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Effectiveness of medical simulation among nursing students

Magdalena Brodowicz-Król[1,A-B,D-E], Maria Malm[2,C], Katarzyna Ewa Wiśniewska[3,F], Paweł Więch[4,E], Paulina Maria Kaczor-Szkodny[5,C-F] ✉

[1] *Department of Nursing and Public Health, Institute of Health Sciences, College of Medical Sciences, University of Rzeszów, Poland*
[2] *Department of Medical Informatics and Statistics with E-learning Laboratory, Medical University, Lublin, Poland*
[3] *Faculty of Health Sciences, Radom Higher School, Radom, Poland*
[4] *Collegium Medicum, University of Rzeszów, Poland*
[5] *Department of Epidemiology, Institute of Rural Health, Lublin, Poland*
A – Research concept and design, B – Collection and/or assembly of data, C – Data analysis and interpretation, D – Writing the article, E – Critical revision of the article, F – Final approval of the article

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Abstract

Introduction and Objective. Medical simulation is experiencing rapid growth in medical education, including nursing. Combining traditional teaching with medical simulation allows nursing students to develop both technical and non-technical skills in a controlled, safe environment. The aim of the study is to evaluate the effectiveness of nursing student education using medical simulation by assessing the simulation assumptions and student satisfaction and confidence in the learning process, along with an analysis of their predictors.

Materials and Method. The study was conducted from October 2023 – May 2024, and involved 306 nursing students from the Zamojska Academy in Zamość and the WSEI Academy in Lublin, both in eastern Poland. The Simulation Design Scale (SDS) and Student Satisfaction And Self-Confidence In Learning (SSCL) tools were used in the study.

Results. Nursing students experience confidence and satisfaction in the learning process, were significantly more pronounced among rural residents ($p<0.05$). Self-confidence and satisfaction in the learning process were negatively correlated with age ($p<0.05$), and are positively influenced by higher evaluation and importance of simulation objectives, and information and evaluation of problem solving, and negatively correlated by importance of problem solving ($p<0.05$).

Conclusions. The different elements of medical simulation teaching are highly valued by nursing students in the learning process. The evaluation of the assumptions of medical simulation and the importance of the role of prebriefing and debriefing as its most important elements, allow the prediction of the level of confidence and satisfaction of students, translating into the achievement of the assumed learning outcomes in terms of knowledge, skills and social competences.

Key words

effectiveness, skills, nursing students, medical simulation

INTRODUCTION

Simulation is an artificial reality created within the real world that enables nursing students to learn by experiencing potential clinical situations in a safe environment [1]. Simulations are typically classified as high-, medium-, or low-fidelity, with high-fidelity simulations providing the most accurate representation of clinical scenarios that nurses may encounter in their professional practice [2]. Combining traditional teaching by using simulation, nursing students are able to develop both their practical abilities and interpersonal competencies – such as cognitive, social, and personal competencies – including critical thinking and reflection on practice [3].

Research indicates that active participation in medical simulations enables students to systematically develop and refine the clinical skills undertaken within a safe and controlled environment [4, 5]. Such settings allow learners to make mistakes without negative consequences, reflect on them, and transform these experiences into valuable learning opportunities. Importantly, this approach eliminates any potential risk to real patients while promoting experiential learning. As a result, students often demonstrate increased self-efficacy, confidence, and overall satisfaction with their learning process. At the same time, engagement in simulation-based education has been shown to significantly reduce levels of anxiety and fear, thereby creating more favourable conditions for both personal and professional growth [4, 5].

Currently, due to the development of new information technologies, medical simulation is experiencing rapid growth in medical education, including nursing. Medical simulation is the subject of numerous studies by Polish [6, 7] and foreign researchers [8–12], who emphasize the importance of medical simulation in the development of technical and non-technical skills necessary for clinical practice. In Poland, the current applicable legal acts regarding the importance and use of medical simulation in teaching nursing students are the 'Regulation of the Minister of Science and Higher Education of 26 July 2019 on the standards of education preparing for the professions of doctor, dentist, pharmacist, nurse, midwife, laboratory diagnostician, physiotherapist and paramedic',

✉ Address for correspondence: Paulina Maria Kaczor-Szkodny, Department of Epidemiology, Institute of Rural Health, Jaczewskiego 2, 20-090 Lublin, Poland
E-mail: paulina.kaczor7@wp.pl

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together with the amendments introduced into the *Journal of Laws* in 2021 (*Journal of Laws 2021*, item 755) and in 2022 (*Journal of Laws 2022,* item 1555), the 'Long-term National Policy for Nursing and Midwifery in Poland from 2019', and 'Accreditation Standards for Nursing and Midwifery Degree Programs (2023)'. Currently, the development of new information technologies has resulted in the very dynamic development of medical simulation in teaching nursing students is being observed.

OBJECTIVE

The aim of the study is to evaluate medical simulation assumptions and the satisfaction of nursing students, imperative for instilling a sense of confidence in the learning process, together with the influence of socio-demographic variables. A priority of the study was also to identify the factors with the strongest impact on the high ratings of medical simulation assumptions, and the satisfaction of the students and their confidence in the learning process using the Medical Simulation Centre.

MATERIALS AND METHOD

The study was completed between October 2023 – May 2024 among nursing students at the Academy of Zamość in Zamość and the Lublin Academy of WSEI in Lublin, both in eastern Poland. A diagnostic survey method was used, employing the Simulation Design Scale (SDS) and Student Satisfaction and Self-Confidence in Learning (SSCL) research tools in their Polish adaptations. The SDS is a 20-item scale assessing key features of the simulation model: objectives and information – 5 items, support – 4 items, problem-solving – 5 items, reflection/feedback – 4 items, and fidelity – 2 items. Items are rated on a 5-point Likert scale (1 – 5), with higher scores reflecting stronger recognition of these features. The tool demonstrated high reliability (Cronbach's $\alpha = 0.92$) [13]. The second tool – SSCL – includes 2 subscales assessing feelings and satisfaction: 5 items on learning satisfaction and 8 on self-confidence. In total, the SSCL contains 13 statements rated on a 5-point Likert scale. Reliability measured by Cronbach's alpha was 0.87 for satisfaction and 0.84 for self-confidence [14]. A total of 306 first- and second-level nursing students at all levels, who were pursuing courses at the Medical Simulation Centre on a full-time or part-time basis, completed the questionnaires. This ensured that the sample was adequately representative in terms of assessing the assumptions of medical simulation. Prior to the study, respondents were informed about the purpose of the study, and that participation was anonymous and voluntary. Both SDS and SSCL questionnaires were completed correctly by a total of 302 nursing students (98.69%). In contrast, three respondents did not complete the SSCL questionnaire and one did not answer the SSCL scale questions.

The research project received a favourable opinion from the Bioethics Committee at the Zamojska Academy (Approval No. KBAZ1/2024).

The nursing students were between the ages of 20–50, with an average age of 30.57±8.12, among whom one-third of the study participants had studied nursing at degree I (n=108, 35.29%) and two-thirds at degree II (n=198, 64.71%). Almost half of the respondents lived in a rural area (n=144, 47.06%), one-third in a large city (n=96, 31.37%), while one-fifth lived in a city of up to 100,000 inhabitants (n=66, 21.57%). The majority were most often single (n=159, 51.96%) or married (n=126, 41.18%).

Statistical methods. Data from the collected questionnaires were entered into Microsoft Excel 365, after which statistical analysis was conducted utilising the Statistica 13.3 software. Data were subjected to various statistical assessments, including the calculation of counts, percentages, and a range of descriptive statistics. These encompassed the mean, standard deviation, median, first and third quartiles, minimum, and maximum, were used to characterise the study group and the results of the SSCL and SDS standardised questionnaires.

Pearson's relationship between age and the assessment of simulation assumptions, as well as student satisfaction and confidence, was analysed using the correlation coefficient in the learning process. In contrast, the Kruskal-Wallis test, together with Dunn's *post-hoc* test, was used to compare the results of the SSCL and SDS standardised questionnaires, according to place of residence. The non-parametric Kruskal-Wallis statistic was the variables were selected on the basis of the pronounced left asymmetry exhibited by the analysed distributions. The Lilliefors test yielded a rejection of the hypothesis of normality for the distribution.

A backward stepwise multiple regression was conducted for the purpose of examining the relationship between elements of the simulation scenario and nursing students' satisfaction and self-confidence in learning. All independent variables were quantitative, and included both the perceived importance and evaluation of 5 scenario components: objectives and information, support, problem-solving, reflection with feedback and fidelity (realism). The analysis started with a full model containing all 10 independent variables. Variables were entered or retained in the model based on an F-value threshold: inclusion required $F \geq 4$ and removal occurred if $F < 3$. These criteria, aligning with approximate p-values of 0.05 and 0.10, helped maintain model rigour while avoiding the premature elimination of potentially relevant predictors, in line with standard practices in regression modelling [15, 16]. The process involved 10 steps and ended when no variables met the removal criteria. Model comparisons were performed using F-tests to evaluate the significance of regression coefficients. A significance level of $\alpha = 0.05$ was applied in the analysis.

RESULTS

The overall evaluation of the simulation assumptions was best regarding the realism of the scenario elements (Me=5.0), and worst regarding support (Me=4.0), goals, and information (Me=4.2). Respondents indicated realism (Me=5.0) and reflection with feedback (Me=4.8) as their most important areas, while the other elements were only slightly less important to respondents (Tab. 1). The results of the SSCL questionnaire, on the other hand, indicated that both student satisfaction with the learning process (Me=4.2) and confidence in the learning process (Me=4.3) were at similar levels (Tab. 2).

In the next step, the results of the SDS and SSCL questionnaires were analysed in relation to the demographic

Table 1. A comprehensive evaluation of the simulation assumptions by the SDS questionnaire administered to a cohort of students

Scale	Assessment 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
Problem solving	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 2. General level of satisfaction and confidence in the learning process according to the SSCL questionnaire among surveyed students

Scale	Assessment of the learning process				
	M	SD	Me	Q1	Q3
Student satisfaction with the learning process	4.2	0.8	4.2	4.0	5.0
Confidence in the learning process	4.2	0.7	4.3	3.9	4.8
Total	4.2	0.7	4.2	4.0	4.8

variables of the nursing students. Statistically significant results were obtained for age and place of residence, and only these data were chosen to be included in the study. A weak negative correlation was identified between age and ratings for goals and information (R:-0.180; p=0.002), support (R:-0.154; p=0.007), and rates of simulation assumptions overall (R=-0.145; p=0.011). However, there was no significant association between age and the importance of scenario elements in the simulation for nursing students (Tab. 3).

Table 3. A comprehensive evaluation of the of simulation assumptions according by the SDS questionnaire administered to a cohort of students according to age

Scale	Correlation with age					
	Assessment 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

Statistical analysis showed significant differences in nursing students' evaluation of the simulation assumptions according to place of residence ($p<0.05$ for all scenario elements). Dunn's *post-hoc* test further indicated that significant differences were found between residents of rural areas and cities with more than 100,000 inhabitants, with scenario elements rated significantly better by those living in rural areas. For the importance of the scenario elements, significant differences were found only for support, but the Dunn's *post-hoc* test showed no differences between specific groups (Tab. 4).

A weak, negative correlation was found between age and satisfaction (R=-0.122; p=0.034) and confidence (R=-0.151; p=0.009) of nursing students, as well as overall assessment of learning (R=-0.136; p=0.018) (Tab. 5).

Nursing students living in rural areas rated their satisfaction (p=0.003) and confidence (p=0.003) in the learning process, as well as the learning process overall (p=0.002), significantly better than those living in cities with more than 100 000 inhabitants (Tab. 6).

Table 7 presents the multiple regression model of the impact of the evaluation of simulation assumptions on learning satisfaction. The evaluation and significance of scenario elements, such as objectives and information and problem solving, significantly influenced the nursing students' learning satisfaction. In addition, the assessment of reflection with feedback and fidelity of the scenario were included in the multiple regression model. Better ratings of goals and information, problem solving, as well as reflection with feedback and the importance of goals and information, resulted in higher satisfaction with the learning processes. In contrast, the higher the importance of problem solving in the nursing students' opinion and the higher the rating of scenario fidelity, the lower the satisfaction with the learning process. The multivariate regression model developed explained 76% of the variation in satisfaction with the learning process, and the mean prediction error (0.035165) represented only 0.88% of the full scale of the variable. This indicated the very good predictive power of the model. The Durbin-Watson statistic (d = 2.009) indicated no significant autocorrelation in the residuals. VIF values were below 5 for all variables, with the exception of 'Problem Solving' (score) (VIF = 5.26). Since the VIF was not excessively high and all variables were meaningful for model interpretation, none were removed. The residuals' normality analysis revealed a few outliers, and the predicted vs. residuals plot showed a random distribution of residuals around zero.

The relationship of nursing students' confidence in learning with their evaluation of simulation assumptions is shown in Table 8. Backward stepwise regression analysis produced a model explaining 76% of the variation in confidence in learning with very good predictive power – the mean prediction error of 0.033097 was only 0.83% of the full scale variable. The Durbin-Watson statistic (d = 2.041) confirmed that there was no significant autocorrelation in the residuals. VIF values reached up to 5, indicating moderate multicollinearity, with no need to remove independent variables. The residuals' normality analysis identified a few outliers, and the predicted vs. residuals plot demonstrated a random scatter of residuals around zero. Better evaluation of scenario goals, and information, support and problem solving, and the importance of goals and information, influenced greater confidence in nursing students' learning. In contrast, greater importance of problem solving is associated with lower confidence.

DISCUSSION

The results of the study allowed the adopted research objectives to be met. The first objective was to evaluate the training at the Medical Simulation Centre, as perceived by nursing students through ratings of individual elements of medical simulation, as measured by the domains of the SDS

Table 4. A comparative analysis of simulation assumptions using the SDS questionnaire among a group of nursing students based on their geographical location

Scale	Assessment of scenario elements					Importance of scenario elements				
	village	city up to 100,000	city of over 100,000	Kruskal-Wallis test		village	city up to 100,000	city of over 100,000	Kruskal-Wallis test	
				H	p				H	p
Objectives and information	4.4 (4.0-5.0)[a]	4.4 (4.0-5.0)[ab]	4.0 (3.2-4.9)[b]	7.574	0.023	4.6 (4.0-5.0)	4.4 (4.0-5.0)	4.4 (4.0-5.0)	1.611	0.447
Support	4.3 (4.0-5.0)[a]	4.1 (4.0-4.8)[ab]	4.0 (3.8-4.5)[b]	11.779	0.003	4.5 (4.0-5.0)[a]	4.5 (4.0-5.0)[a]	4.3 (4.0-5.0)[a]	6.074	0.048
Problem solving	4.6 (4.0-5.0)[a]	4.4 (4.0-5.0)[ab]	4.0 (3.4-4.8)[b]	16.102	<0.001	4.8 (4.0-5.0)	4.6 (4.0-5.0)	4.4 (4.0-5.0)	3.469	0.177
Reflection with feedback	4.8 (4.0-5.0)[a]	4.6 (4.0-5.0)[ab]	4.1 (4.0-5.0)[a]	8.002	0.018	4.8 (4.0-5.0)	4.8 (4.0-5.0)	4.5 (4.0-5.0)	2.029	0.363
Fidelity (realism)	5.0 (4.0-5.0)[a]	5.0 (4.0-5.0)[ab]	4.5 (4.0-5.0)[b]	9.300	0.010	5.0 (4.0-5.0)	5.0 (4.0-5.0)	5.0 (4.0-5.0)	2.281	0.320
Total	4.5 (4.0-5.0)[a]	4.4 (4.0-4.8)[ab]	4.3 (3.6-4.7)[b]	13.672	0.001	4.6 (4.1-5.0)	4.6 (4.1-5.0)	4.4 (4.1-5.0)	2.577	0.276

The median is given for each group (Q1-Q3), Dunn'a post-hoc test with Bonferroni correction was additionally used in case of statistically significant results; different letters indicate statistically significant differences between groups.

Table 5. The relationship between student satisfaction, as measured by the SSCL questionnaire, and age in surveyed students

Scale	Correlation with age		
	R	t	p
Student satisfaction with the learning process	-0.122	-2.135	0.034
Confidence in the learning process	-0.151	-2.648	0.009
Total	-0.136	-2.380	0.018

questionnaire, and to assess the students' level of satisfaction and confidence in the learning process according to the SSCL questionnaire. The results obtained showed that nursing students achieved high scores on the SDS scale, particularly in terms of the realism of the elements of the medical simulation scenario (Me=5.0) which, together with reflection with feedback (Me=4.8), was also indicated as its most important aspect. On the other hand, support (Me=4.0) and the goals and information of the scenario (Me=4.2) were rated slightly lower. The results of the SSCL questionnaire, on the other hand, showed that nursing students generally felt confident (Me=4.3) and satisfied (Me=4.2) in the learning process.

A further research objective was to analyse the assessment of simulation assumptions and nursing students' satisfaction and confidence in the learning process in relation to socio-demographic variables. A negative correlation was identified as the assessment of objectives and the evaluation of information (R=-0.180; p=0.002), support (R=-0.154; p=0.007), and the evaluation of simulation assumptions in general (R=-0.145; p=0.011). Age was also found to be negatively correlated with satisfaction (R=-0.122; p=0.034) and confidence (R=-0.151; p=0.009) of nursing students. In addition, rural residents rated the elements of the medical simulation scenario significantly better and felt significantly more satisfied and confident in the learning process, compared to residents of cities with more than

Table 6. Relationship between student satisfaction and confidence in the learning process, measured by the SSCL questionnaire and place of residence among a sample of students

Scale	Assessment of the learning process				
	village	city up to 100,000	city of over 100,000	Kruskal-Wallis test	
				H	p
Student satisfaction with the learning process	4.4 (4.0-5.0)[a]	4.2 (4.0-4.8)[ab]	4.0 (3.6-4.6)[b]	11.766	0.003
Confidence in the learning process	4.4 (4.0-5.0)[a]	4.1 (4.0-4.6)[ab]	4.1 (3.7-4.5)[b]	11.911	0.003
Total	4.4 (4.0-4.9)[a]	4.2 (4.0-4.6)[ab]	4.1 (3.7-4.5)[b]	12.316	0.002

The median is given for each group (Q1-Q3), Dunn'a post-hoc test with Bonferroni correction was additionally used in case of statistically significant results; different letters indicate statistically significant differences between groups.

Table 7. Effect of evaluation of simulation assumptions according to the SDS questionnaire on student satisfaction with the learning process according to the SSCL questionnaire

N=302	Regression Summary for Dependent Variable: Satisfaction with the learning process R=0.87319319, R2=0.76246634, Adjusted R2=0.75763515 F(6,295)=157.82, p<0.0000 Std.Error of estimate:0.37344, RMSE=0.035165 (0.88% of range)					
	b*	Std.Err. of b*	b	Std.Err. of b	t(296)	p-value
Intercept			0.073971	0.208099	0.35546	0.722498
Objectives and information (evaluation)	0.390818	0.059677	0.359973	0.054967	6.54884	0.000000
Objectives and information (relevance)	0.231482	0.053845	0.295573	0.068753	4.29904	0.000023
Problem solving (evaluation)	0.396289	0.065603	0.445033	0.073672	6.04074	0.000000
Problem solving (relevance)	-0.196772	0.059617	-0.285889	0.086617	-3.30060	0.001083
Reflection with feedback (evaluation)	0.198671	0.059969	0.274400	0.082828	3.31289	0.001038
Fidelity (assessment)	-0.104407	0.045114	-0.119323	0.051560	-2.31427	0.021340

b* – standardized regression coefficient, b – unstandardized regression coefficient, RMSE – mean prediction error of the regression model expressed in units of the dependent variable

Table 8. Effect of assessing simulation assumptions according to the SDS questionnaire on student confidence in learning according to the SSCL questionnaire

N=302	Regression Summary for Dependent Variable: Confidence in the learning process R= 0.86934362 R2= 0.75575833 Adjusted R2= 0.75163262 F(5,296)=183.18, p<0.0000 Std.Error of estimate:0.33081, RMSE=0.033097 (0.83% of range)					
	b*	Std.Err. of b*	b	Std.Err. of b	t(296)	p-value
Intercept			0.973821	0.179763	5.41725	0.000000
Objectives and information (evaluation)	0.352214	0.064842	0.283892	0.052264	5.43189	0.000000
Objectives and information (relevance)	0.108422	0.054298	0.121148	0.060671	1.99678	0.046764
Support (assessment)	0.225127	0.051724	0.191288	0.043949	4.35250	0.000019
Problem solving (evaluation)	0.393668	0.063791	0.386866	0.062688	6.17124	0.000000
Problem solving (relevance)	-0.162963	0.059842	-0.207192	0.076083	-2.72322	0.006849

b* – standardized regression coefficient, b – unstandardized regression coefficient, RMSE – mean prediction error of the regression model expressed in units of the dependent variable

100,000 inhabitants (p<0.05). In contrast, the importance of scenario elements did not vary significantly by place of residence.

The higher evaluations of medical simulation scenarios and learning experiences reported by nursing students from rural areas may be explained by several factors. Students from rural regions often have limited access to advanced educational resources and clinical training opportunities compared to their urban peers [17]. Consequently, participation in high-fidelity simulation may be perceived as a unique and particularly valuable experience, leading to higher satisfaction and scenario ratings. Additionally, students from smaller communities may exhibit greater motivation and engagement when opportunities for advanced learning, such as simulations, become available [18]. Social and educational support in rural settings may further enhance students' satisfaction, especially when they perceive that they receive more individualized attention and guidance [19]. Overall, these findings are consistent with literature suggesting that access to resources and environmental context significantly influence nursing students' satisfaction and engagement with the learning process.

Accordingly, the impact of the assessment of the simulation assumptions on student satisfaction with the learning process was then analysed. Performing a stepwise backward regression analysis allowed 2 models to emerge, with confidence and satisfaction as dependent variables, respectively. In both cases, the fit of the model to the data turned out to be good, with a coefficient of determination of around 76%, and average prediction errors of less than 1% of the total scale of the dependent variables. Multivariate regression analysis found that better evaluation of goals and information (b=0.360; p<0.001), problem solving (b=0.445; p<0.001), as well as reflection with feedback (b=0.274; p=0.001) and importance of goals and information (b=0.296; p<0.001), were associated with greater satisfaction with learning processes. In contrast, the higher importance of problem solving as perceived by nursing students (b=-0.286; p=0.001) and the higher rating of scenario fidelity (b=-0.119; p=0.021) influenced lower satisfaction with learning among nursing students. The situation was similar when modelling the variable 'confidence' and the independent variables 'evaluation of goals and information' (b=0.284; p<0.001), 'importance of goals and information' (b=0.121; p=0.047), 'evaluation of problem solving' (b=0.387; p<0.001) and 'importance of problem solving' (b=-0.207; p=0.007). In addition, the evaluation of support in medical simulation appeared to have a positive impact on nursing students' self-confidence (b=0.191; p<0.001).

The results of this study are similar to those obtained by Wojcieszek et al. which also indicated high self-confidence and satisfaction among nursing students during medical simulation training, achieving mean scores of 4.42 for the satisfaction area and 4.36 for the self-confidence area (4). The study group consisted of first-year full-time nursing bachelor's students enrolled at a university located in southern Poland. Sałacińska et al. at the University of Rzeszów, Poland, compared and assessed nurses' satisfaction and self-confidence at a high level, regardless of the type of simulation – traditional high-fidelity (manikin-based) simulation and virtual high-fidelity simulation [20]. The median confidence satisfaction scores among the respondents were 4.6 and 4.13 for the virtual reality method and 4.6 and 4.5 for the traditional method; therefore, the SSCL scale scores were at a slightly higher level than in the current study. The overall assessment of simulation assumptions and satisfaction and confidence was also high in a study by Albagawi et al. on Saudi students [21]. Gillan et al., in their study 'Nursing students' satisfaction and self-confidence with standardized patient palliative care simulation focusing on difficult conversations', examined the individual items of the SSCL and SDS scales. The findings demonstrated that nursing students exhibited a high level of satisfaction and self-confidence in providing care for a simulated palliative patient. Furthermore, the study indicated that both the simulation design and the pedagogical strategies employed during the learning experience were perceived as highly effective [22].

A correlation analysis of the assessment of simulation assumptions with satisfaction and confidence among nursing students in Korea showed a positive association between the 2 (r=0.74; p<0.001) [23]. The authors also conducted a regression analysis which included the Educational Practices in Simulation Scale, and found a positive effect of summation assumption scores on satisfaction and confidence (beta=0.38; p=0.011). In a study assessing the attitude of Thai undergraduate nursing students during the COVID-19 pandemic towards antenatal care, simulation design (beta = 0.338; p < 0.011) was significantly associated with a high level of satisfaction, while the effect of satisfaction with simulation design on self-confidence was found to be statistically insignificant (p = 0.221) [24]. On the other hand,

the multivariate regression used in the Olaussen et al. study, did not confirm a significant effect of evaluation of simulation assumptions on satisfaction with the learning process, and although the relationship between support and confidence was found to be negative (beta=-0.18; p=0.038), it indicated a positive effect of goals and information on students' confidence (beta=0.29; p=0.001) [25], a result similar to the present study. In a study by Bdiri Gabbouj et al., in contrast to the results obtained in the current study, the relationship between objectives and information (p=0.852), problem solving (p=0.144), feedback/guided reflection (p=0.260) and fidelity (p=0.077) and student's satisfaction, proved to be statistically insignificant [26]. Instead, support was found to be positively correlated with satisfaction (r=0.468; p<0.001). Furthermore, a positive correlation of objectives and information (r=0.450; p<0.001) and support (r=0.477; p<0.001) with student self-confidence was confirmed. A positive effect of simulation design on simulation education satisfaction was also observed in studies by Lee and Ji [27], and Gaspar et. al. [28], while in a study by Blaak et al., this relationship was confirmed only for objectives and information and satisfaction (beta=0.27; p=0.040); additionally, a positive effect of feedback on self-confidence was shown (beta=0.298; p=0.035) [29].

The findings of the present study, together with evidence reported by other authors, underscore the critical role of medical simulation in the education of nursing students. The development of high-quality simulation environments has been shown to foster both satisfaction and self-confidence in the learning process among medical students. The application of the regression model made it possible to show the predictors of the impact of high evaluations of classes conducted using medical simulation methods in the opinion of its most important recipients – students, which may contribute to greater effectiveness in achieving the assumed learning outcomes in terms of knowledge, skills and social competences. The obtained results also emphasise the special role played by prebriefing and debriefing in effectively and efficiently implemented medical simulations.

CONCLUSIONS

Nursing students demonstrated high overall evaluations of medical simulation, as well as its specific components, including objectives and information, support, problem-solving, guided reflection with feedback, and fidelity. All of these elements were perceived as important for the educational process. Furthermore, simulation was associated with high levels of learning satisfaction and self-confidence. The analysis revealed that students residing in rural areas reported significantly higher evaluations of both scenario elements and learning experiences, compared to their peers from cities with populations exceeding 100,000.

Learning satisfaction was positively associated with the evaluation and perceived importance of objectives and information, problem-solving, and guided reflection with feedback, while it was negatively related to the importance of problem-solving and the evaluation of fidelity. Self-confidence, in turn, was positively influenced by the evaluation and importance of objectives and information, support, and problem-solving, whereas an excessive emphasis on problem-solving was associated with lower self-confidence.

Further research remains warranted to explore this issue in greater depth, with particular attention paid to the diverse factors that may shape the effectiveness of medical simulation in nursing education.

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