = 1183.614; df = 171; $p < 0.000$). Rotation Sums of Squared Loadings–Cumulative % (1, 2, 3 components) = 69.860%. Table 4 shows the structure of the three components resulting from the test.

Table 4. Rotated Component Matrix with 3 separated components

Rotated Component Matrix[a]			
	Component		
	1	2	3
V4 – SCENARIO – L	,814	,229	,191
V5 – SCENARIO – L	,810	,203	,176
V6 – SCENARIO – L	,755	,253	,396
V12 – SCENARIO – C	,729	,148	,385
V14 – SCENARIO – C	,722	,176	,385
V13 – SCENARIO – C	,716	,218	,456
V3 – SCENARIO – L	,694	,252	,225
V17 DEBRIEFING	,125	,829	,262
V19 DEBRIEFING	,282	,765	,068
V2 PREBRIEFING	,448	,749	,055
V18 DEBRIEFING	,053	,733	,285
V15 DEBRIEFING	,218	,723	,197
V16 DEBRIEFING	,108	,679	,464
V1 PREBRIEFING	,564	,596	,042
V8 – SCENARIO – L	,362	,467	,404
V11 – SCENARIO – C	,359	,290	,754
V10 – SCENARIO – C	,394	,203	,730
V9 – SCENARIO – C	,496	,144	,728
V7 – SCENARIO – L	,236	,402	,633
Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.			
a. Rotation converged in 7 iterations			

The factor analysis sharply separated the PRE- and DEBRIEFING questions (Factor 2) from the SCENARIO questions, which were included in Factors 1 and 3. Only the V8 question shows the ambiguous position of the component classification.

Question V8 is included in the five items that showed the lowest dependency value in the rough set analysis ($\gamma = 0.7089$–question 5; $\gamma = 0.7468$–questions 1, 7, 8, 14; $\gamma = 0.960$–question 2; $\gamma = 9747$–question 13; for the other questions the dependency value was $\gamma = 1$). This means that for most questions full dependency can be shown in relation to the other questions. There are minor differences in the dependency for the cases listed.

The reliability of the questionnaire was tested with Cronbach's alpha, which was 0.950 for all questions. The Cronbach's alpha coefficients for the subscales were 0.895 (pre-discussion), 0.880 (learning), 0.907(confidence) and 0.860 (post-discussion).

The results of the Item-Total Statistics are summarised in Table 5. It can be seen that by deleting questions one by one from the question set, Cronbach's alpha values hardly change. For further analysis, the SET-M questions were also examined using the Split-Half procedure. The procedure split the question set into two parts (questions 1–10 and 11–19). The Cronbach's alpha values for the two sets of questions were 0.918 and 0.894, respectively. Correlation between the two sets of questions was 0.886, Spearman-Brown Coefficient = 0.939; Guttman Split-Half Coefficient = 0.931.

Table 5. Item Total Statistics of the SET-M questionnaire

Item-Total Statistics				
	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
V1	45,52	66,689	,684	,948
V2	45,38	67,239	,705	,947
V3	45,41	67,706	,675	,948
V4	45,58	65,400	,722	,947
V5	45,66	66,023	,696	,948
V6	45,67	65,172	,810	,946
V7	45,57	66,479	,660	,948
V8	45,46	66,918	,665	,948
V9	45,54	65,431	,738	,947
V10	45,54	65,764	,706	,947
V11	45,57	65,351	,748	,947
V12	45,53	66,098	,720	,947
V13	45,58	64,887	,794	,946
V14	45,57	66,248	,733	,947
V15	45,30	68,624	,609	,949
V16	45,54	65,790	,645	,949
V17	45,39	67,754	,642	,948
V18	45,30	69,112	,549	,950
V19	45,33	68,249	,609	,949

Discussion

There are several conditions for the validity of a measuring instrument. One of these is reliability, but reliability does not guarantee the validity of a measurement instrument [21]. The validity of a measurement instrument is usually assessed by researchers through content validity and factor construct validity. The content validity of the SET-M HU measure was 0.95. This is very similar to the results of the

original questionnaire and the results of measurements conducted by other national research teams (Table 6). The results show that the content validity of the SET-M HU questionnaire as a measurement instrument is adequate.

Table 6. Reliability (Cronbach's alpha) values of the different studies

	Total	Prebriefing	Learning	Confidence	Scenario	Debriefing
EN	0.950	0.985	0.880	0.907	0.944	0.860
Elfrink-Cordi et al. [19]	0.93	0.83	0.85	0.91	–	0.90
Bergamasco et al. [22]	–	0.792	0.823	0.874	–	0.758
Leighton et al. [18]	0.936	0.833	0.852	0.913	–	0.908
Olvera-Cortes et al. [23]	0.932	–	–	–	–	–
Sahin et al. [21]	0.920	0.900	0.850	0.890	–	0.840

The results of the factor analysis differ slightly from the factor structure of the original questionnaire where 4 components were identified, while in the present study 3 principal components were identified accounting for 69.8% of the total variance. In the components, the components for the scenario, prebriefing and debriefing are well separated, which is in line with the structure of the original questionnaire. The results of the present study show that the results of the factor analysis were reasonable. In the future, when a larger number of items is available, confirmatory factor analysis can be performed to investigate in more detail the fit between the data collected and the principal components.

A reliable measuring instrument provides sensitive, consistent and stable measurement results. To measure the reliability of the measurement instrument, the internal consistency and correlation (Spearman's rho coefficient) relationships were analysed in this study. Internal consistency was measured by item analysis and Chronbach's alpha coefficient. The correlation coefficient of all items ranged from 0.55 to 0.96. This indicates the adequacy of the reliability level of the items (Table 6). Based on the internal consistency scores of the subscales and the entire instrument, it can be concluded that the Hungarian version of the instrument (SET-M HU) has a high reliability.

The Split-Half procedure was used to assess the reliability of the instrument, where Chronbach's alpha values for the two halves of the instrument were between 0.91 and 0.89.

Leighton et al. converted the 5 response options of the original instrument to a 3-point Likert scale, which did not change the reliability of the instrument [18]. In the present study, the instrument included a 3-point Likert scale for all items.

In previous studies, it was observed that most people did not answer question 7 on medication (*I developed a better understanding of medications*), with 8.3% of participants in the original study not completing this question [18, 21]. This was because the researchers assumed that the scenario did not include an element of medication. In the present pre-study, this question was also the one with the highest proportion of non-response (9.9%, Table 1), presumably because the competences of nurses and midwives in our country do not include prescribing medication, only the administration of after doctor's order. Previous studies have suggested that if medication administration is not included in the scenario tasks, students should not complete this question [21]. Overall, based on the responses to each question, students' perceptions of the simulation exercise were positive in this preliminary study.

Conclusions and recommendation

The results of the studies showed that the SET-M HU questionnaire is a reliable and valid measurement tool that will be used in clinical simulation in Hungary. Simulation education practitioners can use the measurement tool to measure students' perceptions of the effectiveness of simulation education and the effectiveness of learning in a simulation environment.

A preliminary analysis of the Hungarian version of the SET-M questionnaire confirms the need for further implementation of the questionnaire. This justifies the research team's goal of completing the full validation process and finalising the Hungarian version. The planned measurements will include the investigation of additional socio-demographic factors (gender, age, type of course, etc.) and an increase in the sample size.

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Clinical escape room from theory to practice: the experience of an Italian nursing bachelor degree

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Abstract

Introduction: The clinical escape room (CER) is a strategy, applied in the adult education, in various contexts and based on different settings or thematic areas. It is developed in a room or series of rooms, where inside students, solve a problem or a puzzle that may lead to the discovery of a key, or a numerical combination to unlock a lock. The CER supports learning in the clinical-care field combining knowledge, skills and fun, stimulates new knowledge, trains students to works in a group and develops skills in different contexts.

Aim: The main aim of the chapter is to summarize our experience regarding the CER.

Material and methods: A total of 55 students participated in the CER, divided into 11 teams of five members each.

Results: On average it took 56.6 minutes (min 50–max 66), a value that did not differ greatly from what was hypothesized in the design phase. At the end of CER, the students' responses freely at the question from a form for guarantee the anonymity.

Conclusions: An activity considered in its digital version involving students during the period of social isolation. Having considered the potential of escape rooms and the curiosity for novelty, the CERs as a possible future strategy to support continuous training.

Key words: escape room; game; learning; nursing students and simulation

Introduction

Due to the intrinsic characteristics that distinguish it, the game represents a stimulus for learning, not only in the developmental stage but also throughout

life, including in undergraduate and continuing education settings. It is well known that the contribution of play and movement, albeit in different ways, implies cognitive and creative activities that may trigger learning [1]. The game manages to simultaneously involve and motivate, leads to surprises and is able to bring illusions to life; it trains you to adapt to situations or rules and offers the possibility of developing new skills [2]. No game is to be considered trivial, it always has a purpose and can include a rewarding or successful aspect. even for adults. In addition to providing a sense of achieved competence and social usefulness (especially if played in a team), the game can contribute to self-esteem with respect to one's own abilities and resolution skills [3]. However, there is a risk that some individuals will attribute greater importance to the social expectations derived from the assigned tasks (obtaining better results than others) than to the personal aims achieved (achieving personal learning goals) [4]. There are games that are defined as 'serious' when they are aimed at the application of imagination, or lead to exploration, encouraging individuals to prepare and finally to follow precise rules. Participants are aware that they will have to solve problems and/or face new situations. Accessing this type of game involves exploring multiple options or paths, including developing innovative visions [2]. It has been investigated whether game-based learning is linked to different outcomes leading to perceptual and cognitive results, rather than behavioral or motivational ones.

Many reference theories, research questions and studies have been presented/conducted to date by different authors [5]. The question naturally arises, then, as to whether game-based learning or game-based learning situations could be more useful, especially if they involve situated experiential learning. Games do not always involve materials stored in cardboard boxes or traditional shapes and volumes; there is a type of game that involves particular places and a level of interaction that comes close to the real world or takes its inspiration from the real world. Specifically, we are referring here to the recreational activity known as 'escape room' (ER) in its different presentations, where intuition and logic are combined. It must be said that ER is nothing new; conceived as a game, it has transformed into a strategy applicable in adult education in various contexts and based on different settings or thematic areas. It involves a room or a series of rooms in which a one-way path is reconstructed, characterized by stages whose overcoming is linked to the resolution of problems of different natures and levels of difficulty, with a view to discovering a material pass such as a key or a numeric code for opening a padlock that allows the participant to open the exit door. Inside the room, resolving a problem or a puzzle can lead to the discovery of a key, or the result of a calculation could provide the unlocking of a numeric combination padlock. This activity usually involves group

participation, problem solving and teamwork; in fact, each participant makes the knowledge and skills in which they are most expert available to their team, all in a limited time frame as the team that takes the least amount of time to complete the entire journey wins. So-called 'penalties' may be foreseen for incorrect choices or failure to resolve the problems faced.

Here, the idea was to create an escape room activity to support learning in the clinical-care field, combining knowledge, skills and fun–hence the creation of a clinical escape room (CER) designed for nursing students in order to stimulate new knowledge, train students in teamwork and develop skills in relation to situations in different healthcare contexts.

Over time, ERs have become increasingly popular types of games, representing a novelty for those who are looking for interactive and movement games. Added to this is the fact that the evolution towards digital has marked new possibilities in terms of access to the game, remote participation and interaction even remotely. A catalytic effect was determined by the need generated during the period of social isolation between 2020 and 2021 caused by the COVID-19 pandemic. Although the current technologies applicable to games allow you to enter a virtual gaming context from your mobile device wherever you are, the sensations and immersive power determined by one's physical presence in a certain environment are probably difficult to achieve.

In an ER, the aim of the game is to exit the room or rooms by solving puzzles and riddles in the shortest time possible. An ER represents a physical and mental challenge in realistic environments, with or without the support of innovative technologies; they can essentially be defined as live role-playing games or themed entertainment events [6]. The evolution of ERs is demonstrated by the increasingly numerous locations that have arisen in recent years in various cities. Adapted individual rooms or abandoned premises have given way to custom-designed structures, sometimes with long-term exhibitions as in Milan, Paris, Budapest or Toronto (however an ER remains active for a maximum of 2 or 3 years). Almost all ERs, as has happened with the best video games, present a sort of normal expiry, accompanied in this case by the progressive experiences of the participants. The attractiveness and potential of an ER do not depend exclusively on the number of rooms or the duration of the route, but these are factors to be added to various material variables. The level of immersion is limited by the availability of sensitive effects in the scenario (for example, linked to variations in lighting or sound), by the presence of themed objects (real or simulated) and by the appearance of characters (actors). The game is engaging if the setting in turn is refined and enthralling. Participants tend to initially explore the room in a timid, indecisive and superficial

way, but as time passes, they usually become more aggressive, looking for possible clues everywhere [6].

The success of the game in terms of its positive impact on the participants depends on the details in the preparation and on the emphasis conveyed during the presentation of the story (real-life situation, even a clinical one), the mission or case being addressed, as well as on the engagement of a facilitator – serving as a kind of 'Charon' – who enables participants to move between successive rooms. The emotional and relational involvement between subjects then contributes to the immersive value of ERs. It is not just about putting pieces together but about living a challenging adventure together with other people sharing ideas, experiences, problems and solutions [7].

Each ER is characterized by a series of puzzles, of different types and levels, the solution of which requires multiple skills, both cognitive (through calculation, memory, knowledge) and physical (technical skills), rather than communicative or relational ones. The solutions to the puzzles can lead directly to the solution for the exit or may only provide useful elements regarding the escape but require further effort, i.e. identifying or applying the connection between the solution of the puzzle itself and its use; for example, a number may be found but then it becomes necessary to understand what to do with this sequence: use it for the lock, rather than adding it to another number or transforming the numbers into letters of the alphabet to find where the key is hidden.. Some solutions can be used immediately, others come in handy later, so they represent something to keep and use when needed. In the setting of the development nothing is left to chance, therefore nothing is inserted arbitrarily into the environment. Every element, whether fixed or mobile, must be considered potentially useful; in fact, due to its characteristics, position or functioning, it exerts an interest in the possible physical or rational connection with other available elements. The individual puzzles together with the progressive solutions and the progress along the path help to stimulate the search for new knowledge or consolidate previously acquired knowledge, allow the development of reasoning and promote technical skills.

The value of an ER in terms of learning does not end with passing the tests encountered and the end of the path but finds further consistency only after the exit in being able to receive feedback. In addition to this, a score can be applied based on the time taken and the errors made, thus allowing a ranking to be drawn up.

A valid application strategy includes a structured debriefing session, with or without video support, for a guided re-elaboration of what happened. In fact, it is well known that after each experiential activity it is advisable to ensure that a debriefing takes place; this also applies in the case of ERs for which dedicated sessions

can be activated [8]. A structured and guided debriefing is an important strategy for engaging students in learning and is relevant even in simulated training. It is during such a debriefing that the players (as the learners), even in the case of a CER, are made aware of the learning that occurred during the course of the game; furthermore, they are helped to make connections with previous knowledge and in general with the development of skills in which the specific ER fits. ERs still represent, to some extent, a novelty; most of the available literature in fact focuses on describing their implementation and management rather than on analyzing the effects on those who experience them–in other words, the participants. Those who study changes in ER players state that following these activities, an increase in knowledge and enhanced learning skills are noticeable in adult subjects [9].

The design of a CER also requires considering the elements described above as valid for a generic ER, adding, or rather adapting, contents, settings and exit solutions to the clinical-care context. The education of nursing students involves a natural evolution in terms of knowledge and skills, but also respect for opportunities for clinical learning and therefore for direct experiences in different clinical contexts. The creation of a CER, if aimed at them, must also take these variables into account and, consequently, require adaptation based on the profile, level and achievable aims with respect to the professional area of competence and the year of the student.

Participating in a CER as a nursing student means living an experience that represents a stimulating resource for individuals' learning. If we then consider that the participants are adults and the learning process coincides with concrete interests (represented in this case by escape) as well as educational-professional ones, students are put in a position to learn as they are placed in real situations (involving their physical presence) and not purely theoretical ones [10].

Thus, the design of an ER presents some standardizable and common elements, regardless of the game theme; however, customized designs offer more value than large-scale products. It would be appropriate to know the characteristics and training needs of the participants, even more so when an ER takes on an educational purpose [11]. Knowing and using the participants' previous clinical experiences represents a particularly useful assessment phase in order to select objectives and work out ways to achieve them.

Developing a CER requires clinical knowledge and a wealth of technical skills that guide the design and creation of scenarios and riddle, suggesting puzzles, pitfalls and escape routes. Key figures in the implementation of CERs include developers, clinical experts and tutors, who are in charge of the students' learning process.

It is well known that competitive contexts push people towards overcoming difficulties and limits dictated by the knowledge they possess [10]. The development of critical thinking, an orientation towards problem solving and teamworking skills together with creative talent summarize the decisive elements for overcoming crises in different working contexts; consequently, education should also cover these competencies, thereby enabling students to experience and develop them.

The development of some skills such as those indicated above can be supported by traditional strategies but also by innovative, original and apparently less stressful ones. With ERs it is possible to enable students to develop transversal skills such as communication, leadership and teamwork. Moreover, games, unlike other more traditional activities aimed at learning, have the power to arouse positive emotions capable of expanding cognitive resources and are able to improve the level of attention, promoting decision-making and problem solving [12].

Aim

The main aim of the chapter is to summarize our experience regarding the CER.

Material and methods

There were considered some elements on designing a CER planned with in-person methods, suggesting that material and human resources should be taken into maximum consideration: the drafting and sharing of game rules, the winning criteria and any scores to be attributed together with the criteria for proceeding. Last but not least, the path must be defined, the different ways of exiting the rooms and environmental safety. Finally, it will be necessary to take care of the technologies to be used and the documentation to support the implementation.

To participate in a CER, it may be beneficial to register, perhaps via a link. This can be open or linked to groups of students, in which case it is advisable to use temporary or fixed access codes for compilation. In order to facilitate the organization, it is advisable to activate some sort of pre-registration at least one month in advance of the opening date of the CER. In this way, students are allowed to reflect in advance on the learning aims, and define the composition of the teams, which usually occurs autonomously. Each individual team is usually made up of 5 members, one of whom plays the role of team leader; it is advisable for the groups to also investigate the availability of a reserve figure, in case one of the team members is unable to participate.

The name of the team is communicated by interested parties at the time of registration. Access is free and participants must attend the operational briefing 30 minutes before the booked time. The entire process lasts approximately 60 minutes.

During the operational briefing, the rules for gaining access to the rooms, the functioning of some devices, the security measures of the entire route (for example, rapid opening of the doors, which are never completely blocked) and the options available for requesting support are shared with the staff. As explained at the time of registration, it is recommended to wear comfortable clothes compatible with the expected scenarios. On this occasion, the methods for attributing any points and the 'penalty' measures such as in the event of necessary unlocking with a guided exit from the room or in the case of damage to the setting or devices are declared. Penalties can be of a temporal nature (addition of minutes to the escape timing) rather than material (a beneficial object is removed) or sensitive (obligation for a member to wear a sensory or movement deterrent/limiter) for the rest of the route. Clear and shared instructions must be provided to participants regarding the use of the various devices. If video recordings of the activity are planned (for example for the debriefing), specific consent must be prepared for the participating students as per current legislation.

It is possible to design the evaluation at two levels: one of a playful nature, which can result in a score that is useful for defining the position in a ranking, independently of the evaluation of learning; the other is of an educational nature, more in the form of formative feedback than a summative evaluation. As already reported, the team that takes the least time to complete the entire course wins. The main criterion is therefore temporal; however, variants and integrative elements can be introduced that, for example, take into account transversal aspects and meta-competences. Examples of team performance evaluation sheets include the role of the team leader, the involvement of all group members, unforeseen and original strategies for solving problems or puzzles, resource management. If unblocking aids or similar are provided, these are associated with a time penalty that impacts the final result. For example, in the case of an unlocking aid, five minutes are added to the total time taken; the same penalty applies if objects that should have been kept and delivered at the end of the route are broken or left behind in a room. This situation could include the breakage of a test tube with a blood sample taken from a mannequin, or the forgetting of a radiological report or a card showing the trend of vital parameters. In some cases, bonuses are foreseeable, which can be spent at certain stations; this mechanism is then used to identify critical points or difficulties to highlight during the debriefing session.

Each ER, as conceived by the developers with all its different aspects, is characterized by a variety of necessary resources. The same ER could, however, be

designed with different levels of quality, realism and immersion–choices guided in particular by the set objectives. Many ERs that can be practiced today in various countries are identified as recreational activities available for a fee and subject to commercial logic; consequently the resources vary based on the interest and user base, the possible investment, sustainability and maintenance over time There seems to be no evidence or described experiences of ER recycling available yet regarding locations, scenarios and materials.

To activate an ER, a suitable environment in terms of size and division of spaces must be designed, one that is easily accessible, free of architectural barriers, and possibly subdivided into small confined areas that can be closed off by doors or elements that restrict the passage if not open. Depending on the location, it could be an environment dedicated to the activity (for example, a permanent display of the ER) or adapted (e.g. a classroom). Regardless, the environment should meet the requirements for creating a route. The rooms can remain unchanged, and only the elements aimed at the gaming activity need to be added, or they can be completely adapted with respect to horizontal (floors) and vertical (walls) characteristics and present furnishings, various objects or devices. In particular cases, the scenario can benefit from real or simulated locations already prepared for other purposes; an example of this is the implementation at a real simulation centre in the healthcare sector. The possibility of setting up a CER directly in a clinical simulation centre offers various opportunities and advantages: a) the scenario is ready for specific use and therefore usable without requiring major modifications; b) the centre is usually equipped with an audio/video system through which the game master can control and manage the live proceedings; c) the location is mostly characterized by a series of rooms (simulation rooms) that can easily be adapted to the CER route; d) in most cases the centre is equipped with a debriefing room where the final reflection session on the activity carried out can be held. In this context, it is plausible to think that CERs are identified with a particular form of simulation.

As previously reported, the ER can be developed in a single room with different stages within it or be divided into multiple rooms located in one or more buildings. Single-escape room CERs are more developed in Asia, according to the study by Nicholson [6].

The CER is characterized by the creation of a one-way path with clinical scenarios in the case of both adjacent and communicating rooms (Photograph 1), through which a sequential path is created, and in which the rooms are non-communicating and distributed along a corridor resulting in an open model (Photograph 2). In this last case, where entry and exit from the room coincide (same door), the developer will have to take into account the necessary indications, human resources and

technologies to ensure the entry, the closing and the consecutive exit, thus allowing participants to follow the path. The logistical characteristics of the setting influence these design choices. Before the players enter, they are informed through a diagram or plan about the characteristics of the itinerary to be undertaken.

In order to guarantee exit from the single room only after solving the puzzle, different types of locks are used (Photograph 3); they can be key and numeric combinations. Each exit door can have one or more padlocks depending on the expected level of difficulty and consequently on the number of physical and non-physical passes to be found for the exit (for example the key to a padlock rather than a phone call to the simulated care-giver capable of opening the door from the outside). They can be considered tests or puzzles in amounts equal to the number of participants in order to promote the active participation of all members of the team and enhance the contribution of each one. Each developer can set a maximum time spent in the room, at the end of which support interventions are provided by the gamemaster to unlock the static nature of the game.

In the case of both dedicated and adapted environments, the safety rule applies. No door must ever be completely and irreversibly blocked. The closing methods must still leave the possibility of rapid opening if necessary. Quick-opening techniques must be illustrated at the briefing and repeated before the start of the game. An applicable strategy is to adapt each closure with ring devices fixed with Velcro (Photograph 4). This technique allows opening with key or combination, offers a certain resistance to movement; however, if necessary it absolutely guarantees rapid opening by pulling in any direction. It can be easily repositioned and removed at the end of the activity; it is also reusable and has a relatively low impact cost. A supervisor throughout the activity guarantees every form of response in the case of need with respect to escape routes or inconveniences with the devices and materials made available. Before starting, however, all information relating to environmental and health safety will be provided (behavior in the event of fire, useful telephone numbers, internal emergency system).

In an ER, students usually have to find the physical or other key to open boxes, cabinets or doors. This involves having to look for clues and work on their characteristics, meaning or relationships. They can be called upon to solve physical or graphical puzzles, identify codes or build something. There may be different activities with which players will interact during the gaming experience. Puzzles to solve may require individual or a mixture of individual and multiple effort (on the part of each member) or involve teamwork. Alongside the use of technologies, it is always possible to refer to techniques or types of puzzles, which for feasibility and sustainability can be used at various levels and even by novice ER developers.

Below are some examples of puzzles or situations characterizing the discovery of the object or the escape solution. Sometimes the solution is found simply by tidying up (Photograph 5).

PUZZLE: The composition of a puzzle whose pieces are made to be found by the students in a given place can directly offer the solution, or part of it, to open the passage to another room, or represent the basis through which to solve a specific task reported on the back of the puzzle whose original image does not necessarily have to be of a clinical nature (but could make the team relax and have fun for a moment). The puzzles help to make the gaming experience more interesting and challenging by requiring composition and coordination skills with respect to the contribution of the participants, who can decide how to organize themselves by defining roles and sequences (Photograph 6). This activity should include an adequate work surface in terms of size, height, position and lighting, allowing all subjects to interact and contribute actively, while always guaranteeing access even to people with physical limitations (for example, access to a person in a wheelchair). An application example can be represented by a therapy puzzle, where a therapy prescription is inserted on the back of the original image (depicting characters from famous cartoons): only the total assembly of the tiles can allow complete reading with the indication of the drug to be prepared and this will allow the process to continue.

INSIDE BLACK BOX: In order to stimulate the curiosity and dexterity of the students, along the lines of the mystery box attributable to the Montessori method, an operational puzzle can be envisaged that exploits the characteristics of an *Inside Black Box*, through which the participants experiment with their sensory, tactile and imaginative abilities [13]. Through this system, the memory of what has been learned, seen and felt in classroom, laboratory or clinical settings is stimulated; this represents an opportunity for involvement and leaves room for creativity. At the same time, this strategy can stimulate ideas for learning or in-depth knowledge of the devices used in clinical care. The method essentially involves a closed box with two narrow openings through which students can insert only their hands and search among the objects available inside for the components of a specific device that must be reconstructed without relying on sight (for example, setting up a device for dispensing oxygen therapy with bayonet coupling) (Photograph 7). Confounding elements can complicate the mandate or, vice versa, ease the tension (for example, with the introduction of children's objects, kitchen accessories or acoustic toys). At the end of the set-up, you are asked to deposit the device in a space accessible via a one-way door on the back of the box, and this step can directly (mechanically/electronically) or indirectly (sheet with written instructions) provide the necessary element to continue.

DISTORTED SKILL TABLE: The challenge to be faced in this case consists in recovering the information or the physical key by passing a test of a dual nature, i.e. cognitive and technical. To be precise, students are invited to carry out a specific mandate despite the momentary distorted abilities generated by the setting and materials made available to solve the puzzle. The example could consist of having to follow instructions regarding a medication prescription received via audio through headphones and characterized by environmental acoustic disturbances. The prescription requires the application of calculations in non-optimal conditions, and the preparation of the simulated medication can only take place through a vision limitation system. This last part can be activated through a box with a blurred lens (Photograph 8a) or through the use of simulators of visual and/or movement deficits such as glasses reproducing diabetic retinopathy or gloves that generate hand tremors (Photograph 8b). Only the achievement of administration through the correct route can enable the solution and therefore the exit from that room.

CROSSWORD PUZZLE: Among puzzle games, crosswords that require you to insert words into a given grid are very well known and widespread. In this case, participants must solve one or more free-form crosswords created ad hoc characterized by topics that can be traced back to clinical pictures or healthcare problems identified by characteristics of the CER or relevance in the real world. Once students have completed the compilation, using the instructions provided, they can obtain the code or instructions on how to open the exit route. The process may involve individual work for each member, or working in pairs, with the option or not of being able to access consultable sources. To create crossword puzzles, educators can rely on specific generators available online, sometimes for free; they require upstream planning with the prior formulation of the definitions to be included. They can benefit from customization and be written in multiple languages. This activity allows you to share thematic knowledge, request help from other team members and reformulate priorities based on the evolution of the game (Photograph 9).

e-STATION: The estimate symbol (℮) is associated with masses or volumes, as can be read on the packaging of products marketed in European Union (EU) countries, to certify compliance with the criteria defined for estimating the content. In the context of assistance, it is sometimes necessary to estimate water balances, body weights, heights or other measurements necessary for the assessment. Even in an ER, situations can be introduced that involve the estimation of volumes or weights (Photograph 10), whose numerical value represents the unlocking code of a padlock (for example, a non-graduated bag with 500 ml of liquid inside, once the content has been estimated, offers a numerical solution equal to five-zero-zero as an unlock for the exit).

EVIDENCE POCKET: In a CER, puzzles can be introduced whose resolution requires an evidence-based approach starting from a real situation (Photograph 11). For example, scientific articles are provided on a specific research question and participants are asked to identify the best solution to the problem by consulting the available bibliography; the exit pass may be included in the selected article (for example, p-value of statistical significance reported in the results or emphasized in the conclusions). Themes or topics that may have already been addressed in the classroom or that characterize clinical internship activities are selected.

MANNEQUINS: In the rooms, low- or high-fidelity mannequins (therefore life-size human simulators) or procedural simulators (consisting of simulated anatomical parts) can be placed, on which to act to identify the escape mode. In particular, keys or codes are inserted into anatomical locations that can be explored during a physical examination, when posture changes or by activating prevention or intervention measures in the event of a health emergency. For example, a paper code can be inserted into the mannequin's mouth and this will only be found in an attempt to guarantee the patency of the airway at a given moment. Another case is represented by the key placed in the diaper of a mannequin simulating a bedridden and non-self-sufficient person who complains about the loss of urine in the absorbent device worn; only attention to the comfort of the simulated person will be able to offer the element for the way out. Technical tests on specific trainers are also considered, such as the placement of a peripheral venous catheter or blood sampling via venipuncture (Photograph 12). The carrying out and conclusion of the envisaged mandate leads to the envisaged pass (such as a numerical code inserted into the medication applicable after positioning the venous catheter or glued onto the syringe containing the correct drug to be administered).

In order to implement an ERC, it is necessary to have a set of figures to pave the way without losing useful elements and data for a possible ranking:

1. The leader is responsible for welcoming, preparing and training participants, explaining and illustrating the rules to be followed and teaching safety principles.
2. The controller, whose job it is to check the correct direction and sequence of the rooms, especially if they are not physically in sequence for logistical reasons. He/She assists the game master, without interfering with the game, by observing and noting elements and data that will be useful in formulating the final score.
3. The unscrambler, who takes care of tidying up rooms, materials and renewing consumables, including rearranging keys, passes and locks before the next team arrives, especially if the frequency of access is concentrated over a period of time.

4. The debriefer, who leads the debriefing session at the end of the course and offers a set of take-home messages that can be developed for the context of the game and based on the actions, reactions and experiences of the participants.
5. The gamemaster may be assisted by one or more controllers who, without interfering with the game, observe and record, on screen or in person, elements and data useful for the formulation of the final score.
6. The mole, i.e. a member of the team chosen by the gamemaster or introduced into the scenario with the task of interacting with the players only at the remote instruction of the gamemaster or on the basis of specific situational criteria; his intervention can also be activated by radio or telephone or by pre-arranged signals.

The CER can benefit from audio-video technological support capable of allowing control of what is happening in the rooms (alternatively the presence of an employee inside will be necessary); furthermore, the recording, if foreseen, can be used in the debriefing session, as well as providing the developers of that CER with useful elements for improvement. In the event that the CER is activated at an existing simulation centre, this will already be equipped with the necessary systems (Photograph 13). In order to witness the event or collect more details, it is plausible for the participants to use wearable action cameras, ensuring targeted editing only at the end. A sequence of photos can be provided upon exit as a souvenir of the immersive experience just ended, to which a final group photo is added. Each strategy just described must provide the necessary authorizations according to current legislation. Video and photographic recordings by participants are not usually permitted or expected, so as not to reveal the secrets that govern the ER activity itself. From the moment the course starts, when the participants enter the first room, each team is followed and observed in person. The observation makes use of annotation sheets, which at the end can provide the necessary data for calculating the score obtained by each individual team as well as representing a precious source of suggestions for any improvement actions with respect to puzzles, devices, exit mechanisms and levels of difficulty.

Results

Our experience of CERs with third-year students saw clear progress between the first and second edition, in which we managed to implement some improvements compared to the first edition. Furthermore, a more detailed data collection was activated for the second edition. Twelve groups of students signed up for the

second CER, one of which announced it was withdrawing a few hours before the start. Therefore 11 teams participated, one of which was made up entirely of students from the Erasmus project from different European countries and attending the course in that period at our headquarters. For this team, all information, texts and written parts were specifically translated into English in order to facilitate inclusion. Indications were also provided regarding the functioning of some devices used exclusively in the local clinical sites present within the path so as not to generate different levels of difficulty. The routes were prepared together with the assembly of all the materials in the preceding days, and the simulation centre was booked and used for the entire established day. The teams arrived in a staggered manner and participated in the briefing, during which instructions and the rules of the game were shared. Common elements were also provided, such as a backpack with materials that could be used during the journey. The CER took place at CSAF, the Simulation Centre of the Udine Teaching Hospital and the University of Udine commonly used by nursing students for clinical training prior to their internship.

A total of 55 students participated in the CER, divided into 11 teams of five members each. Among the participants, 48 (87.2%) were female; the composition of the teams was found to be mixed gender for six teams (50.0%), while the others included only female students.

To foster a cooperative environment, the composition of the different teams was decided independently by the students, who were asked to give a name to their team. These organizational aspects, as emerged during discussion meetings at the end of the experience, immediately increased their engagement, helping to create a spirit of belonging to the team.

The times recorded by each team were logged. On average it took 56.6 minutes (min 50–max 66), a value that did not differ greatly from what was hypothesized in the design phase. The groups' departures were spaced by at least 15 minutes in order to allow the progressive rearrangement of the scenarios. All situations were addressed and no technical problems occurred, except in one case in which a group, in a hurry, on leaving a room took away with them the key used to open the padlock; immediately a member of the organizing staff took steps to replace it with the reserve one that was already available on site as foreseen in the development phase. There was no damage to the structures or devices, there were no problems for the participants and no injuries during the course. Since the rooms were not completely soundproofed, the voices or excited shouts of the members of the various teams could also be heard several times in the transit corridor at moments of excitement or anger at not being able to find the solution, or vice versa of exultation at having managed to quickly solve the puzzle (Photograph 14). During the course it was also

permissible for students to use smart devices, for example to consult sites, scientific articles or updated data with respect to particular treatments or definitions, rather than to perform calculations. In at least two cases the team leader seems not to have actively carried out his function, but in both cases the rest of the group managed to compensate with proposals, decision-making or autonomous interventions. These elements were then taken up again during the debriefing phase, where they represented a valid basis for reflection. Upon leaving, all the teams immortalized the moment with a souvenir photo at the finish line.

To collect feedback from the students and stimulate reflection on what they experienced, at the end the students were asked to answer freely a question selected from a list of ten in total. The questions were sent using an electronic response collection form guaranteeing the students' anonymity. In total, 37 responses to the questionnaire were received. The table below (Table 1) lists the ten questions, the number of students who chose to answer each one and a sentence that summarizes the content of the answers.

Table 1. Table of questions and themes that emerged from the questionnaire

Request	No. of responses (%)	Theme
What inspired you to participate in the CER?	3 (8.1)	Getting involved
What was the most exciting room in the CER and why?	5 (13.5)	Playing as a team
What was the toughest challenge you faced during the CER?	7 (18.9)	Acting in the dark
According to what logic was the team leader of your team chosen?	3 (8.1)	Having peer leadership experiences
What emotions did you feel during the journey?	3 (8.1)	Feeling suspended between joy and fear
Were you able to have good collaboration as a team? With what strategy?	6 (16.2)	Making your talents available
What climate was created in the team before the start, at the start and at the end of the CER?	3 (8.1)	Moving from tension to harmony
What advice would you give to anyone wanting to participate in the next CER?	2 (5.4)	Listening
Would you recommend that first-year and/or second--year students participate in a CER and why?	2 (5.4)	
Would you like to be involved in designing a CER for first-year nursing students?	3 (8.1)	Perceiving the training scope of the CER
Total	37 (100)	

Legend: CER–The clinical escape room

What inspired you to participate in the CER?

The motivations that pushed the students to participate in the CER are linked to the desire to get involved; in particular, the three students (8.1%) who answered the question underlined the desire to be able to self-evaluate various skills, such as speed in decision-making relating to pharmacological therapy (calculation speed), technical-gestural skills and knowledge possessed in reference to certain 'general' topics.

What was the most exciting room in the CER and why?

A total of five students (13.5%) responded to this question. The rooms of the CER that drew the most enthusiastic response were those in which students were asked to work more as a team in order to solve the exit question. Specifically, the room called 'chain reaction' and the room with the crossword were the ones where the students said they had to resort to greater collaboration and discussion around all the components.

What was the toughest challenge you faced during the CER?

For the seven students (18.9%) who responded to this question, the most difficult challenges were those that required them to act in the dark, especially managing a procedure (such as setting up the therapy or assembling the flow meter) without having direct visual control. This theme also summarizes the sensation experienced and reported by two students who wore the headband with the word to be guessed in the 'chain reaction' room: having to guess a word based exclusively on the clues provided by their teammates made them feel a little 'helpless,' without being in full control of the situation.

According to what logic was the team leader of your team chosen?

The choice of the team leader was based on taking into account the peer leadership skills already demonstrated by that person within the group, both in the strict sense as a team that participated in the CER and in a broader sense. In fact, as reported in one response, the choice of team leader was obvious as one of the team members also held the role of student representative for the third year of the course.

What emotions did you feel during the journey?

The students were suspended between joy and fear in carrying out the CER. The three students (8.1%) who answered the question underlined how the whole experience oscillated between these two emotions: on the one hand, the fear of not finishing the tests in time; on the other, the joy of finding the key for moving on to

the next station. This emotion goes hand in hand, as reported in one response, with the pleasure of being in tune with the members of one's work team.

Were you able to have good collaboration as a team? If so, with what strategy?

Making one's talents available is the theme that best summarizes the answers to this question. In fact, all six students (16.2%) underlined how collaboration within the team was achieved thanks to the fact that each member supported the others, making their talents and their certainties available. The strength and cohesion of the team resulting from each member recognizing themselves as bearers of something 'useful' for the group represented the most effective strategy for overcoming moments of doubt, effectively moderating the perception of difficulty.

What climate was created in the team before the start, at the start and at the end of the CER?

As with the emotions felt, and with respect to the climate perceived in the team, the three students (8.1%) reported an evolution that consisted of moving from tension to harmony. In fact, while at the beginning there was a certain tension in the group linked to the uncertainty regarding what to expect from the experience, by the end of the CER, thanks to teamwork and the awareness of having 'gone out together,' this had given way to harmony.

What advice would you give to anyone wanting to participate in the next CER? Would you recommend that first-year and/or second-year students participate in a CER and why?

From the answers of the four students who selected these questions, it emerged that they would suggest should take their advice and sign up; this experience, in fact, represented an excellent opportunity to test one's ability to work in a team while recognizing how important it is to be able to find mediation across conflicting opinions. This element also represents the main reason why students would suggest to their classmates from previous years that they should participate in a CER.

Would you like to be involved in designing a CER for first-year nursing students?

Perceiving the educational significance of the CER emerged as the main reason why third-year students would be willing to plan an experience of this type for their classmates. One student in particular underlined how he would consider it useful, after having designed the CER, to also organize debriefing sessions with students from previous years with the aim of sharing both the doubts and difficulties experienced and the awareness gained after the experience of the CER (Photograph 15).

Discussion

Two online CER editions and two physical ones have been activated since 2020 in the Udine University Bachelor of Nursing degree. The remote ones were dedicated to second year students, while the in-person ones were for third year of the course students. For each edition a logo was created, printed and provided to each participant (Photograph 16a). Participation in the CER was voluntary and recognition of the time spent as an elective activity was expected.

Both editions were developed by tutors and teachers of the Nursing degree after consulting literature on the topic and reflecting on what is available online regarding international ER experiences, even if not necessarily of a healthcare nature. The editions were carried out at the reference simulation and higher education centre (Centro di Simulazione e Alta Formazione di Udine–CSAF), thus exploiting locations already available with a clinical setting. The availability of healthcare-related devices and equipment allowed a greater degree of experiential immersion (Photograph 16b). The structure made it possible to generate a mixed-path ER, i.e. partly open, partly sequential, while still defining a starting point and an arrival point.

We have fulfilled several learning aims in these two editions, in particular regarding the need to always guarantee video or in-person control for all participating teams. Furthermore, we realized that it is essential to provide logistical and material recovery support in numbers adequate for the planned shift of game, and therefore for the number of teams registered and the time interval in which to carry out this activity. We have had confirmation of the surprising, entertaining and at the same time applicative impact of some puzzles or situations reconstructed in the rooms. In particular, we have detected greater interest and group involvement in the rooms containing Inside Black Box, Distorted Skill Table and Crossword Puzzle. However, these perceptions should be confirmed with appropriate data collection in order to accumulate evidence.

Each degree in healthcare sciences may activate its own escape creativity group for the creation of a CER and the involvement of students in its development and management with a view to activities intended as peer-to-peer education aimed at students from previous years. The design of a CER requires, as described above, knowledge of the contents of the disciplines characterizing the thematic area of the game (story, situation or clinical case). A first step could consist in the creation of a digital CER to then be transferred to a real context This first step requires minimal economic and material resources, although it does require development time commensurate with the knowledge and expertise of the developers. The digital version can be created very simply through platforms already available at the organization

(for example, Drive or Forms) and prepared on the basis of consecutive modules with passage blocks. For the second phase, which is probably the most ambitious and impactful one, set in a real location, it is suggested to explore the availability of simulation centers capable of hosting these activities and providing support in terms of logistics, devices, audio/video systems and, if necessary, simulation instructors to conduct targeted debriefings.

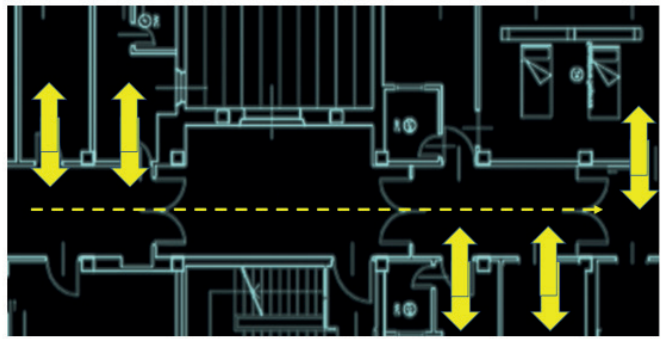
Conclusions

An activity considered in its digital version involving students during the period of social isolation due to the pandemic has become a structured learning opportunity to be undertaken in person. After an initial rather empirical approach supported only by reading some documents available online, we have continued the initiative with an approach based on the available evidence. Hence a literature search for studies regarding the method and contents of CER has been conducted adapted to address the training needs identified.

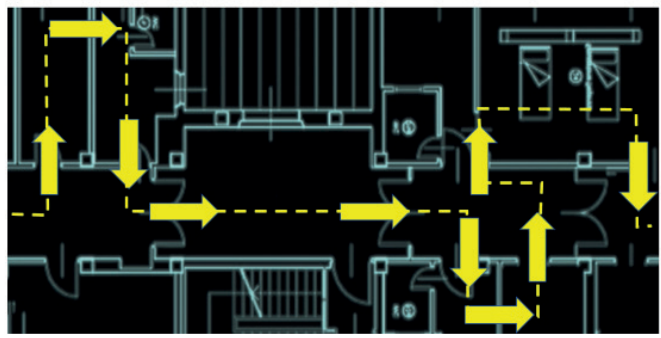
The interest on the part of the students and the success of the two editions have led to the consolidation of a small group of tutors and teachers interested in further developing the educational initiative, seeking new elements of improvement and starting to investigate publications on the topic more assiduously. We are currently involving some third-year students in a project called Simulation Experience, which includes, among other things, their creation of a CER for a peer-to-peer approach. At the same time, other versions of a digital CER have been implemented to support laboratory learning activities.

This propensity led us to ask ourselves what data it would be useful to collect in order to contribute to fuelling new reflections and knowledge about the CER, highlighting the need to perhaps systematically introduce interviews with participants in order to gather their experiences. Having considered the potential of escape rooms and the curiosity for novelty, some interest has also emerged on the part of clinical professionals who are starting to see CERs as a possible future strategy to support continuous training. As already hypothesized by Nicholson (2015), perhaps we will have to rethink ERs by attributing to them a broader and more flexible meaning with the transition towards escape games (EGs). Notwithstanding the introduction of advanced technologies (for example, virtual or augmented reality), in-person team play offers an atmosphere and harmony that are difficult to achieve and experience remotely or only through IT devices and multimedia connections.

Photographs of the students' work in progress.



Photograph 1. Map of a one-way path with clinical scenarios

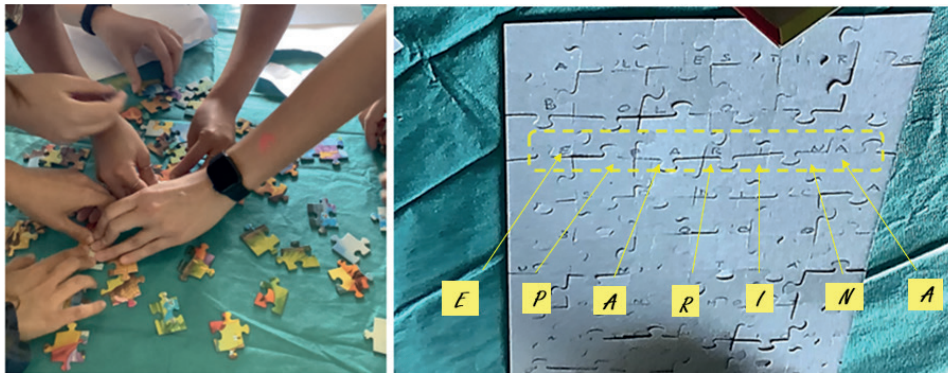


Photograph 2. Map of a sequential path with clinical scenarios

Photograph 3. Types of locks: with key (left) and with numeric combination (right)

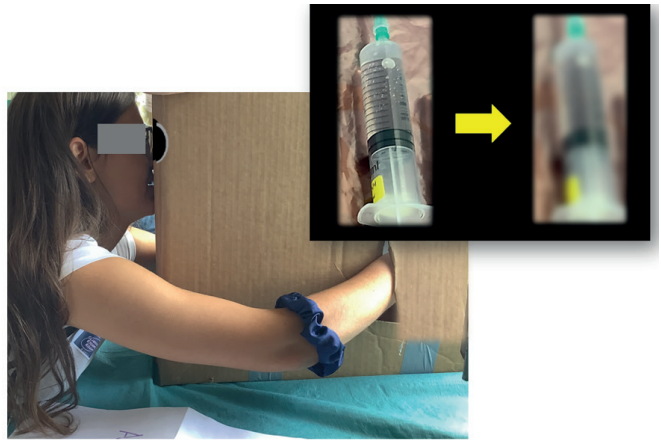
Photograph 4. Closure with ring devices fixed with *velcro*

Photograph 5. Example of puzzles: the solution is found by tidying up



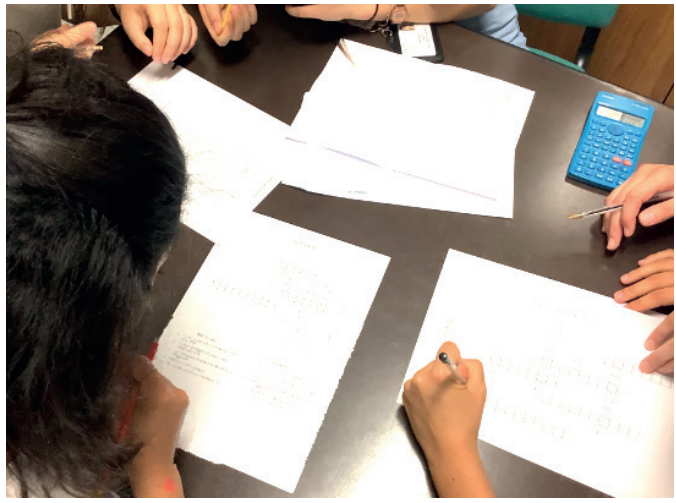
Photograph 6. Example of puzzle with key solution on the back
(*Prepare a bolus of heparin 3000 units*)

Photograph 7. Example of black-box: setting up a set for dispensing oxygen therapy with bayonet coupling



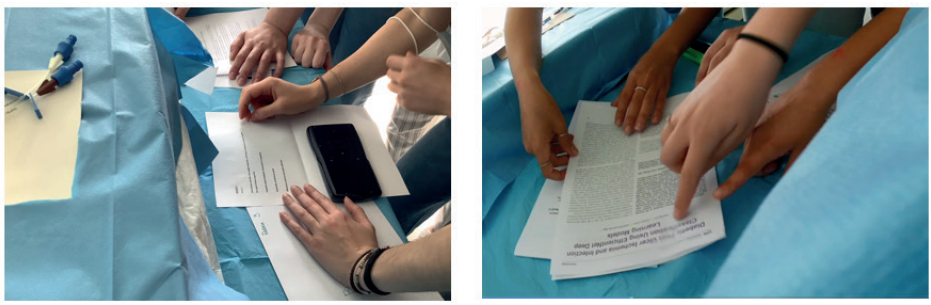
Photograph 8a. Box with a blurred lens: left is normal vision, right is student vision

Photograph 8b. Glasses and gloves used to reduce students' vision and sensitivity



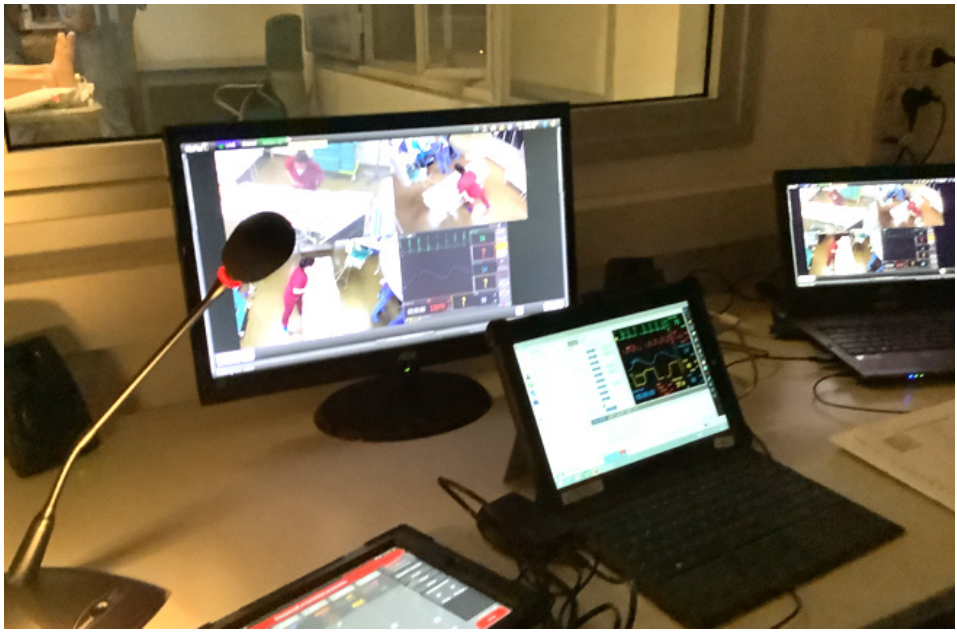
Photograph 9. Students solving crossword puzzle

Photograph 10. Example of ℮-station: estimation of volumes



Photograph 11. Evidence Based scenario

Photograph 12. Scenarios with high fidelity mannequins and skill-trainers



Photograph 13. Directing system within a simulation centre

Photograph 14a. Logos of CER first and second edition

Photograph 14b. Two moments of the oxygen therapy scenario

Photograph 15. Students at work in a scenario

Photograph 16. Students collaborate in solving a clinical question in a scenario with low-fidelity mannequin

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The role of virtual medical simulation in teaching and in developing the soft skills of nursing and medical students

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Abstract

Introduction: Medical simulation is an important training tool used in the medical profession. Traditional teaching methods are not sufficient in the face of rapid changes in medicine. Body Interact (BI) is an interactive VPS software that can be operated via a touch interface. BI provides an interesting and dynamic learning environment. Although this tool has many advantages, there is still a need for further research to optimize its use.

Aim: The purpose of this study was to analyze the impact of VPS training in small groups on perceptions of individual learning and curriculum integration among nursing and medical students.

Material and methods: Baseline perceptions of individual learning process and curricular integration were assessed using a 27-item pre-session questionnaire. Students subsequently participated in small-group VPS training sessions lead by a clinical tutor and then completed a 32-item post-session questionnaire, including 25 paired items. Pre- and post-session responses were compared to determine the impact of the small-group VPS experience.

Results: Analysis of the differences between the pre-session and post-session Assessments of curricular needs showed a negative difference between the results identified in the group of students doing Bachelor's course in nursing a minimal difference, approaching zero, in the group doing Master's

course in nursing and a highly positive difference in the group doing Master's course in medicine. Statistically significant post-hoc differences were shown between the groups doing Bachelor's course in nursing and Master's course in medicine.

Conclusions: The survey showed that nursing students had high expectations for simulation training that allowed them to develop soft skills and improve their professional skills. The nursing group was more satisfied with the level of training than the medical group.

Key words: virtual patient simulator; curricular integration; simulation training; clinical education; high-fidelity simulation

Introduction

Medical simulation is an advanced teaching tool and has for many years been used as an important aid in the training process in health professions. The traditional teaching models, which mainly focus on the transmission of knowledge, appear to be insufficient given the increasing pace of change in medicine. Initially, simulations applied simple phantoms, and that was followed by advanced patient simulators, software for high-fidelity simulation systems and virtual patient simulators (VPS) for clinical settings, which created opportunities for communication and virtual patient assessment [1, 2]. Body Interact (BI) is an interactive VPS software package that is operated via a touchscreen interface. It can be used without any additional medical equipment, and without a model, actor or the simulated patient. Like high-fidelity simulators (HFS), the VPS provides an opportunity to apply acquired knowledge in a low-risk setting and to integrate the knowledge of the basic science with clinical competences [3]. It provides an interesting and dynamic learning environment in which students can take on the role of a medical professional managing a virtual patient, making decisions and administering therapeutic interventions. Furthermore, it allows students to consolidate their skills needed for performing the medical interview and physical examination, and to make real-time observations of the medical procedures performed. Although the tool presents considerable advantages and seems to be attractive for educational purposes, there is a lack of Polish research investigating the VPS and its practical value in education of medical and nursing students [4, 5].

Material and methods

The present study used the data collected in the original article "The impact of small-group virtual patient simulator training on perceptions of individual learning

process and curricular integration: a multicentre cohort study of nursing and medical students" BMC Medical Education (2022) [6]. The project was conducted in the Medical Simulation Centre at the University of Rzeszów. The group of participants of the Polish part of the project included 76 medical students and 119 nursing students doing their respective courses at the University of Rzeszów. The research project was conducted in the frames of three courses: Physical examination and Intensive care (groups doing Bachelor's course and Master's course in nursing, respectively) as well as Neurosurgery (group doing Master's course in medicine). The students perceptions were collected using the VPS Study Instrument previously validated and published (Mestre et al.). The pre-session questionnaire–U0–consisted of 27 questions from U0.1 to U0.27 was completed via an online form. A detailed description of the table and questions are in original article Mestre and Muster et al. (2022) [6]. After the session, participants completed the post-session questionnaire–U1 consisted of 32 questions from U1.1 to U1.32 (Mestre et al.). The research tool was divided into three parts making it possible to collect data for the following dimensions: 1) Assessment of individual learning difficulties of the specific students; 2) Assessment of curriculum related needs; 3) Perception of the VPS as a learning aid intended to fill in the educational gaps. The pre-session questionnaire contained 27 items (part I and II), whereas the post-session questionnaire consisted of 32 items (part III and IV). The two tools contained 25 paired items, to enable comparative analysis of the pre- and post-session responses as well as assessment of the impact produced by the VPS experience on the learning process of nursing and medical students in Poland. Two items were exclusive to the pre-questionnaire (U0.7 and U0.8) and seven items were exclusive to the post-questionnaire (U1.26 to U1.32). The study protocol and implementation of the questionnaires have been described in the main article [6]. Approval of the bioethics commission was acquired before the study began.

Statistical analysis

The statistical analyses were computed using IMB SPSS STATISTIC, version 24iR. The reliability coefficient of the questionnaire was assessed using Cronbach's alpha, and statistical significance was determined using the Kruskal-Wallis test, which rejected the null hypothesis at $p < 0.01$. The analyses took into account the paired items that were considered statistically significant when the null hypothesis was rejected. The remaining unpaired items were subjected to descriptive analysis and correlations were determined using Pearson's correlation coefficient.

Results

A total of 195 students of the University of Rzeszów participated in the study, including 119 nursing students and 76 medical students. The survey questionnaire was used to obtain answers to questions about the learning process and the approved curriculum for both courses of study.

Pre-session questionnaire

One of the first item (U0.2) asked about a focus on theory in the educational process, and produced an average score of 5.72 on a 7-point Linkert scale, and medical students were more likely than nursing students to report they focused on theory in their learning process. Similar results were obtained for the item relating to the balance between the theoretical knowledge and its practical application in the course of study (U0.3), and nursing students rated their course as more balanced ($M = 4.71$; $SD = 1.44$) compared to medical students ($M = 4.91$; $SD = 1.48$). Nursing students emphasised that through the training they developed soft skills, including communication skills, and gained the ability to build a professional image, and to perform activities at work with confidence, and they acquired skills needed for group management and conflict resolution (U0.4, U0.5, U0.6). Additionally, they were more likely than medical students to indicate that the simulation activities and clinical experience were appropriately matched to their level of knowledge ($p < 0.001$) (U0.7, U0.8). Integration of the educational curricula was also assessed and the scores on a 7-point Likert scale ranged between 2 and 7. According to the students' rating, (U0.9) the nursing courses were more integrated than the medical course ($M = 5.84$; $p < 0.001$). Both groups showed high expectations related to the VPS training as regards its usefulness for increased learning effectiveness ($M = 5.56$; $SD = 1.31$), and as a tool in the clinical decision-making process ($M = 6.55$; $SD = 1.10$), which also makes it possible to modify the therapeutic process, where decision-making errors provide opportunities for applying different procedures and can be transformed into a constructive learning process ($M = 6.8$; $SD = 1.01$) (U0.10, U0.11).

The effectiveness of the VPS training was assessed based on students' responses to paired items, provided before and after the simulation session. The results of the survey demonstrated significant improvements in the learning process, especially in the use of theoretical knowledge for practical clinical application ($p < 0.001$), and development of communication skills ($p < 0.001$) as well as group management and conflict management skills ($p < 0.001$) (U1.3–U1.6). It is noteworthy that students who selected the lowest ratings before the VPS session tended to selects the highest

values after the session, which resulted in a negative correlation between the scores before and after the VPS training ($p < 0.001$). Gains were found in the opinions about the integration of educational curricula, and positive effects were shown in the evaluation of opportunities for practical learning in specific clinical situations, the possibility to participate in medical simulation, and to improve communication skills as well as conflict and group management skills ($p < 0.001$). The assessment also showed that the VPS training favourably affects professional confidence ($p < 0.001$) (U1.12). Overall impressions of all those participating in the VPS training sessions were positive. The students reported high levels of satisfaction with the use of the VPS for learning ($M = 6.68$; $SD = 1.02$), with the use of the technology resource ($M = 6.78$; $SD = 1.01$), and the BI VPS itself ($M = 6.71$; $SD = 1.02$) (U1.16, U1.17) It appears that the VPS, used as an educational tool, affects the learning process by making it possible to fill in the gaps in one's knowledge ($M = 6.48$; $SD = 1.04$), to obtain feedback related to the learning process ($M = 6.69$; $SD = 1.00$), and to identify weaknesses in one's competences ($M = 6.70$; $SD = 0.90$). The VPS also provided opportunities to practice various clinical decision-making strategies, and to see consequences of such decisions ($M = 6.58$; $SD = 1.01$); owing to this it was an effective tool for correcting erroneous clinical decisions and learning from one's own mistakes ($M = 6.8$; $SD = 0.80$). According to the study participants, the VPS was an important teaching tool ($M = 6.62$; $SD = 1.01$) which allowed them to develop and improve communication skills ($M = 5.32$; $SD = 1.30$), decision-making skills ($M = 6.67$; $SD = 1.01$), self-directed learning skills ($M = 6.47$; $SD = 1.03$), as well as reasoning and critical thinking ($M = 6.76$; $SD = 0.85$), which as a result allowed them to get constructive feedback ($M = 6.76$; $SD = 0.86$), made it possible for them to handle specific clinical cases ($M = 6.75$; $sd = 0.88$) and to gain better understanding of the complexity of the therapeutic process in specific clinical situations (U1.26–U1.32).

Table 1 presents descriptive statistics for the results achieved by the students in the five measurements: *I Assessment of weaknesses in individual student learning–PRE, II Assessment of curricular needs–PRE, III Assessment of weaknesses in individual student learning–POST*, *IV Assessment of curricular needs–POST*, *V Perception of the VPS as a learning tool and to fill gaps in student learning;* it also shows differences in the PRE and POST measurements, i.e., III–I and IV–II. All the results are shown separately for three groups.

The results of the *Assessment of weaknesses in individual student learning* before and after the training differed significantly in each of the investigated groups: physical examination ($p = 0.006$), intensive care ($p = 0.001$) and neurosurgery ($p = 0.001$). The mean Post-session results were higher compared to the Pre-session results in each group (Table 2).

Table 1. Overall results acquired by the students

Likert Scale [1–7 points] N		Basic descriptive statistics							
		χ	Me	Min	Max	Q I	Q III	SD	
Bachelor's in nursing									
Pre	I	51	5.31	5.27	2.20	7.00	4.80	6.13	1.05
	II	51	5.93	6.00	2.58	7.00	5.58	6.75	0.93
Post	III	51	5.63	5.67	3.87	7.00	4.93	6.33	0.91
	IV	51	5.78	6.00	2.67	7.00	5.17	6.58	1.04
	V	51	5.99	6.00	4.27	7.00	5.20	6.80	0.83
Difference	III–I	51	0.32	0.33	–2.04	2.60	–0.07	0.67	0.79
	IV–II	51	–0.15	0.00	–2.00	2.58	–0.50	0.17	0.85
Master's in nursing									
Pre	I	68	5.08	5.17	1.53	7.00	4.40	6.00	1.12
	II	68	5.66	5.92	2.20	7.00	5.08	6.38	0.99
Post	III	68	5.37	5.47	2.93	7.00	4.60	6.07	1.04
	IV	68	5.74	6.00	3.33	7.00	4.96	6.67	1.07
	V	68	5.97	6.17	3.20	7.00	5.43	6.67	0.90
Difference	III–I	68	0.30	0.25	–1.27	2.80	–0.13	0.53	0.71
	IV–II	68	0.07	0.08	–2.25	3.38	–0.25	0.33	0.81
Master's in medicine									
Pre	I	76	4.15	4.07	1.73	7.00	3.23	4.90	1.14
	II	76	5.88	6.08	2.92	7.00	5.21	6.63	0.92
Post	III	76	4.49	4.30	2.20	7.00	3.63	5.40	1.19
	IV	76	6.40	6.75	2.58	7.00	6.13	7.00	0.97
	V	76	6.58	6.80	3.07	7.00	6.53	7.00	0.69
Difference	III–I	76	0.34	0.20	–1.73	3.20	–0.20	0.80	0.82
	IV–II	76	0.52	0.67	–4.00	2.75	0.00	1.00	1.06

Legend: – number of observations; χ–arithmetic mean; Me–median; Min–minimum; Max–maximum; Q1–lower quartile; Q3–upper quartile; SD–standard deviation

Table 2. Comparison of the results in the Assessment of weaknesses in individual student learning, Pre and Post, separately for three groups

	Pre I		Post III		t	p
	χ	SD	χ	SD		
Bachelor's in nursing	5.31	1.05	5.63	0.91	–2.89	0.006
Master's in nursing	5.08	1.12	5.37	1.04	–3.43	0.001
Master's in medicine	4.15	1.14	4.49	1.19	–3.62	0.001

Legend: t–value of Mann-Whitney U test; p–probability value, χ–arithmetic mean, SD–standard deviation

A comparison of the results of the pre- and post-session *Assessments of curricular needs*, separately in three groups, showed significant differences in the group of medical students ($p < 0.001$). The participants in this group acquired higher mean results in the assessments after the training, relative to the measurement before the training (Table 3).

Table 3. Comparison of the results in the *Assessment of curricular needs.* Pre and Post, separately for three groups

	Pre II		Post IV		t	p
	χ	SD	χ	SD		
Bachelor's in nursing	5.93	0.93	5.78	1.04	1.27	0.212
Master's in nursing	5.66	0.99	5.74	1.07	–0.74	0.463
Master's in medicine	5.88	0.92	6.40	0.97	–4.26	< 0.001

Legend: t–value of Mann-Whitney U test; p–probability value, χ–arithmetic mean, SD–standard deviation

The differences in the results of pre-session and post-session *Assessments of weaknesses in individual student learning* were compared in the three groups. The analysis showed no statistically higher or lower differences between these assessments in any of the groups relative to the remaining groups ($p = 0.939$) (Table 4).

Table 4. Comparison of the differences between the Pre-session and Post-session Assessments of weaknesses in individual student learning

	Bachelor's in nursing		Master's in nursing		Master's in medicine	
	χ	SD	χ	SD	χ	SD
III–I	0.32	0.79	0.30	0.71	0.34	0.82
p	F = 0.06; p = 0.939					

Legend: F–value of Fischer's F-test (one-way analysis of variance ANOVA); p–probability value, χ–arithmetic mean; SD–standard deviation

Analysis of the differences between the pre-session and post-session *Assessments of curricular needs* showed a negative difference between the results identified in the group of students doing Bachelor's course in nursing (–0.15 ± 0.85), a minimal difference, approaching zero, in the group doing Master's course in nursing (0.07 ± 0.81), and a highly positive difference in the group doing Master's course in medicine (0.52 ± 1.06). The differences in the three groups were not the same ($p < 0.001$). Statistically significant post-hoc differences were shown between the groups doing Bachelor's course in nursing and Master's course in medicine ($p < 0.001$) (Table 5).

Table 5. Comparison of the differences between the Pre-session and Post-session Assessments of curricular needs

	Bachelor's in nursing		Master's in nursing		Master's in medicine	
	χ	SD	χ	SD	χ	SD
IV–II	k–0.15	0.85	0.07	0.81	0.52	1.06
p	F = 8.79; p < 0.001					
Post-hoc	Bachelor's in nursing		Master's in nursing		Master's in medicine	
Physical examination			0.396		< 0.001	
Intensive care	0.396				0.011	
Neurosurgery	< 0.001		0.011			

Legend: F–value of Fischer's F-test (one-way analysis of variance ANOVA), post-hoc: Tukey's test; p–probability value, χ–arithmetic mean; SD–standard deviation

Discussion

In recent years, medical simulation has become one of the priority methods for teaching in healthcare related courses of study. Medical simulation provides an approximation of clinical setting that requires students to take appropriate actions in the face of changing conditions, and to respond to problems as they arise, in the same way as in real life. The use of simulation makes it possible to more effectively prepare students to enter the real clinical settings and to interact with the real patient. Soft skills such as stress management, and the ability to communicate with team members, or to give clear instructions or listen to members of the therapeutic team are extremely important in the daily work of health professionals.

The present study focused on the use of the BI VPS in the educational process and on testing the soft skills and their improvement. Despite the noticeable gains resulting from the use of this tool, so far few studies have evaluated the integration of this tool into the training process intended for health professions. A study by Padilha et al., which involved a group of nursing students, showed that the VPS is easy to use and suitable for the learning process [1]. Another randomised study showed an increase in clinical reasoning and knowledge consolidation in students participating in a VPS-aided training session compared to a group of students using low-fidelity simulation [7]. Similar findings were reported by Watari in a study involving a group of medical students in Japan, in which he showed that participation in a single BI VPS session improved knowledge and clinical reasoning [8]. Similar results were reported by other authors [9, 10]. Favourable opinion about this educational tool, reported by nursing students, was also shown by Tjoflat et al. whereas Gu et al. reported improved knowledge-related scores when the VPS training was added to the core

clinical programme [11, 12]. The study in a group of nursing and medical students at the University of Rzeszów is consistent with studies by other researchers showing greater effectiveness in knowledge acquisition, individual pace of learning and integration of the curriculum [13, 14]. The students greatly appreciated the opportunity to learn from their mistakes without negative consequences for the patient and to see the consequences of clinical decisions, which is consistent with other studies in which students participated in virtual simulation training [15, 16]. Another gain was related to the practice of soft competences, in particular the abilities of effective communication, negotiation, as well as conflict resolution and group management. The teaching process was carried out in small groups which may also have favourably impacted student satisfaction and effectiveness of the VPS training. A study by Edmunds and Brown showed that the training environment of a small group contributes to students' involvement in learning, makes it possible to more rapidly identify the learner's weaknesses, stimulates teamwork and also encourages the development of soft skills [17].

The VPS training was perceived to increase effectiveness of one's learning process, to contribute to the curriculum integration and to enable improvement in non-technical competences. Students who awarded the lowest rating to the integration of the curriculum prior to the VPS session, tended to benefit the most from attending the VPS training. The study focused on the results and subjective assessment of the students and no long-term evaluation was carried out taking into account knowledge, analysis and clinical reasoning or the development of non-technical skills. This may provide a direction for future research focusing on advanced tools supporting the process of training nurses and medical professionals.

Conclusions

The present findings show that the students' expectations related to the VPS training were high, with regard to such factors as the effectiveness of learning and clinical decision-making, and the possibility to modify the therapeutic process, where erroneous decisions provided grounds for changing the procedure applied. According to nursing students, the medical simulation training allowed them to develop soft skills, including communication skills, and to gain the ability to build a professional image, and to perform activities at work with confidence, and finally to acquire skills needed for group management and conflict resolution. In the entire study group, the nursing students were more likely than medical students to indicate that the simulation training and clinical experience were appropriately matched to their level of knowledge.

Limitations

The study did not include quantitative assessment of the knowledge gained as a result of the VPS session, nor did it evaluate long term effects of the training. Another limitation of the study lies in the fact that the VPS was not compared, in terms of effectiveness, to low, medium or high fidelity simulation. Furthermore, the study did not investigate effectiveness of learning in small groups, large groups or individually, nor did it compare the effectiveness of the VPS training during the first years of study (pre-clinical course) in relation to the final years of study (clinical training).

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The basis for the development of e-learning modules in teaching patient safety: the perspective of nurse educators

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Abstract

Introduction: Safe care provision is a critical global healthcare issue. Nurse educators play a vital role in identifying strengths and weaknesses in patient safety education across academic and clinical settings.

Aim: To explore nurse educators' opinions and experiences with patient safety education in academic and clinical settings.

Materials and methods: Thirteen nurse educators from two nursing faculties participated in the study. Data were collected via an online self-designed survey using Google Forms in February 2024 and analyzed through content analysis.

Results: Three key themes emerged: the interpretation of safe nursing care, teaching patient safety–characteristics and requirements, and reflections on patient safety education.

Conclusions: Integrating patient safety education into nursing curricula and ensuring practical, hands-on learning experiences are essential to prepare students for real-world challenges.

Key words: e-learning modules; nurse educators; nursing students; patient safety; education

Introduction

Patient safety remains a critical global health issue, heavily impacted by shortages of nurses and support staff [1]. An estimated one in ten patients experiences harm during healthcare delivery, with nearly 50% of these cases being preventable [2]. Patient safety focuses on preventing harm to patients and is defined by the World Health Organization (WHO) as "the absence of avoidable harm during the healthcare process" [4]. It involves a framework of culture, processes, behaviours, and technologies designed to reduce risks, prevent errors, and minimize harm [3]. Developing and regularly evaluating a patient safety culture is essential to improving healthcare safety

[3]. Since 1999, organizations like the WHO and the IOM have emphasized the inclusion of patient safety in nursing curricula to equip students with the necessary skills and competencies to ensure safety and reduce errors in clinical practice [4]. Nursing students' ability to provide safe and quality care is significantly influenced by the academic environment [8], where educational institutions aim to prepare students for safe care provision across various clinical settings. However, patient safety education is not systematically included in nursing curricula across the European Union (EU), and disparities exist between theoretical and practical training. E-learning has emerged as an effective method to enhance patient safety education, particularly in the wake of the COVID-19 pandemic, which accelerated its adoption [9]. It incorporates simulation-based methods, such as virtual simulations and interactive scenarios, to develop skills like critical thinking and decision-making [10, 11]. Research shows that e-learning significantly improves patient safety culture [12, 13], often proving more effective than traditional methods [14, 15].

Aim

The study aimed to explore nurse educators' opinions on and experiences with patient safety education in both academic and clinical settings.

Material and methods

A qualitative descriptive study was carried out to meet the study objectives and was approved by the Ethics Committee of the Jessenius Faculty of Medicine in Martin, Comenius University in Bratislava (ref. no. 37/2023). Regarding the sample, two faculties were approached in which nursing students are educated in the bachelor's degree programme. After obtaining consent from both faculties to conduct the research, nurse educators actively involved in teaching clinical subjects in the undergraduate programme were selected using the convenience sampling method. Giving informed consent was a prerequisite for including nurse educators in the sample. A total of 17 nurse educators were approached, of which 13 participated (response rate: 76.47%).

The study was carried out in February 2024 through the Google Forms® platform due to its accessibility and rapid availability of data. The online form included informed consent at the beginning. After giving informed consent, the nurse educators were directed to the list of eleven semi-structured questions on the topic of patient safety education. The questions in interviews were developed based on

reviewed literature, for example [16], and reflected topics such as provision of safe nursing care, or patient safety education in general,

Participant narratives were analyzed using summative content analysis. This approach began with manifest content analysis, quantifying specific words or content to identify patterns without inferring meaning. The analysis then progressed to latent content analysis, interpreting underlying meanings [17]. Data coding was performed line-by-line by two independent reviewers, who assessed similarities and resolved differences to group codes hierarchically. New codes were created to capture the meaning of initial code groups, resulting in ten subthemes and three themes. The process was supported by Atlas.ti software.

Results

Through the analysis of the narratives, three significant themes related to the nurse educators' opinions on and experiences with patient safety education were identified in both academic and clinical settings (Figure 1).

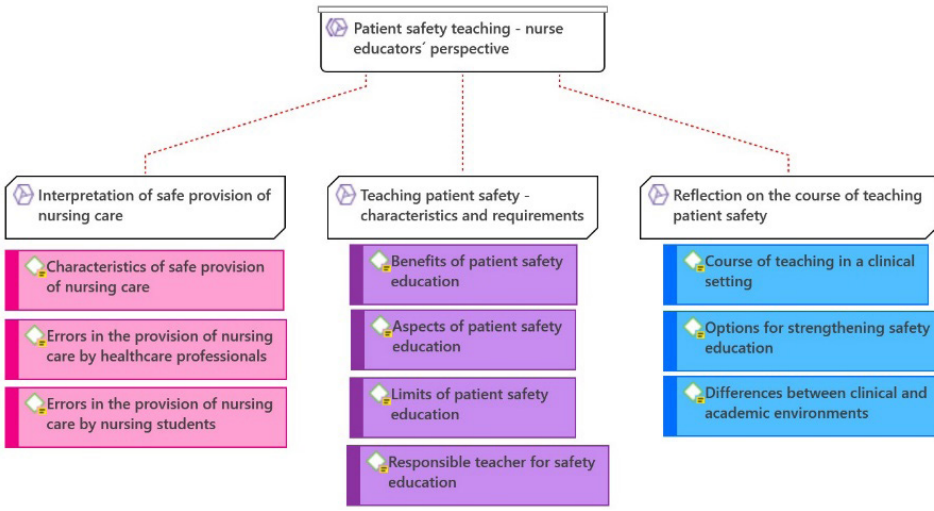

Figure 1. Patient safety education–nurse educators' perspective

Theme 1: Interpretation of safe provision of nursing care

The first theme was synthesized from three subthemes: Characteristics of safe provision of nursing care; Errors in the provision of nursing care by healthcare professionals; and Errors in the provision of nursing care by nursing students.

Subtheme 1: Characteristics of safe provision of nursing care

Nurse educators perceived safe nursing care as adherence to standards, rules, and internal regulations: …*adherence to defined procedures that are part of the internal regulations of healthcare facilities* (P13). They emphasized the importance of staff competencies, critical thinking, and a shared goal: *Safe care is… measures, norms, and patterns of behaviour… to provide the safest and highest quality care for the patient* (P6). Safe care involves individualized, patient-centred care that meets biopsychosocial and spiritual needs beyond the treatment plan (P8) and minimizes harm, adverse events, and errors: *Providing care that prevents or minimizes harm to the patient* (P10).

Subtheme 2: Errors in provision of nursing care by healthcare professionals

In the clinical setting, nurse educators identified several errors in safe care provision, primarily by nurses. Common issues included inadequate patient education, non-compliance with patient rights, and failure to follow procedural standards: *The standard procedure is not always followed…* (P2). Insufficient identification of high-risk patients, such as mobility issues, was also a concern (P11). Overstepping staff competencies further jeopardized care: *Nurses or aides exceed their competencies without apparent reasons…* (P8). Errors were notable in pressure ulcer prevention due to insufficient aids, medication administration with poor record-keeping and management (P9), and fall prevention, hindered by malfunctioning equipment and unsuitable facilities (P11). Communication failures and inappropriate behaviour towards patients, particularly those who are aggressive or confused, were also highlighted (P8, P9). Additionally, staff safety was compromised through practices like mishandling needles and improper patient handling: …*all of this affects nurses as well* (P5). Errors were attributed to time constraints, inattention, and lack of interest among healthcare personnel: *Mistakes occur due to lack of time or inattention* (P2).

Subtheme 3: Errors in provision of nursing care by nursing students

Nurse educators frequently observed errors and mistakes in nursing students' provision of safe care: …*not realizing the risks associated with unprofessionally provided nursing care* (P7). Common issues included inadequate skills and knowledge, particularly in aseptic principles, medication substitutions, incorrect dosages, and poor hand hygiene. Communication errors were also highlighted, involving insufficient interaction with patients, mentors, and other healthcare professionals: …*inadequate communication with the patient, mentor, and other healthcare professionals* (P9). Students often modelled their behaviour on nurses and mentors who failed to comply with care standards: *Adopting from nurses–the identification of patients*

by room and bed number, instead of requesting full patient details… (P11). Similarly, students were observed mimicking improper techniques, as reflected in the statement: *Nurse as a role model, the nurse does not take sterile swabs, why should I?* (P8). Errors were most common in specific nursing tasks, often due to students' lack of focus and interest. Additional concerns included unkempt appearance, a focus on task completion rather than patient-centred care, and overconfidence in their abilities.

Theme 2: Teaching patient safety–characteristics and requirements

The second theme was synthesized from four subthemes: Benefits of patient safety education; Limits of patient safety education; Aspects of patient safety education; and Responsible teacher for safety education.

Subtheme 1: Benefits of patient safety education

Nurse educators highlighted several benefits of patient safety education, particularly in subjects focused on nursing management. One participant emphasized its role in protecting both patients and nurses: *There are countless benefits… safely provided healthcare, from patients' perspective, speeds up and improves their treatment* (P7). Another key benefit identified was improved student preparedness for clinical practice: *More information, better preparation for practice in the clinical environment…* (P3), further supported by the statement: *The student receives information about possible risks and is prepared to provide quality nursing care* (P10). Additionally, patient safety education was noted to raise awareness among students about recognizing safe and unsafe practices in nursing care (P5).

Subtheme 2: Limits of patient safety education

Nurse educators identified several limitations in patient safety education, with inadequate attention being a significant concern. They noted that educators' readiness to teach patient safety could be a challenge: *Can educators adequately 'deliver' patient safety issues? Do we have sufficient knowledge in the field of patient safety? Are students interested?* (P5). Additionally, patient safety is often not taught as a standalone subject but integrated into other courses, limiting its focus: *…that education in patient safety does not universally occur as a separate subject…* (P6). A lack of resources was another recurring issue. In academic settings, this includes insufficient interactive tools, such as e-learning materials, videos, and case studies, as well as a shortage of professional literature in Czech and Slovak languages (P8). Similarly, clinical practice suffers from limited material and technical resources (P7), including inadequate personal protective equipment (P2).

Subtheme 3: Aspects of patient safety education

Nurse educators emphasized that patient safety education should cover both general and specific topics. General topics include patient safety characteristics, safety culture, assessment tools, and influencing factors: …*characteristics of patient safety and safety culture, tools that can be used in their assessment*… (P8). Specific topics should address care for confused or aggressive patients and adherence to aseptic techniques (P9). A primary focus should be on preventive measures to reduce risks and enhance safety: …*risks endangering patient safety and their prevention* (P3), along with safe care practices, errors in nursing, and unintentional harm (P1). Education should also integrate sociocultural aspects, such as communication, evidence-based practice (EBP), teamwork, adverse event management, and fostering a blame-free environment (P6). Reporting adverse events and overcoming reporting barriers were also highlighted as key topics (P5). Staff safety is another essential component, addressing issues like the prevention of nosocomial infections, consistent use of personal protective equipment, and reducing occupational risks (P8).

Subtheme 4: Responsible teacher for safety education

Nurse educators largely agreed on the key participants in patient safety education across academic and clinical settings. In the academic environment, nurse educators should play a central role, with one participant emphasizing the integration of patient safety into all nursing-related topics: …*it should concern all teachers in the academic environment involved in nursing education and care* (P11). Additionally, experts in patient safety or professionals publishing in the field were suggested as valuable contributors: *A person who publishes in the field of patient safety* (P13), or *A researcher-nurse expert in patient safety* (P5). Some participants highlighted the importance of qualifications, suggesting educators with a Ph.D. in nursing and clinical experience (P8). In the clinical environment, the involvement of specialized nurses, mentors, ward nurses, and head nurses was emphasized: *Head nurses and ward nurses… should provide training for students on patient safety within healthcare facilities* (P11). Participants also suggested that nurse mentors should have advanced practice qualifications to effectively educate students (P8).

Theme 3: Reflection on the course of patient safety education

The third theme was synthesized from three subthemes: Course of teaching in a clinical setting; Options for strengthening safety education; and Differences between clinical and academic environments.

Subtheme 1: Course of teaching in a clinical setting

Nurse educators described patient safety education in the clinical setting as building on theoretical preparation and simulated learning: …*reinforcing skills related to patient safety in clinical conditions* (P2). Shadowing mentors and observing their behaviour was highlighted as crucial (P6). Education focuses on adverse events and key safety aspects (P8), with practical demonstrations at the bedside offering students opportunities to address real-life situations under mentor supervision: …*students are questioned about possible risks to patient safety* (P11). Students also learn ward-specific routines and measures (P10). However, challenges include large patient loads and limited individual attention, often resulting in a focus on error prevention rather than comprehensive learning: …*the mentor tries to prevent potential risks and errors* (P8). Some patient safety issues were not consistently addressed or explained in depth (P9), highlighting the need for more structured and focused clinical education.

Subtheme 2: Options for strengthening safety education

To strengthen patient safety education in undergraduate nursing programs, nurse educators emphasized the importance of familiarizing students with care standards, thorough preparation, and the acquisition of practical skills alongside theoretical knowledge: *Thorough practice of nursing activities in simulated conditions with subsequent reinforcement in clinical conditions under the guidance of a mentor* (P2). They suggested introducing dedicated courses, such as a subject on safe nursing care or broader safety issues, ideally spanning multiple semesters: …*a two-semester course on the basis of which students could build the knowledge necessary for clinical practice* (P8). Educators also highlighted the need for specialized training for themselves in patient safety topics, including courses and seminars on areas like managing aggressive patients and fall prevention (P7). Interactive teaching methods, such as problem-based learning, case studies, and workshops, were recommended to enhance student engagement: …*use interactive teaching methods for this issue* (P9). Effective communication with mentors and peers, the use of critical thinking, and tools like the SBAR method were also deemed essential (P12).

Subtheme 3: Differences between clinical and academic environments

A key difference in patient safety education between academic and clinical environments lies in the ability to conduct practical demonstrations directly at the bedside in the clinical setting. This environment allows students to interact with real patients and understand the risks of improper procedures: …*the student comes into personal contact with the patient and is thus forced to realize the deeper*

significance of the risk of providing nursing care when procedures are not followed (P7). It also enables students to address immediate situations and apply theoretical knowledge in practice (P6). Clinical education is seen as a continuation of the foundation established in the academic environment, allowing students to perceive real-world implications of insufficient patient safety or even witness and address adverse events: …*education in the clinical setting should only build on the knowledge gained in academic education* (P8). Conversely, the academic environment focuses on theory, lectures, simulated teaching, and case studies but often lacks the realism and responsibility inherent in clinical settings (P9). Nurse educators highlighted several challenges, including inadequate attention from mentors in the clinical setting (P2), difficulty linking academic knowledge to specific procedures and patient conditions (P11), and the limited application of evidence-based practice (EBP) in real-world settings (P12).

Discussion

The findings of the present study focused on the interpretation of the safe provision of nursing care, as the first identified theme. The nurse educators characterized safe provision of nursing care, highlighting the importance of delivering care according to nursing standards, rules, and norms, which is in line with the recommendations for quality and safe education for nursing students [18, 19]. This aligns with the principles of evidence-based practice in nursing reflecting research-based guidelines and best practices [18]. This understanding of safe nursing care provision emphasizes the importance of adherence to defined procedures and development of staff competencies [20]. Nurse educators play a crucial role in instilling the characteristics of safe provision of nursing care among nursing students [21]. Furthermore, they recognized that even experienced healthcare professionals can make mistakes in the provision of nursing care. It is important to acknowledge that errors can occur in any healthcare setting despite the best efforts to provide safe care [22]. This highlights the need for a culture of openness, transparency, and continuous learning within healthcare organizations [23]. Addressing errors and near-misses through reporting systems and root cause analysis can contribute to improving patient safety [24]. Furthermore, the study emphasized the importance of teamwork and communication in ensuring safe nursing care provision. Effective communication between healthcare professionals, including nurses, physicians, and other members of healthcare teams, is crucial to prevent errors and promote patient safety [25]. Furthermore, nurse educators highlighted the importance of

addressing potential errors and mistakes made by nursing students during their education and training. The findings highlight the importance of nurse educators in preparing future nurses to navigate the complexities of healthcare care delivery and promote patient safety. Nurse educators play a crucial role in teaching error prevention, fostering a culture of openness and transparency, and focusing on the importance of teamwork and effective communication [26, 27]. They model professional behaviour, facilitate critical thinking and problem-solving skills, and promote a patient-centred approach to care [26, 28]. Furthermore, strong supervision, support, and guidance from nurse educators are needed to ensure that nursing students are equipped with the necessary knowledge and skills to provide safe and competent care [29]. In general, nurse educators play a vital role in shaping the nursing workforce to contribute to a safer healthcare environment through continuous learning and improvement [26].

The study highlights the characteristics and benefits of patient safety education, emphasizing its role in improving patient outcomes, enhancing nurse readiness, and fostering a culture of safety. Integrating theoretical knowledge with practical application enables nurses to deliver care more efficiently, adhere to standards, utilize care plans, and reinforce nursing diagnostics [18, 30, 31, 32]. However, patient safety education faces significant challenges, including insufficient attention, limited resources, and a lack of qualified educators [33]. Additionally, inadequate clinical resources and failure to address nursing mistakes hinder effective learning [31]. These findings underscore the need for comprehensive support and resources to strengthen patient safety education.

Nurse educators identified a broad spectrum of topics for patient safety education, spanning general principles to specific preventive measures. Education should encompass clinical and sociocultural factors influencing patient safety, emphasizing risk minimization, adverse event prevention, communication, evidence-based practice, teamwork, and incident reporting [19, 20, 33]. Staff safety is also integral, highlighting the link between patient and healthcare worker well-being [20]. Comprehensive training requires addressing these diverse areas to prepare nursing students effectively. Both academic and clinical settings benefit from involving knowledgeable and experienced educators. While nurse educators play a central role in academic settings, contributions from patient safety experts and those with relevant research or clinical experience are valuable [33]. In clinical environments, nurse specialists, mentors, ward nurses, and head nurses are key educators. Regardless of the setting, educators must possess both theoretical knowledge and practical skills to effectively teach patient safety [31].

Furthermore, the findings of this study illustrate the reflection on the course of patient safety education, as the third and last identified theme. The nurse educators outlined the progression of patient safety education in clinical settings, highlighting its roots in theoretical preparation, simulated education, and hands-on experiences such as shadowing mentors. The emphasis is on practical aspects of safety, including hygiene, patient mobilization, medication administration, and prevention of adverse events. Although clinical education offers advantages such as direct bedside demonstrations and reinforcement of acquired skills, challenges such as high patient volumes and limited individualized attention can hinder effective learning [19, 20, 33]. Therefore, it is important to improve patient safety education. The nurse educators in the present study suggested various strategies, including introducing dedicated courses on safe nursing care, increasing practical training, and providing nurses with information on patient safety. Interactive teaching methods, smaller student groups, and regular audits during nursing procedures are also recommended [13]. Collaboration with internal patient safety systems and the development of evidence-based standards are key strategies for improving patient safety in nursing care. A multifaceted approach is required, beginning with interprofessional education, which provides nursing students with opportunities to learn alongside other healthcare disciplines, fostering teamwork and understanding of collaborative roles in patient care [16]. Simulation-based learning is another essential strategy, allowing students to practice clinical skills and decision-making in a controlled, risk-free environment, building their confidence and competence [20]. Integrating quality improvement initiatives into nursing education and practice is also crucial. This approach encourages students to critically analyze healthcare systems, identify areas for improvement, and adopt proactive risk assessment and mitigation practices [13, 32]. Additionally, mentorship programs for nursing students offer essential guidance and support, helping them bridge the gap between theoretical knowledge and practical application. Under the mentorship of experienced nurses, students can develop the skills and confidence needed to deliver safe, high-quality care [27, 32].

Conclusions

This study underscores the critical role of patient safety education in nursing, highlighting nurse educators' perspectives on its significance. The first theme emphasizes safe nursing care, focusing on adherence to standards and error prevention, while identifying common mistakes among healthcare professionals and

students, such as inadequate education and non-compliance. The second theme explores the benefits of patient safety education, despite challenges like insufficient attention and limited resources. To address these issues, education should prioritize prevention and involve knowledgeable educators from both academic and clinical settings. The third theme advocates for curriculum development and interactive teaching methods, emphasizing practical demonstrations and collaboration to bridge gaps between academic and clinical environments. Implications for nurse educators include developing comprehensive curricula, employing interactive approaches, fostering continuous professional development, and collaborating with healthcare professionals. Nurse educators play a pivotal role in shaping competent nurses and fostering a culture of safety in healthcare.

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Virtual simulation education of students from specialty of "Nursing care"

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Abstract

Introduction: Virtual reality (VR) simulation training has emerged as a promising educational tool in nursing, offering immersive and interactive learning experiences. This summary discusses the implementation and outcomes of a pilot training initiative using VR glasses at the Medical Simulation Training Center of Medical University Plovdiv.

Aim: The aim of the pilot training was to evaluate the effectiveness of VR simulation training in nursing education and its impact on student and teacher perceptions, empathy development, and preparedness for patient care.

Material and methods: Thirty-four participants, including nursing students and teachers, underwent VR simulation training following practical instruction with models. Qualitative analysis was conducted to assess participants' reactions, empathy levels, and perceptions of the training.

Results: Participants expressed strong interest in VR simulation training, noting its realism and impact. Students demonstrated heightened empathy towards virtual patients, while teachers exhibited a more professional response. Both groups emphasized the benefits of VR simulation for patient care and recommended greater autonomy and interactivity in virtual scenarios.

Conclusions: VR simulation training with VR glasses offers a valuable educational approach in nursing, fostering active learning, empathy development, and clinical competence.

Key words: virtual reality; simulation training; nursing education; empathy development; qualitative analysis

Introduction

In Bulgaria, the training regimen for nurses in specialized fields adheres to a rigorously structured protocol: initial theoretical instruction, practical training within specialized facilities, hands-on experience in authentic healthcare settings, and culminating with a pre-graduation internship.

Theoretical instruction typically comprises lecture-based sessions. Within specialized educational facilities, students, under the supervision of instructors, engage in a variety of nursing procedures, tasks, and patient care simulations using models and simulators. Subsequently, students transition to real-world healthcare environments, such as hospitals or outpatient facilities, where they apply their acquired professional competencies while under the supervision of instructors. The training program concludes with a pre-graduation internship, during which students autonomously execute tasks under the guidance of experienced mentors.

Aim

The article aims to showcase the outcomes of a pilot training initiative involving both nursing students and instructors at the Medical Simulation Training Center of the Medical University Plovdiv, utilizing virtual reality (VR) glasses as an educational technology.

Material and methods

The pilot training initiative conducted at the Medical Simulation Training Center (MSTC) of the Medical University-Plovdiv under the auspices of the Erasmus+ project *Caring violent children safely in child psychiatric and residential units (Safe4Child) 2021-1-FI01-KA220-HED-000032106* held from March 23 to April 12, 2024, featured a comprehensive methodological approach.

Participants were stratified into two distinct cohorts: third-year nursing students and academic lecturers specializing in nursing education. The training regimen encompassed various stages, including enrollment on the Moodle platform, comprehensive examination and assimilation of theoretical materials pertinent to the project's thematic scope, completion of assessments following each of the five modules within the theoretical curriculum, and individualized practical sessions employing virtual reality (VR) technology, under the supervision of project implementation team members. Upon satisfactory completion of both the theoretical coursework and practical exercises, participants were conferred with certificates denoting their successful fulfillment of the Moodle platform-based training course affiliated with the project.

After the training, a qualitative analysis incorporating reflective theme analysis techniques was applied to evaluate the outcomes and insights gleaned from the

initiative. Upon successful completion of both the theoretical coursework and practical exercises, participants were awarded certificates signifying their adept navigation of the Moodle platform-based training course associated with the project.

Results

During the pilot phase of the training, 34 participants were engaged and divided into two distinct focus groups. The first group comprised 16 individuals, consisting of teachers possessing foundational nursing education and 16 third-year nursing students. All teachers held master's degrees in "Health Care Management," with three of them additionally holding Ph.D. degrees in the same scientific discipline. In Bulgaria, the nursing care specialty entails a four-year academic curriculum, in accordance with standardized state requirements. The profession is regulated, with training encompassing both theoretical and practical components, culminating in a one-year pre-graduation internship. Upon successful completion of the training program, graduates are conferred with a bachelor's degree and the professional designation of "Nurse."

Participation in the training course was entirely voluntary. Given that the theoretical training on the Moodle platform was conducted in English, proficiency in the English language was a prerequisite for inclusion. Following the promotion of the course among both students and teachers, a predominant motive that surfaced was a notable interest in the innovative educational technology of learning through VR glasses. All participants expressed a lack of prior experience with VR glasses training but displayed enthusiasm for the commencement of practical training.

After acquainting themselves with the theoretical materials and completing an entry questionnaire, participants underwent individual practical training with VR glasses. Subsequently, a small group comprising 5–6 individuals engaged in discussions facilitated by a moderator immediately after the practical training session.

The Table 1 presents the initial reactions of both students and teachers following the removal of VR glasses. Students expressed profound interest, describing the experience as *very interesting*, *very real* and akin to being transported to another location. They appreciated the immersive nature of the training, with comments like *it's like you're there* and *it's like it's real*. Some expressed gratitude for the opportunity to participate and praised the presentation of real-life case studies. Teachers echoed similar sentiments, emphasizing the incredible and impactful nature of the experience. They highlighted the realism of the simulation and the way it surpassed

their expectations. Overall, both groups found the VR training to be engaging, immersive, and effective in enhancing their learning experience.

Table 1. Initial reaction of the participants, immediately after removing the VR-glasses

Students	Teachers
Very interesting;	Incredible, very strong impact.
Very real;	
It's like you're there;	
It's like it's real.	
Thank you for inviting me to participate;	
interestingly presented case study from real practice;	
Very realistic;	
Real;	
It's like you're somewhere else;	
Nice experience;	
Exceeded my expectations.	

After removing the VR glasses, two of the participating students requested additional training because they *did not want it to end*. The teachers pointed out that learning with VR glasses is very suitable for students who are now starting their nursing education.

Following the VR training session, feedback from participants revealed some noteworthy observations. One teacher mentioned feeling slightly disoriented upon removing the VR glasses, while another reported feeling a mild sense of dizziness. Among the students, opinions varied: one student admitted experiencing a degree of stress and tension, whereas another expressed feeling more relaxed compared to a real-life environment. Despite these variations, all students successfully grasped and articulated the scenario presented in the virtual environment, demonstrating a clear understanding of its intended purpose. They were particularly impressed by the detailed presentation of the virtual setting, which included the participants, their surroundings, views through windows, and the presence of medical staff. In the second focus group comprising teachers, there was unanimous agreement that the case study was well-conceived and comprehensive, incorporating pertinent family history.

An aspect of paramount importance highlighted by the training was the cultivation of empathy towards patients, particularly in scenarios involving aggressive behavior. It was gratifying to observe strong emotional reactions from students encountering such situations for the first time, indicating their engagement and investment in the training process. Moreover, teachers, drawing from their practical

nursing experience and extensive teaching backgrounds, responded to these scenarios with professionalism and expertise. This collective feedback underscores the efficacy of VR training in preparing future nurses to navigate complex patient interactions with empathy and professionalism.

The Table 2 depicts the empathetic responses of both students and teachers towards the virtual patient in the simulated environment. Students expressed a strong desire to assist the child/patient and recognized the need for individualized attention from a nurse. Some students also expressed feelings of sadness and helplessness, unable to alleviate the child's virtual suffering. Conversely, others reported feeling a sense of euphoria and a desire to engage with the patient further, indicating varying emotional responses to the scenario. Additionally, students expressed curiosity about the child's feelings and experiences, showing a genuine interest in understanding the patient's perspective. Teachers, on the other hand, interpreted these responses as normal expressions of empathy, noting a natural inclination to comfort and console the virtual child. Overall, the responses from both students and teachers highlight the development of empathetic attitudes crucial for effective patient care.

Table 2. Demonstrates feelings of empathy for the virtual patient in a simulated environment

Students	Teachers
I felt the need to help the child/patient;	Normal feelings, but you want to hug the child and comfort him.
The child needs individual work with a nurse;	
The child needs to play with other children under the supervision of a nurse;	
I felt a strange feeling of sadness for this child;	
I got very emotional, I felt sad that I couldn't do anything in such a virtual situation;	
A feeling of euphoria came over me, I want to talk to the patient;	
I want to know how the child feels;	
I want to understand the child's experiences.	

The Table 3 outlines the perceived benefits of simulation training with VR glasses for both students and teachers. Students highlighted the importance of thorough preparation at the Medical Simulation Training Center (MSTC) to effectively handle real-life patient encounters. They emphasized the immersive nature of the training, which allows them to actively participate and gain practical insights, surpassing the passive learning experience of traditional instruction. Additionally, students noted that problem situations within the virtual environment are swiftly

resolved, fostering an understanding of correct professional behavior, and contributing to enhanced education quality. Furthermore, they acknowledged that such training reduces the stress associated with direct patient interaction during learning. Teachers echoed these sentiments, emphasizing the value of simulation training in providing students with exposure to diverse practice scenarios that may not always be feasible in real-life environments. They recognized the potential of simulation training to complement overall nursing education and improve the quality of learning while minimizing student stress. Overall, both students and teachers underscored the significant educational benefits offered by simulation training with VR glasses, enhancing student preparedness and fostering a supportive learning environment.

Table 3. Benefits of simulation training with VR-glasses for the patient

Students	Teachers
To prepare well at the MSTC, so that when we meet such a patient in a real environment, we can react and know how to approach;	It is not always during nursing education in a real environment that students can see everything. It is good to have such simulation training scenarios for different practice situations to complement the overall training of nursing students.
I actually become a participant and it is better than being told about a situation from practice;	
it is understandable, the problem situation is quickly resolved.	
after training in a virtual environment, an algorithm for correct professional behavior will be created for the students;	
the quality of education will increase; the students will not be trained directly on a patient and in this way the stress in the learning process will be avoided.	

Discussion

The integration of virtual reality (VR) simulation training with VR glasses into nursing education represents a significant advancement with profound implications for patient care. Our study contributes to the growing body of literature supporting the efficacy of this innovative educational approach. By incorporating VR simulation training immediately following practical training with models or phantoms, our findings suggest that students can benefit from a seamless transition between theoretical and practical learning modalities. This sequential approach allows students

to consolidate theoretical knowledge and immediately apply it in a realistic virtual environment, thereby enhancing their preparedness for direct patient interaction.

Our results resonate with previous research, such as the study by Wolf et al. [1], which demonstrated the positive outcomes of case-based simulation scenarios in university-level practical courses. Similarly, findings from Pence et al. [2] and Tiang et al. [3] highlight the perceived supportiveness of VR simulation training and its potential to facilitate knowledge application in clinical settings. These studies collectively underscore the value of VR simulation as a supplementary learning tool for improving procedural knowledge and clinical decision-making abilities among nursing students.

Moreover, our study aligns with research by Eunju et al. [4], which identified the effectiveness of VR simulation nursing education programs in enhancing students' performance confidence and clinical reasoning skills. The successful integration of a virtual psychotherapy course into advanced nursing education, as demonstrated by Vives et al. [5], further illustrates the versatility and applicability of VR-based training across diverse healthcare contexts.

Additionally, the positive impact of a virtual exchange and clinical simulation program on nursing students' cultural intelligence, as reported by Galan-Lominchar et al. [6], highlights the broader educational benefits of VR simulation beyond clinical skills development.

Our pilot training with VR glasses unveiled several noteworthy conclusions. Firstly, the novelty and immersive nature of VR technology elicited strong interest and perceived realism among participants, indicating its potential to engage learners effectively. Secondly, while both students and teachers recognized the benefits of VR simulation for patient care, students exhibited a more pronounced emotional response, suggesting a deeper level of empathy and engagement with virtual patient scenarios. Finally, the consensus among participants regarding the benefits of VR simulation training for patient care underscores its potential to enhance nursing education and ultimately improve healthcare outcomes.

Recommendations

Based on the feedback provided by both students and teachers during the pilot training with VR glasses, several recommendations emerge to enhance the effectiveness of VR simulation training in nursing education:

1. Increase Autonomy: Both students and teachers expressed a desire for greater autonomy in the actions of the virtual nurse. This suggests a need to develop VR scenarios that allow learners to make decisions independently and respond

flexibly to dynamic patient situations. By empowering learners to take control of their virtual interactions, they can develop critical thinking skills and gain confidence in their clinical judgment.

2. Promote Active Learning: Participants highlighted the importance of active participation and decision-making in virtual scenarios. To address this, educators can design VR simulations that encourage learners to engage actively with the virtual environment, rather than passively following predetermined steps. Incorporating interactive elements, such as branching scenarios or decision points, can foster deeper engagement and facilitate learning through hands-on experience.
3. Enhance Realism: Both focus groups emphasized the need for realistic virtual scenarios that accurately reflect the complexities of clinical practice. To achieve this, developers should prioritize the incorporation of realistic patient interactions, lifelike simulations of clinical environments, and dynamic scenarios that challenge learners to adapt and problem-solve in real-time. By immersing learners in lifelike situations, VR simulations can effectively bridge the gap between classroom learning and real-world practice.
4. Provide Feedback and Reflection: Participants highlighted the importance of feedback and reflection in the learning process. Educators should incorporate mechanisms for providing timely feedback within VR simulations, such as debriefing sessions or virtual mentors. Additionally, learners should be encouraged to reflect on their experiences and decision-making processes, both during and after VR training sessions. This reflective practice can deepen learning, enhance self-awareness, and promote continuous improvement.
5. Tailor Content to Learner Needs: Recognizing the diverse learning needs and preferences of students, VR simulations should be designed to accommodate individual learning styles and skill levels. Educators should offer a range of scenarios and difficulty levels to cater to the varying needs of learners, ensuring that each student receives a personalized learning experience. Additionally, VR content should be aligned with curriculum objectives and clinical competencies to maximize educational outcomes.

By implementing these recommendations, educators can optimize the effectiveness of VR simulation training in nursing education, fostering a dynamic and engaging learning environment that prepares students for the complexities of clinical practice. By empowering learners with greater autonomy, promoting active learning, enhancing realism, providing feedback and reflection opportunities, and tailoring content to learner needs, VR simulation training can serve as a powerful tool for developing clinical competence and improving patient care outcomes.

Conclusions

The conducted pilot training with VR glasses at the Medical Simulation Training Center of Medical University Plovdiv, under the Erasmus+ project "Caring violent children safely in child psychiatric and residential units (Safe4Child) 2021-1-FI01-KA220-HED-000032106," showed that the innovative educational technology of learning with VR glasses is very suitable for students who are now starting their nursing education.

Our study provides compelling evidence supporting the integration of VR simulation training into nursing curricula as a valuable and effective educational tool. By leveraging the immersive capabilities of VR technology, educators can enhance students' learning experiences, foster empathy, and clinical competence, and ultimately prepare future nurses to deliver high-quality patient care in diverse clinical settings. Further research is warranted to explore the long-term effects and broader implications of VR simulation training in nursing education and practice.

The participants in the training course, both students and teachers, expressed a strong interest in the innovative educational technology of learning with VR glasses. The results of the pilot training show that the manifestation of a feeling of empathy is significantly more pronounced in the focus group of students, who react strongly emotionally, and not so strongly expressed in the focus group of teachers, whose reaction is rather professional. The fact that both groups of subjects emphasize the benefit of stimulation training with VR-glasses for the patient is satisfactory.

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Effectiveness of medical simulation in the education of nursing students

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Abstract

Introduction: Medical simulation is a complex teaching method commonly used in academic education. It serves as a key tool in the education of nursing students, allowing them to acquire practical skills in a safe, controlled environment.

Aim: The aim of the study was to analyze the effectiveness of the education of nursing students using medical simulation as a teaching method.

Material and methods: The study was conducted from October 2023 to January 2024 at the Zamość Academy in Zamość and the Lublin Academy WSEI in Lublin. The study included nursing students who participated in classes at the Medical Simulation Center, having previously been qualified for the study. The diagnostic survey method was used for material collection. The research tools included the Educational Practices Questionnaire (EPQ) and the Simulation Design Scale (SDS). The study received a positive opinion from the Bioethics Committee of the Zamość Academy, and the participants were informed about the voluntary nature of participation and the principles of anonymity.

Results: The students gave the highest rating to educational techniques related to cooperation (Me = 5.0). Statistical analysis showed a weak negative correlation between age and the evaluation of active learning (R = –0.137; p = 0.016), expectations (R = –0.181; p = 0.001), and the overall evaluation of educational techniques (R = –0.141; p = 0.014). Students with children rated the expectations domain significantly lower (p = 0.027). A weak negative correlation was found between age and the evaluation of objectives and information (R = –0.180; p = 0.002), support (R = –0.154; p = 0.007), and the overall evaluation of simulation assumptions (R = –0.145; p = 0.011). The realism of scenario elements was rated the highest (Me = 5.0).

Conclusions: The study showed that the students rated educational techniques related to collaboration the highest, recognizing this area as crucial in the educational process. With increasing age, the evaluation of scenario elements decreases, including objectives and information, support, and overall assumptions of medical simulation. Students with children rated the expectations domain of educational techniques significantly lower. Students highly rated the realism of the simulation, considering it an essential element in education that will have a significant impact on their future professional practice.

Key words: medical simulation; simulation effectiveness; SDS scale; EPQ, nursing student

Introduction

Medical simulation is one of the fundamental teaching tools in the education of nursing students. It serves as a valuable resource in the learning process, allowing students to acquire practical skills in a safe environment. Safety and a controlled learning environment can be crucial factors influencing the effectiveness of medical simulation. This approach enables students to practice various procedures and techniques without exposing patients to risk. This form of learning allows for stress-free mistake-making and learning from errors, which is essential for the professional development of future nurses. Performing various tasks within the framework of simulation scenarios helps students develop both standard nursing procedures and complex clinical situations, including crisis scenarios. As a result, future nursing professionals are better prepared for a wide range of situations they may encounter in their careers. Students have the opportunity to repeatedly practice specific procedures, increasing their confidence and precision in performing dedicated tasks. Additionally, both individuals and teams can train their responses to sudden and difficult situations in controlled conditions, significantly improving their readiness for real-life circumstances. In the chosen research area, "Effectiveness of Medical Simulation in the Education of Nursing Students," there is a niche in the scope of this research in Poland. Therefore, there is a need to analyze the effectiveness of medical simulation as a teaching method in the education of nursing students.

Aim

The aim of the study was to analyze the effectiveness of nursing education using medical simulation as a teaching method.

Material and methods

The study was conducted between October 2023 and January 2024 at Zamość Academy in Zamość and Lublin Academy WSEI in Lublin. A total of 306 nursing students from undergraduate and graduate programs (both full-time and part-time) across all academic years participated in the study. All the students attended classes at the Medical Simulation Center (CSM), ensuring an appropriate sample representation for evaluating educational practices and medical simulation assumptions. Participation in the study was voluntary, and the students were informed about the

nature of the study and the principles of anonymity. The research project received a positive opinion from the Bioethics Committee of Zamość Academy, designated with the approval number KBAZ1/2024. The study was conducted using the diagnostic survey method, using research tools such as the Educational Practices Questionnaire (EPQ) and the Simulation Design Scale (SDS).

The students evaluated the elements of the EPQ questionnaire using two rating scales: one assessing their agreement with specific statements about educational techniques and the other evaluating the importance of these statements in the context of their own educational experiences. When rating educational techniques, a five-point scale was used, where 1 meant "Strongly disagree," and each subsequent number represented an increasing level of agreement with a given statement. If a given statement did not apply to the simulation exercise being performed, the participant selected the N/A (Not Applicable) option, indicating that the statement was irrelevant to the specific exercise. Additionally, the students assessed the importance of each statement in the context of the applied educational technique using a five-point importance scale, where 1 meant "Not important" and 5 meant "Very important." A five-point rating system was used when rating the best elements of the scenario on the SDS scale. As the numerical value increased, the participants expressed a stronger agreement with a given statement. If a statement did not apply to the simulation scenario, the N/A (Not Applicable) option was selected. Additionally, the students rated the importance of specific aspects of the scenario for their educational experience using the following scale: 1–Not important, 2–Slightly important, 3–Neutral, 4–Important, 5–Very important. The study was designed based on the NLN Jeffries simulation framework, developed for the advancement and implementation of simulation in nursing education [14]. This simulation framework addresses the following issues of simulation: design (objectives, fidelity, problem-solving, student support, and debriefing), educational practices (active learning, feedback, student-instructor interaction, collaboration, high expectations, diverse learning methods, and time allocated for task completion), outcomes (learning, knowledge acquisition, skill performance, learner satisfaction, critical thinking, and confidence).

The collected data underwent an quantitative analysis (frequencies, percentages, and descriptive statistics) and a qualitative analysis. Statistical calculations were performed using Statistica 13.3 (StatSoft), applying the following statistical tests: Spearman's correlation coefficient, the Mann-Whitney U test, the Kruskal-Wallis test. For variables with a non-normal distribution, the median (Me) and quartiles (Q1–Q3) were used as measures of central tendency and dispersion. For normally distributed variables, the results were presented as the arithmetic mean

(M) and standard deviation (SD). Spearman's correlation coefficient was used to analyze the relationship between age and the evaluation of educational practices. The Mann-Whitney U test was applied to compare the results of standardized EPQ and SDS questionnaires based on education level and parental status, while the Kruskal-Wallis test was used for the marital status variable. A statistical significance level of $\alpha = 0.05$ was adopted for the analysis.

Results

The study included 306 nursing students aged 20 to 50 including 64.71% with secondary education and 35.29% reported having a higher education. The majority of the students lived in rural areas (47.05%) and were either single (51.96%) or married (41.18%). The percentage of respondents with children (48.37%) was similar to the percentage of those without children (51.63%). The sociodemographic characteristics of the students are presented in Table 1.

Table 1. Characteristics of the students

Variable	M ± SD	Me	Min–Max
Age	30.57 ± 8.12	30.0	20–50
		N	%
Education	Secondary	198	64.71
	Higher	108	35.29
Place of residence	Rural area	144	47.06
	Town	66	21.57
	City	96	31.37
Marital status	Single	159	51.96
	Married	126	41.18
	Divorced	21	6.86
Do you have children?	Yes	148	48.37
	No	158	51.63

The students evaluated the elements of the EPQ questionnaire using two rating scales: one for evaluating agreement with statements regarding educational techniques and the other for evaluating their importance in the context of educational experiences. The agreement scale ranged from 1 (strongly disagree) to 5 (strongly agree). The importance scale ranged from 1 (not important) to 5 (very important). If a statement did not apply to a given exercise, the N/A (Not Applicable) option was selected. The highest-rated educational techniques were those related to collaboration (Me = 5.0), followed by diverse learning methods (Me = 4.0) and

expectations (Me = 4.0). Collaboration was also rated as the most important aspect for the students (Me = 4.8), while the remaining factors were at a similar level. Thus, we can conclude that both the evaluation of educational techniques and their perceived importance were at a high level in the study group (Figure 1).

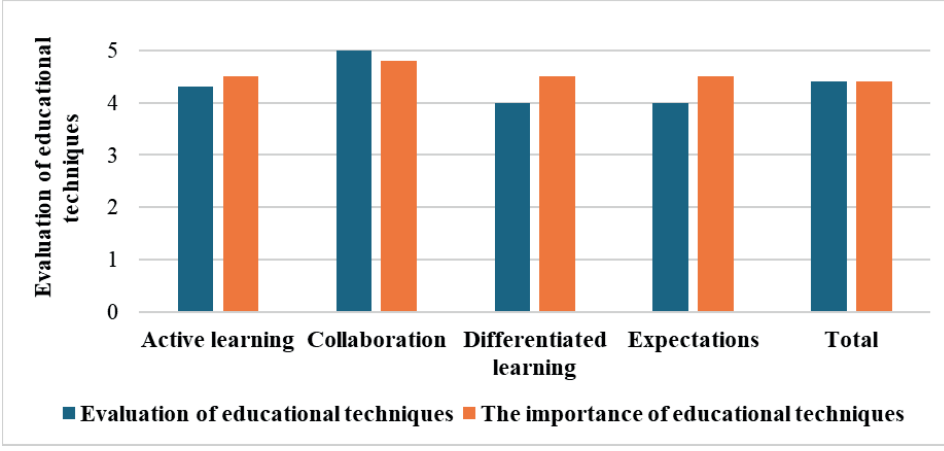

Figure 1. Evaluation of Educational Practices According to the EPQ Questionnaire; the results are presented as median and interquartile range

Statistical analysis revealed a weak negative correlation between age and the evaluation of active learning (R = –0.137; p = 0.016), expectations (R = –0.181; p = 0.001), and the overall evaluation of educational techniques (R = –0.141; p = 0.014). This indicates that as age increases, the perceived importance of these educational areas decreases. However, no significant relationship was found between age and the importance of educational techniques (Table 2).

Table 2. Evaluation of Educational Practices according to the EPQ Questionnaire among students by age

Scale	Correlation with age					
	Evaluation of educational techniques			Importance of educational techniques		
	R	t	p	R	t	p
Active learning	–0.137	–2.420	0.016	–0.001	–0.019	0.985
Collaboration	–0.100	–1.759	0.080	0.035	0.609	0.543
Differentiated learning	–0.036	–0.627	0.531	0.076	1.324	0.187
Expectations	–0.181	–3.205	0.001	–0.005	–0.081	0.935
Total	–0.141	–2.475	0.014	0.021	0.362	0.718

Legend: R–correlation coefficient between the evaluation of the scenario element and the age of the study participants

Students with children rated the expectations area of educational techniques significantly lower (p = 0.027). In other cases, the evaluation of educational techniques did not differ significantly based on parental status. Additionally, no significant differences were found in the importance of educational techniques (Table 3).

Table 3. Evaluation of Educational Practices according to the EPQ Questionnaire among the study students based on parental status

Scale	Evaluation of educational techniques				Importance of educational techniques			
	Respondent has children	Respondent does not have children	Mann-Whitney U test		Respondent has children	Renspondent does not have children	Mann-Whitney U test	
			Z	p			Z	p
Active learning	4.2 (3.8–4.6)	4.3 (4.0–4.7)	–1.525	0.127	4.5 (4.1–4.9)	4.5 (4.0–4.8)	0.209	0.834
Collaboration	5.0 (4.0–5.0)	5.0 (4.5–5.0)	–1.442	0.149	4.8 (4.0–5.0)	4.8 (4.0–5.0)	0.220	0.826
Differentiated learning	4.0 (4.0–5.0)	4.3 (4.0–5.0)	–0.354	0.724	4.5 (4.0–5.0)	4.5 (4.0–5.0)	0.507	0.612
Expectations	4,0 (3.0–5.0)	4.5 (4.0–5.0)	–2.215	0.027	5.0 (4.0–5.0)	4.5 (4.0–5.0)	–0.436	0.663
Total	4.3 (3.8–4.6)	4.4 (4.0–4.7)	–1.575	0.115	4.4 (4.0–4.9)	4,4 (4,0–4.9)	0.146	0.884

Legend: The median (Q1–Q3) is provided for each group.

Table 4. Evaluation of simulation assumptions according to the SDS Questionnaire among students by age

Scale	Correlation with age					
	Evaluation of scenario elements			Importance of scenario elements		
	R	t	p	R	t	p
Objectives and Information	–0.180	–3.184	0.002	–0.014	–0.244	0.808
Support	–0.154	–2.712	0.007	0.016	0.283	0.778
Problem-solving	–0.103	–1.805	0.072	–0.042	–0.736	0.462
Reflection with Feedback	–0.108	–1.886	0.060	–0.061	–1.062	0.289
Fidelity (realism)	–0.048	–0.831	0.406	–0.005	–0.085	0.933
Total	–0.145	–2.550	0.011	–0.018	–0.316	0.752

Legend: R–correlation coefficient between the evaluation of the scenario element and the age of the study participants

Statistical analysis revealed a weak negative correlation between age and the evaluation of objectives and information (R = –0.180; p = 0.002), support (R = –0.154; p = 0.007), and the overall evaluation of simulation assumptions (R = –0.145; p = 0.011). This indicates that as age increases, the evaluation of these

scenario elements among nursing students decreases. However, no significant relationship was found between age and the importance of scenario elements in simulation (Table 4).

No statistically significant differences were found in the evaluation of simulation assumptions based on education level. However, it was observed that the respondents with higher education rated problem-solving slightly lower, while they rated simulation realism slightly higher. The importance of scenario elements was relatively similar among the participants with secondary and higher education (Table 5).

Table 5. Evaluation of simulation assumptions according to the SDS Questionnaire among students by education level

Scale	Evaluation of scenario elements				Importance of scenario elements			
	Secondary education	Higher education	Mann-Whitney U test		Secondary education	Higher education	Mann-Whitney U test	
			Z	p			Z	p
Objectives and information	4.2 (3.7–5.0)	4.4 (4.0–5.0)	0.615	0.539	4.4 (4.0–5.0)	4.4 (4.0–5.0)	0.162	0.872
Support	4.0 (4.0–4.9)	4.0 (3.8–5.0)	–0.341	0.733	4.5 (4.0–5.0)	4.5 (4.0–5.0)	0.401	0.689
Problem-solving	4.4 (4.0–5.0)	3.3 (4.0–5.0)	1.094	0.274	4.6 (4.0–5.0)	4.4 (4.0–5.0)	0.923	0.356
Reflection with feedback	4.5 (4.0–5.0)	4.5 (4.0–5.0)	1.065	0.287	4.8 (4.0–5.0)	4.6 (4.0–5.0)	0.636	0.525
Fidelity (realism)	4.5 (4.0–5.0)	5.0 (4.0–5.0)	1.069	0.285	5.0 (4.0–5.0)	5.0 (4.0–5.0)	0.687	0.492
Total	4.4 (3.9–4.9)	4.4 (4.0–4.8)	0.668	0.504	4.6 (4.1–5.0)	4.5 (4.1–5.0)	0.652	0.514

Legend: The median (Q1–Q3) is provided for each group.

The aims and information are significantly better evaluated by nursing students who do not have children ($p = 0.041$). When evaluating the remaining elements of the scenario, no significant differences were found depending on having children. Moreover, the importance of the elements of the scenario was similar in the respondents who have and do not have children. However, it can be seen that the respondents who do not have children rated the received support slightly higher, and the reflection with feedback slightly lower (Table 6).

The students rated the realism of scenario elements the highest (Me = 5.0), while support (Me = 4.0) and objectives and information (Me = 4.2) received the lowest ratings. The most important areas identified by the respondents were realism (Me = 5.0) and reflection with feedback (Me = 4.5), while the other elements were only slightly less significant for the participants (Table 7).

Table 6. Evaluation of simulation assumptions according to the SDS Questionnaire among students based on parental status

Scale	Evaluation of scenario elements				Importance of scenario elements			
	Respondent has children	Respondent has no children	Mann-Whitney U test		Respondent has children	Respondent has no children	Mann-Whitney U test	
			Z	p			Z	p
Objectives and information	4.0 (3.4–5.0)	4.4 (4.0–5.0)	–2.047	0.041	4.4 (4.0–5,0)	4.4 (4.0–5.0)	0.105	0.916
Support	4.0 (3.8–5.0)	4.3 (4.0–5.0)	–1.322	0.186	4.5 (4.0–5.0)	4.3 (4.0–5.0)	0.350	0.726
Troubleshooting	4.4 (4.0–5.0)	4,4 (4.0–5.0)	–1.332	0.183	4.6 (4.0–5.0)	4.6 (4.0–5,0)	–0.645	0.519
Reflection with feedback	5.0 (4.0–5.0)	4.5 (4.0–5.0)	–1.385	0.166	4.8 (4.0–5.0)	4.8 (4.0–5.0)	–1.088	0.277
Fidelity (realism)	5.0 (4.0–5,0)	5.0 (4.0–5.0)	–0.324	0.746	5.0 (4.0–5,0)	5.0 (4.0–5,0)	0.151	0.880
Total	4.3 (3.8–4.8)	4.4 (4.0–4.9)	–1.701	0.089	4.6 (4.1–5.0)	4.6 (4.1–5.0)	–0.199	0.842

Legend: The median (Q1–Q3) is provided for each group.

Table 7. Overall evaluation of simulation assumptions according to the SDS Questionnaire among students

Scale	Evaluation of scenario elements					Importance of scenario elements				
	M	SD	Me	Q1	Q3	M	SD	Me	Q1	Q3
Objectives and Information	4.2	0.8	4.2	4.0	5.0	4.4	0.6	4.4	4.0	5.0
Support	4.2	0.8	4.0	3.8	5.0	4.4	0.6	4.5	4.0	5.0
Troubleshooting	4.3	0.7	4.4	4.0	5.0	4.5	0.5	4.6	4.0	5.0
Reflection with feedback	4.4	0.5	4.5	4.0	5.0	4.5	0.5	4.8	4.0	5.0
Fidelity (realism)	4.5	0.7	5.0	4.0	5.0	4.6	0.6	5.0	4.0	5.0
Total	4.3	0.6	4.4	4.0	4.8	4.5	0.5	4.6	4.1	5.0

Table 8a. Evaluation of simulation assumptions according to the SDS Questionnaire among students based on marital status

Scale	Evaluation of scenario elements				
	single	married	divorced	Kruskal-Wallis test	
				H	p
Objectives and Information	4.3 (4.0–5.0)	4.2 (3.4–5.0)	4.4 (4.0–5.0)	1,257	0.533
Support	4.0 (4.0–5.0)	4.0 (3.8–5.0)	4.3 (4.0–5.0)	0.947	0.623
Problem-solving	4.4 (4.0–5.0)	4.4 (4.0–5.0)	4.2 (4.0–5.0)	0.562	0.755
Reflection with feedback	4.5 (4.0–5.0)	4.5 (4.0–5.0)	4.5 (4.0–5.0)	1,262	0.532
Fidelity (realism)	4.5 (4.0–5.0)	5.0 (4.0–5.0)	5.0 (4.0–5.0)	0.045	0.978
Total	4.4 (4.0–4.8)	4.3 (3.8–4.9)	4.4 (3.9–4.9)	0.663	0.718

No significant differences were found in the evaluation of simulation assumptions among nursing students based on marital status. Both the evaluation of scenario elements and the importance of scenario elements were relatively similar among the participants who were single, married, or divorced (Tables 8a and 8b).

Table 8b. Evaluation of simulation assumptions according to the SDS Questionnaire among students based on marital status

Scale	Importance of scenario elements				
	single	married	divorced	Kruskal-Wallis test	
				H	p
Objectives and Information	4.4 (4.0–5.0)	4.4 (4.0–5.0)	4.4 (4.4–5.0)	1,664	0.435
Support	4.3 (4.0–5.0)	4.5 (4.0–5.0)	4.8 (4.0–5.0)	2,439	0.295
Problem-solving	4.6 (4.0–5.0)	4.6 (4.0–5.0)	5.0 (4.0–5.0)	0.872	0.647
Reflection with feedback	4.8 (4.0–5.0)	4.8 (4.0–5.0)	5.0 (4.0–5.0)	1,669	0.434
Fidelity (realism)	5.0 (4.0–5.0)	5.0 (4.0–5.0)	5.0 (4.0–5.0)	0.318	0.853
Total	4.6 (4.1–5.0)	4.6 (4.1–5.0)	4.7 (4.2–5.0)	1,251	0.535

Legend: The median (Q1–Q3) is provided for each group.

Discussion

In recent years, there has been a significant increase in the use of medical simulation as an educational tool for nursing students [2]. Simulation-based classes prepare nursing students for their future careers and patient care responsibilities [3, 4]. Nowak emphasizes that medical simulators provide a safe learning environment, allowing students to make mistakes without posing any risk to patients' health [5]. Similarly, Zieliński highlights the opportunity for students to repeatedly practice the same scenarios, enabling them to refine their skills and reinforce their knowledge [6]. Also, Pawłowski extensively discussed medical simulation in terms of repetition and the development of not only technical skills but also decision-making and communication abilities [7]. Therefore, it is essential to assess and analyze the effectiveness of medical simulation in nursing education using appropriate research tools. In this study, the effectiveness was evaluated using standardized EPQ and SDS questionnaires. Both scales are simple and relatively new tools for measuring nursing students' perceptions of the presence and importance of best educational practices. In the existing literature, the SDS and EPQ scales are recommended as professional tools primarily used for evaluating simulation experiences and the application of best simulation practices [8]. The research material collected and

analyzed in this study allows for an assessment of the effectiveness of educational methods in the context of simulation-based learning.

Our own study shows that the sociodemographic variables, such as student age, play a significant role in the evaluation of educational techniques and simulation scenarios. Analysis of the results of a study conducted by Zalewska, which included 361 students, shows similarities with the findings presented in this study [9]. Similarly, Zapko et al. found a statistically significant difference between different student cohorts and their expectations regarding the use of best educational practices [10]. Based on the results above, it can be inferred that the higher the year of study (and consequently, the age of students), the lower their evaluation of scenario elements. Additionally, the results of this study suggest that students without children rated scenario elements such as objectives and information higher. However, there is no existing scientific evidence confirming this aspect as a factor affecting simulation effectiveness. Rodriguez et al. emphasized that collaboration is a key component in the education of future medical professionals [11]. In simulation-based learning, active learning and collaboration are crucial elements that enable students to be fully engaged, utilizing their cognitive, psychological, and interpersonal skills to effectively support patients. Moreover, collaboration fosters learning through problem-solving, reflecting real-life situations. Based on these considerations, conducting the present study on student evaluation of educational techniques in the context of nursing education was well justified. Our study demonstrated that students rated collaboration-related educational techniques the highest. These findings are consistent with those of Zapko et al., who found that students considered collaboration the most important element of educational practices [10].

In the study by Khasawneh et al., conducted in the Middle East countries on a group of 370 nursing students, the participants highly rated active and diverse learning methods, collaboration, and expectations. Moreover, these factors were positively correlated with self-confidence and student satisfaction [12]. Comparing these results with the findings of the present study one can notice a convergence regarding elements such as diverse learning methods and expectations. Jeffries describes these educational techniques as supportive of learning and student satisfaction [13]. Another crucial aspect of this study was to determine whether simulation is an effective method for preparing future nurses for clinical practice. The results of the study by Zapko et al. show that simulation is based on solid educational practices and plays a key role in preparing students for their future professional careers [10]. The results of our study demonstrate consistency with the research findings of the authors above, as students rated the realism of simulations at a very high level.

Another study confirming the effectiveness of simulation in realistic clinical situations was conducted by Alshammari et al., whose findings indicated that students appreciated the practicality of simulation and their enhanced competence in applying acquired skills to clinical environments [14]. The use of medical simulation in healthcare education offers numerous advantages, including improved quality of education and training, increased patient safety, enhanced teamwork skills, and continuous professional development. These activities enable future healthcare professionals to better prepare for diverse clinical situations, directly contributing to improved quality of healthcare. Based on the above considerations, medical simulation is confirmed as an effective educational method that allows students to acquire and improve their skills in a safe and realistic environment.

Conclusions

The study showed that students rated educational techniques related to collaboration the highest, identifying this area as crucial in the educational process. Student age and parental status significantly influenced the students' evaluations of educational practices. The participants highly rated the realism of simulation, considering it an essential component of education that would significantly impact their future professional practice**.**

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