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The role of interactive scenarios in simulation training for improving the critical thinking of medical students

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O papel dos cenários interativos no treinamento de simulação para aprimorar o pensamento crítico dos estudantes de medicina

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El papel de los escenarios interactivos en la formación con simulación para mejorar el pensamiento crítico de los estudiantes de medicina

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Abstract: *The aim of the article is to determine the effectiveness of simulation training for the development of critical thinking in medical students. The Starkey's Critical Thinking Test and specialized observation of the critical thinking of doctors in their professional activities were used to check the levels of the studied parameters. The initial diagnostics showed a predominance of low indicators of the general critical thinking of dental students. The medium and low indicators of the parameter were distributed almost equally in the sample of surgical students. The samples recorded a similar division of persons with low, medium, and high levels of critical thinking in professional activity. The delivered simulation training with interactive scenarios resulted in a slight increase in the general indicators of critical thinking in the experimental group (EG) of dental students. No significant dynamics of results for this parameter were recorded in other samples. Critical thinking in professional situations shows positive changes in all control groups (CG) and EGs as a result of simulation training. Therefore, it can be unequivocally stated that educational simulations are an effective tool for the development of clinical thinking. The implementation of interactive scenarios can provide an additional developmental effect. The obtained data enable making the development of professional competencies in medical students more effective. Further research may focus on studying the influence of simulation training on the critical thinking of medical students in other fields (therapeutic, traumatology, neurology, etc.).*

Key words: *Critical thinking. Interactive scenario. Medical students. Simulation training.*

Resumo: O objetivo deste artigo é determinar a eficácia do treinamento de simulação para o desenvolvimento do pensamento crítico em estudantes de medicina. O Teste de Pensamento Crítico de Starkey e a observação especializada do pensamento crítico de médicos em suas atividades profissionais foram utilizados para verificar os níveis dos parâmetros estudados. O diagnóstico inicial mostrou uma predominância de indicadores baixos de pensamento crítico geral entre os estudantes de odontologia. Os indicadores médios e baixos foram distribuídos quase igualmente na amostra de estudantes de cirurgia. Uma divisão semelhante de indivíduos com níveis baixos, médios e altos de pensamento crítico na atividade profissional foi registrada nas amostras. O treinamento de simulação realizado com cenários interativos resultou em um

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leve aumento nos indicadores gerais de pensamento crítico no grupo experimental (GE) de estudantes de odontologia. No entanto, não foram observadas mudanças significativas nos resultados para esse parâmetro em outras amostras. O pensamento crítico em situações profissionais apresentou mudanças positivas em todos os grupos de controle (GC) e GE como resultado do treinamento de simulação. Portanto, pode-se afirmar inequivocamente que simulações educacionais são uma ferramenta eficaz para o desenvolvimento do pensamento clínico. An implementação de cenários interativos pode proporcionar um efeito adicional de desenvolvimento. Os dados obtidos possibilitam tornar o desenvolvimento de competências profissionais em estudantes de medicina mais eficaz. Pesquisas futuras podem focar no estudo da influência do treinamento de simulação sobre o pensamento crítico de estudantes de medicina em outras áreas (terapêutica, traumatologia, neurologia, etc.).

Palavras-chave: Cenários interativos. Estudantes de medicina. Pensamento crítico. Treinamento de simulação.

Resumen: *El objetivo del artículo es determinar la efectividad del entrenamiento en simulación para el desarrollo del pensamiento crítico en estudiantes de medicina. Se utilizaron el Test de Pensamiento Crítico de Starkey y la observación especializada del pensamiento crítico de los médicos en sus actividades profesionales para verificar los niveles de los parámetros estudiados. El diagnóstico inicial mostró una predominancia de indicadores bajos de pensamiento crítico general entre los estudiantes de odontología. Los indicadores medianos y bajos del parámetro se distribuyeron casi equitativamente en la muestra de estudiantes de cirugía. Las muestras registraron una división similar de personas con niveles bajos, medios y altos de pensamiento crítico en la actividad profesional. El entrenamiento de simulación impartido con escenarios interactivos resultó en un leve aumento de los indicadores generales de pensamiento crítico en el grupo experimental (GE) de estudiantes de odontología. No se registraron dinámicas significativas de resultados para este parámetro en otras muestras. El pensamiento crítico en situaciones profesionales muestra cambios positivos en todos los grupos de control (GC) y GE como resultado del entrenamiento en simulación. Por lo tanto, se puede afirmar inequívocamente que las simulaciones educativas son una herramienta efectiva para el desarrollo Del pensamiento clínico. La implementación de escenarios interactivos puede proporcionar un efecto adicional de desarrollo. Los datos obtenidos permiten hacer más efectiva la formación de competencias profesionales en los estudiantes de medicina. Investigaciones futuras pueden centrarse en estudiar la influencia del entrenamiento en simulación sobre el pensamiento crítico de los estudiantes de medicina en otros campos (terapéutica, traumatología, neurología, etc.).*

Palabras clave: *Entrenamiento en simulación. Escenarios interactivos. Estudiantes de medicina. Pensamiento crítico.*

1 INTRODUCTION

Active use of technology is one of the key features of the modern educational process (Dyka *et al*., 2023, p. 189). The use of technologies in the training of medical workers has an important social significance and was significantly updated during the Covid-19 pandemic (Frenk *et al*., 2022, p. 1541). The technological aspect of medical education in a relatively short time has evolved from the use of elementary multimedia tools to the widespread use of online platforms and virtual simulations (Chowdhury *et al*., 2024, p. 5). The use of simulation for medical students is accompanied by a number of difficulties, namely, negative social stereotypes, uneven funding, insufficient academic justification of its effectiveness (Ayaz, Ismail, 2022, p. 302). However, in recent decades, this form of education has been massively implemented in medical educational institutions, which is associated with the optimization of the development of specialists' practical skills of and ensuring patients' safety (Saleem, Khan, 2023, p. 1187). Despite the existing shortcomings in the context of transferring acquired skills to real situations, simulations are a promising tool for medical education (Elendu *et al*., 2024). The studies of interactive scenarios of simulation training in professional education in general and in medical training in particular are relevant.

The development of students' critical thinking is one of the most significant practical areas of higher education, which requires proper academic justification (Bellaera *et al*., 2021). The development of skills of critical analysis of reality enables optimizing the connection of theoretical knowledge and practical competencies (Indrašienė *et al*., 2023). The integration of critical thinking methods into the educational programmes of educational institutions is being updated in the context of the training of medical students (Châlon *et al.,* 2024). Medical education involves the use of a number of both traditional and innovative methods for the development of critical thinking, in particular, simulations (Araújo *et*

al., 2024). However, there is a lack of empirical data in science, which allows to draw reasoned academic conclusions regarding the specified problem.

The aim of the article is to determine the effectiveness of simulation training for the development of critical thinking of medical students. The aim involved the fulfilment of the following research objectives: a) analyse the main aspects of using simulation training in the professional education of medical students; b) identify the levels of indicators of critical thinking of medical students; c) experimentally determine the effectiveness of using interactive scenarios in the simulation training of future doctors for the development of critical thinking.

2 LITERATURE REVIEW

Simulation is a space that imitates various aspects of reality and allows users to interact with models of certain phenomena and situations (Mcalpin *et al.,* 2023). Simulation training is especially relevant in higher education when learning professional competencies in extreme situations, when it is possible to involve people with minimal professional experience (Faber et al., 2022). The effectiveness of professional training using simulations depends on the degree of realism of the generated didactic space (Valori *et al*., 2020). This indicator is determined by the performance of experienced specialists and novices in the created environment (Wood *et al.*, 2020, p. 44). The use of simulations in medical education has a long history: from physical mannequins and models to modern virtual reality (VR)-based simulators (Sun *et al.,* 2024). The advantages of using simulations in medical education are the maximum control of the performance of educational tasks by the teacher, safe learning conditions, reproduction of unique professional situations (So *et al*., 2019, p. 53). Learning critical medical skills using computer simulations can increase students' self-confidence and reduce anxiety (Dhar *et al*., 2023, p. 15). In particular, the creation of an interactive virtual simulation space in the training of surgical students makes it possible to more realistically simulate operations and recreate resuscitation scenarios without the limitations of physical simulators (Zackoff *et al*., 2021, p. 575). An important direction of this educational method is virtual interaction with patient models, which allows practicing the skills of taking an anamnesis, physical examination, and strategies for communicating with patients (Matamala-Gomez *et al*., 2021).

Methodologically grounded virtual simulations in medical education are a tool for identifying problematic aspects of student training, knowledge control, and providing feedback (Mekbib *et al*., 2020, p. 457). Educational approaches that combine virtual models (e.g., patients) with physical simulators are promising (Gasteiger *et al*., 2022). The transition from computer simulation to the performance of specific medical actions is ensured in this way. A mandatory element of simulation training in medical training is the final discussion of the lesson, the so-called debriefing, which aims to reflect on educational and professional actions and correct possible mistakes (Mallik *et al.,* 2022, p. 848). An important element of the educational approach under study is interactive scenarios — an educational algorithm that involves the implementation of several content options depending on the learner's actions (Adebiyi, 2019, p. 332). This scenario should be aimed at maximum students' immersion in educational simulation reality (Oktay, Yuzer, 2023, p. 98).

Critical thinking allows you to effectively function in your professional and personal life. There are many definitions of this phenomenon, but in general, critical thinking is purposeful, argumentative, problem-solving oriented, formulating adequate conclusions, and reasoned decision-making taking into account the specific context and type of task (Halpern, Dunn, 2021, p. 22). In higher education, the development of this intellectual process allows for the formation of effective reflection and an objective attitude to reality (Sagun, Prudente, 2021, p. 68). The critical thinking is developed in the course of improving the argumentation of students' own opinion (Perez *et al.,* 2021,

p. 51). The development of critical thinking in medical students makes it possible to fully analyse the anamnesis data, give reasoned diagnoses, and find the most adequate ways of treating patients (Zia, Dar, 2019, p. 969). Kahlke and Eva (2018, p. 158) distinguished the following types of critical thinking among medical students: a) biomedical — based on a clear, rational formulation of a medical diagnosis; b) humanistic – oriented to altruistic tendencies and human welfare; c) socially oriented – analysis of medical cases in the context of specific social stereotypes and prejudices.

Therefore, the study of the specifics of simulation training in medical education is a relevant direction of pedagogical academic research. The studies aimed at clarifying the development of critical thinking as an important competence of medical students are also relevant. At the same time, the problem of the influence of training simulations on the development of critical thinking of medical students requires a reasonable experimental verification.

3 MATERIALS AND METHODS

3.1. RESEARCH DESIGN

The influence of simulation training on the development of students' critical thinking was studied through a formative experiment. A simulation programme using interactive scenarios was used as an independent variable. The dependent variable of the experiment is the critical thinking of medical students in the context of professional activity. The stages reflect the general logic of the academic research conducted during September 2023 - June 2024.

a) The organizational stage determined the main methodological, strategic, and tactical aspects of the research. The analysis of theoretical sources gives grounds to advance a research hypothesis — the use of interactive scenarios of simulation training contributes to increasing the indicators of critical thinking of medical students. This stage involves active consultations with experts in the medical field, teachers, IT specialists to ensure a valid and reliable data collection. Administrative issues related to sample selection and the use of specialized equipment in the experiment were resolved. Methodical tools for diagnosing the critical thinking of medical students were also selected. The most favourable time intervals for conducting research procedures were determined.

b) The experimental stage provided for data collection and experimental impact. Primary diagnostics of critical and clinical critical thinking of medical students was carried out. A simulation training programme with interactive scenarios was conducted in the EG. The straight-line type simulations were carried out in the CG. Secondary diagnostics made it possible to determine the dynamics of indicators of critical thinking in both groups. This stage lasted 8 months in order to state the systemic experimental influence.

c) The data processing and interpretation stage. Individual diagnostic data were calculated before the beginning and after the completion of the simulation training programme. Ordinal scales were used in the measurements. The correspondence of the distribution of critical thinking diagnostic indicators of the obtained data to the normal distribution law was determined. A statistical hypothesis was tested regarding the differences between the numerical indicators in the EG. The data interpretation included an explanation of the impact of simulations with interactive scenarios on the critical thinking of medical students. A conclusion on the effectiveness of the experimental programme is drawn.

3.2. INSTRUMENTS

Testing is aimed at finding out general indicators of critical thinking of medical students. The Starkey's Critical Thinking Test is valid and adapted for use in the Ukrainian socio-cultural space (Lutsenko, 2014, p. 67). The observation made it possible to determine critical thinking in the context of solving specific clinical problems that arise in the professional activity of doctors. The main criteria for the development

of critical clinical thinking are rational diagnostics, the ability to determine a well-founded treatment plan, solving a medical problem in an extreme situation, independent analysis, and the quality of professional reflection. Each parameter had its own indicators, which were evaluated on a seven-point scale. The diagnostics was carried out during the completion of educational assignments. So, the study covered both general trends in critical thinking and profession-specific manifestations of activity.

3.3. SAMPLE

In the study, it was decided to check the peculiarities of the development of critical thinking of two groups of internship students majoring in Surgery and Dentistry. Two samples were formed in each of these groups: the EG (under experimental influence) and the CG (no experimental influence). The study involved the third- and fourth-year bachelor's students from Danylo Halytsky Lviv National Medical University and Dnipro State Medical University. The age of the subjects is 23–26 years. Quantitative composition of the group of dental students: 43 students in the CG and the EG. Quantitative composition of the group of surgical students: 46 students in each group. So, the total number of subjects is 178 people. The gender distribution of the sample is 137 boys (76.97%) and 41 girls (23.03%). The study was conducted on the basis of mandatory informed consent of the participants.

3.4. COLLECTED DATA

The data were collected by direct diagnostic methods and observation. The tests were carried out by qualified specialists in the field of pedagogy and psychology. The experimental programme of simulation training was implemented in the context of the content of the educational programmes of the relevant majors. Technologies for creating a virtual patient and performing surgical or dental interventions are used. Virtual simulations were used in combination with physical mannequins and models. Each lesson followed the typical structure of the material: introduction, actualization of basic knowledge, theoretical block, completion of simulation assignments, debriefing, which involves consolidating the material. The classes were held in extracurricular time in minigroups of 5-7 people. The duration of each class is two hours, twice a week. The implementation of interactive scenarios in the experimental programme provided for various options for the development of the simulation depending on the subject' actions. For example, the probable error involved not restarting the simulation, but starting a new programme, which involved correcting incorrect medical actions. Various variants of the virtual patient's reactions to treatment were included in the interactive scenarios, which involved changing the strategy and tactics of the students' actions. Discussions with interactive scenarios are the defining forms of developing students' critical thinking. For example, a typical simulation tool was collective diagnostics in study groups. In particular, the teacher offered various options and reasons for the development of the disease and treatment, ranging from pseudoscientific to scientifically grounded. Discussion of these diagnoses taught students to overcome various cognitive distortions and the effect of authority. The variant of the development of each stage of the diagnosis discussion scenario did not have clearly defined stages in terms of duration. It depended on the specifics of the educational content of the simulation and the specifics of the persistence of students' stereotypes and prejudices. The experimental programme and data collection were carried out by the authors of the study together with assistants.

3.5. DATA ANALYSIS

The data analysis is aimed at clarifying statistical indicators of critical and clinical thinking of medical students during the experimental programme. The data was presented in a scale reflecting the following qualitative levels: 0-3 points – low; 4-5 points — medium; 6-7 points — high. Identified trends of percentage distribu-

tion and average values are recorded in charts and tables. The compliance of the obtained indicators with the Gaussian curve was verified by conducting the Kolmogorov–Smirnov test. The Wilcoxon T-test was used to determine the significance of differences in the influence of simulation training in the EG and CG. Statistical analysis was carried out using the Statistical Package for the Social Sciences (SPSS).

4 RESULTS

The results of simulation training using interactive scenarios are presented in tables (Tables 1, 2) and diagrams (Figures 1, 2). Both the change in the percentage trends of the critical thinking parameters and the arithmetic mean are shown for a more complete analysis. Abbreviations of CG and EG in the diagrams represent the control and experimental groups. Numbers 1 and 2, respectively, show the results of pre-diagnostics and post-diagnostics (before and after the delivery of simulation training programme).

The trends of indicators of critical thinking of dental students are presented in Table 1 and Figure 1. Pre-diagnostics showed the dominance of low indicators of students' general critical thinking. Medium values of the parameter at the beginning of the experiment were recorded for about a third of the subjects. A high level of critical thinking was found in only a few students. The results are confirmed by calculating the arithmetic mean, which is in the vicinity of the mark — 3. Visual data show that no significant changes in the critical thinking of future dentists were found in the CG. At the same time, there is a positive dynamics of indicators in the EG, where interactive scenarios were used. So, medium values increased by 37.23%, and high values — by 16.26%. The arithmetic mean of critical thinking of surgical students in the EG shifted from 3.09 to 4.79.

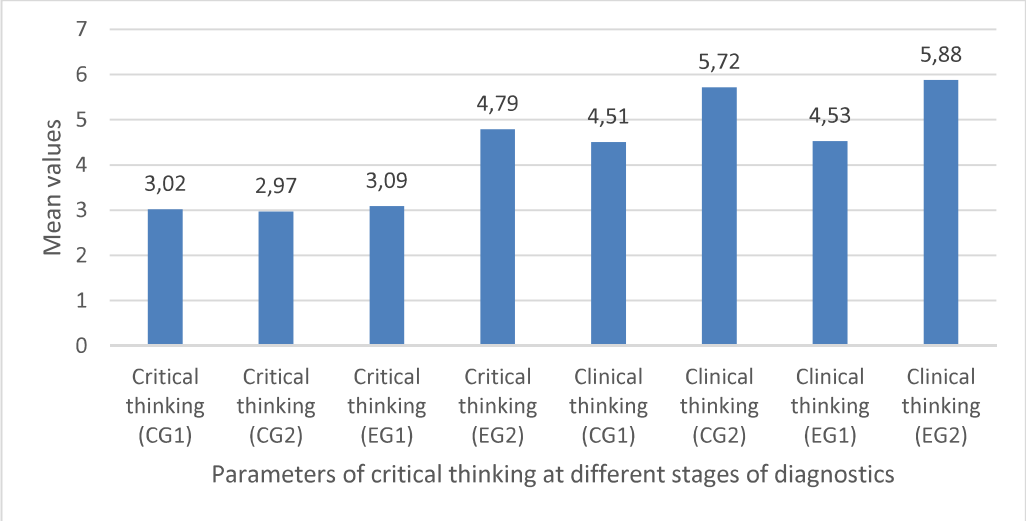
Table 1- Dynamics of the levels of critical thinking parameters of dental students in the during the simulation training

Studied components	Development levels	The number of respondents							
		CG				EG			
		Pre-diagnostics		Post-diagnostics		Pre-diagnostics		Post-diagnostics	
		%	Q-ty	%	Q-ty	%	Q-ty	%	Q-ty
General critical thinking	Low	67.44	29	67.44	29	60.47	26	6.98	3
	Medium	27.91	12	25.58	11	32.55	14	69.78	30
	High	4.65	2	6.98	3	6.98	3	23.24	10
Critical thinking in professional situations	Low	30.23	13	6.98	3	30.23	13	4.65	2
	Medium	30.23	13	9.3	4	27.91	12	11.63	5
	High	39.54	17	83.72	36	41.86	18	83.72	36

Source: Prepared by the authors (2024).

The levels of critical thinking in clinical situations were divided into almost three equal parts (Table 1, Figure 1). Arithmetic mean values reflect the approximation to the central tendency. It can be stated that the professional thinking of dental students is better developed, compared to the general critical thinking. Positive dynamics of changes were recorded in both groups after the completion of the simulation training programme. The difference in indicators for the sample as a whole is more than 40%. The arithmetical mean for clinical thinking of the CG students after the experiment changed from 4.51 to 5.72, while in the EG — from 4.53 to 5.88. Therefore, the simulation training programme with interactive scenarios demonstrated its effectiveness in the development of critical thinking. This especially applies to solving the problems of medical direction in professional activity.

Figure 1- Distribution of average values of parameters of critical thinking in groups of dental students



Source: Prepared by the authors (2024).

The trends of the studied indicators in the groups of surgical students are presented in Table 2 and Figure 2. The primary diagnostics showed a difference with the data obtained in the sample of dental students. Medium and low indicators of general critical thinking were distributed almost evenly. Differences within statistical error were found after completion of the simulation training programme. This is demonstrated, in particular, on the diagram with the indicators of the arithmetic mean (Figure 2). It can be stated that the experimental programme was not effective in forming the general critical thinking of surgical students.

The tendencies of critical thinking in professional situations are considered below. Compared to the sample of dental students, a higher incidence of medium and low indicators was recorded in the group of surgical students.

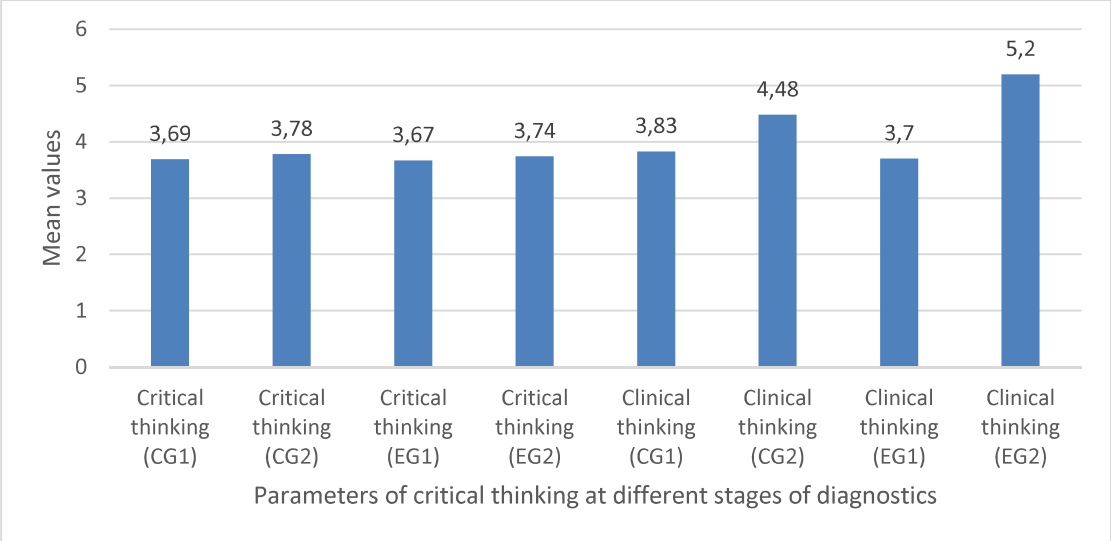
The percentage of individuals with a high level of the parameter is lower compared to the parallel sample. The medium values of critical thinking are 3.83 and 3.7 (Figure 2). The parameter shift was recorded in both samples upon completion of the simulation training. A significant increase in the percentage of persons with a high level of professional critical thinking (by 32.61%) was found in the CG. The arithmetic mean changed from 3.83 to 4.48. This indicator increased from 3.7 to 5.2 in the EG (Figure 2). There is a significant increase in the percentage of surgical students with a high level of clinical thinking after the end of the experiment (by 47.82%). Therefore, the obtained data testify to the effectiveness of the simulation training programme using interactive scenarios for the development of critical thinking in a professional context.

Table 2- Dynamics of the levels of critical thinking parameters of surgical students during the simulation training

Studied components	Development levels	The number of respondents							
		CG				EG			
		Pre-diagnostics		Post-diagnostics		Pre-diagnostics		Post-diagnostics	
		%	Q-ty	%	Q-ty	%	Q-ty	%	Q-ty
General critical thinking	Low	43.48	20	36.95	17	43.48	20	36.96	17
	Medium	43.48	20	47.83	22	47.83	22	54.35	25
	High	13.04	6	15.22	7	8.69	4	8.69	4
Critical thinking in professional situations	Low	39.13	18	6.52	3	41.3	19	8.69	4
	Medium	41.3	19	73.91	34	43.38	20	28.27	13
	High	19.57	9	19.57	9	15.22	7	63.04	29

Source: Prepared by the authors (2024).

Figure 2- Distribution of average values of parameters of critical thinking in groups of surgical students



Source: Prepared by the authors (2024).

A statistical analysis of the obtained experimental data was carried out to confirm the preliminary conclusions. The Kolmogorov-Smirnov test indicates that the studied statistics do not correspond to a normal distribution. This is why it was decided to use the non-parametric Wilcoxon T-test. The results are presented in Table 3. It was found that significant coefficients of difference for general critical thinking were found only in the EG of dental students (T=303). The significance level is 0.05. According to the indicators of critical thinking in professional situations, significant difference was recorded in all groups (T=206, T=194, T=336, T=310). Only in the CG of surgical students, the significance level of the Wilcoxon T-test is 0.05. In all other cases p=0.01.

Table 3- Value of the Wilcoxon T-test of the studied parameters in the context of the simulation training programme

Studied parameterS	Wilcoxon T-test			
	The sample of surgical students		The sample of dental students	
	CG	EG	CG	EG
Critical thinking	401	303*	411	454
Critical thinking in professional situations	206**	194**	336*	310**

Source: Prepared by the authors (2024).

Therefore, the obtained results indicate the effectiveness of the simulation training programme with interactive scenarios for the development of critical thinking in professional activities. In general, it is possible to state a rather positive attitude of the studied students to experimental classes. At the same time, certain difficulties of the subjects with the choice of action during the implementation of the interactive strategy of the lesson were observed. However, they were overcome through teachers' support and the use of problem-based learning. A gradual increase in the confidence of medical students in simulated extreme situations is observed. Gradual positive dynamics were also observed during the debriefing and students' final reflection.

5 DISCUSSION

The research hypothesis stated that the use of interactive scenarios of simulation training helps to increase the indicators of critical thinking of medical students. In general, it is partially confirmed. In particular, positive shifts in general critical thinking were recorded only in the sample of dental students where interactive scenarios were used. We explain such results by the greater focus of doctors in this area on interaction with the patient and solving specific problems of social interaction. In case of critical thinking with a professional orientation, educational simulation is effective both in the CG and in the EG. This means that interactive scenarios do not play a key role in this case. However, the interactive structure of the lesson gave an additional developmental effect in the group of surgical students, which was manifested in the higher statistical significance of the experimental effect. The general tendencies of critical thinking, which were identified in the process of primary diagnostics in samples of dental and surgical students, are explained by the peculiarities of the educational process in these majors.

In general, we confirm the results of other studies on the effectiveness of simulations in medical education (Elendu *et al.,* 2024). We also confirm the positive impact of virtual technologies on the development of critical thinking of medical students (Araújo *et al.,* 2024). We are positive about the conclusions about the combination of virtual simulation and physical simulators in the professional training of doctors (Gasteiger *et al*., 2022). The problem of realism of educational medical content was solved due to this approach (Valori *et al*., 2020)

Our research gives grounds to agree with the conclusions about the main advantages of simulations in medical education, in particular, in relation to ensuring the students' safety and effective control of the educational process (So *et al*., 2019, p. 54). Therefore, this tool is ideal for building skills in extreme situations (FABER et al., 2022). In this context, the use of interactive scenarios is particularly useful. We can also talk about positive psychological effects for higher school students in the context of using simulations (Dhar *et al*., 2023, p. 17). One

of the key elements of simulation is debriefing (Mallik *et al.,* 2022, p. 850). This statement is justified in the context of our study. It is appropriate to offer debates as a form of work in solving medical issues when developing general critical thinking of medical students (Perez *et al.*, 2021, p. 60). In general, the independent, rational solution of professional tasks allows for more reasoned diagnoses and the optimal selection of a treatment strategy (Zia, Dar, 2019, p. 970).

5.1. LIMITATIONS

The academic significance of the results is limited by several factors. First, the quantitative composition of samples is insufficient, which, however, reflects the trends of education in the medical field. Second, the lack of standardized tools to test the critical thinking of medical students could potentially distort the findings. Third, the final conclusions about the development of critical thinking can be obtained in the study of the students' real professional activity. In our opinion, these remarks will not allow us to more clearly use the obtained results in educational practice.

5.2. RECOMMENDATIONS

The results of the study give grounds to make recommendations regarding the use of simulation training for the development of critical thinking of medical students:

a) optimize the methodological argumentation of the use of simulation training in medical education, in particular, to fix clear algorithms in educational programmes of the relevant majors and training programmes of specific subjects;

b) Improve the teachers' competence in using virtual simulators;

c) Create interactive scenarios for educational simulations with the involvement of experts — doctors, psychologists, teachers, lawyers, etc.;

d) inform students about the general sequence of realization of critical thinking;

e) consider and refute, together with the students, popular prejudices and stereotypes regarding the medical profession — their essence and sources.

6 CONCLUSIONS

The implementation of simulation training in the education of medical students is a relevant area of research. The orientation of modern educational technologies not only on professional competencies, but also on soft skills, taking into account professional specifics, is of great importance. In this context, critical thinking is a particularly significant phenomenon. The hypothesis that the use of interactive scenarios of simulation training contributes to increasing the indicators of critical thinking of medical students was confirmed in the course of the conducted formative experiment. The primary diagnostics showed a predominance of low indicators of the general critical thinking of dental students, while the medium and low indicators of the parameter were distributed almost equally in the sample of surgical students. The samples recorded a similar division of persons with low, medium and high levels of critical thinking in professional activity. As a result of the implementation of simulation training with interactive scenarios, the general indicators of critical thinking increased slightly only in the EG of dental students. No significant dynamics of results for this parameter were recorded in other samples. Critical thinking in professional situations shows positive changes in all CGs and EGs as a result of simulation training. Therefore, it can be unequivocally stated that educational simulations are an effective tool for the development of clinical thinking. At the same time, the implementation of interactive scenarios can provide an additional developmental effect. The obtained data make it possible to make the development of professional competencies of medical students more effective. These results are the basis for methodological justification of the use of virtual reality technologies in professional medical education. Prospects for further research are to study the influence of simula-

tion training on the critical thinking of medical students in other fields (therapy, traumatology, neurology, etc.).

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