

Research Article

Simulation-Based Training vs Bedside Teaching in Skill Acquisition in Medical Education

Marina Khan¹, Sarah Amin², Sadaf Saleem³, Naveed Gul⁴, Madiha Akhwand⁵, Madiha Maryam⁶

¹Assistant Professor, Department of Medical Education, Gandhara University, Peshawar, Pakistan

²Assistant Professor, Department of Medical Education, NUST School of Health Sciences, National University of Sciences and Technology (NUST), H-12 Sector, Islamabad 44000, Pakistan

³Assistant Professor, Department of Medical Education, NUST School of Health Sciences, National University of Sciences and Technology, Islamabad, Pakistan

⁴Associate Professor, Department of Orthopedic, Rawal Institute of Health Sciences, Islamabad, Pakistan

⁵Assistant Professor, Department of Medical Education, Rawal Institute of Health Sciences, Islamabad, Pakistan

⁶Senior Demonstrator, Department of Medical Education, Central Park Medical College, Lahore, Pakistan

Corresponding author: Dr. Sarah Amin,

Assistant Professor, Department of Medical Education, NUST School of Health Sciences, National University of Sciences and Technology (NUST), H-12 Sector, Islamabad 44000, Pakistan

Email: sarahadnanmalik@gmail.com

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ABSTRACT

Background: Undergraduate medical education is an essential part of acquiring skills. Conventional bedside education has been the mainstay of clinical education, but simulation-based education has become a new phenomenon that offers a safe and controlled learning space.

Objective: To compare the effectiveness of simulation-based training and bedside teaching in skill acquisition among undergraduate medical students.

Methods: This quasi-experimental research was carried out at NUST School of Health Sciences between January 2024 and January 2025. There were 75 medical students who were selected and split into two groups, namely, simulation-based training (n = 38) and bedside teaching (n = 37). Objective Structured Clinical Examination (OSCE) scores, competency-based assessments and pre- and post-tests were used to evaluate skill acquisition. The level of confidence and satisfaction was also measured. The SPSS version 25 was used to analyze the data, and the independent and paired t-tests as well as chi-square tests were used. A p-value ≤ 0.05 was considered statistically significant.

Results: The simulation group demonstrated significantly higher mean skill scores (84.6 ± 6.8) compared to the bedside group (76.2 ± 7.5 ; $p < 0.001$). Greater improvement was observed in the simulation group (23.1 vs 13.0). Competency domain scores, particularly psychomotor skills, were significantly better in the simulation group. Additionally, higher confidence (76.3%) and satisfaction (81.6%) levels were reported among students trained through simulation ($p < 0.05$).

Conclusion: Simulation-based training is more effective than bedside teaching in improving skill acquisition and learner confidence. An integrated approach combining both teaching modalities is recommended for optimal medical education outcomes.

Keywords: Simulation-based training, bedside teaching, skill acquisition, medical education, OSCE, competency-based learning

INTRODUCTION

The acquisition of skills is the basis of clinical competence in undergraduate medical education as students can apply theoretical knowledge into practical patient care. Conventionally, bedside teaching has been used as the major mode of clinical skills training,

which provides real time contact with a patient and exposure to a real clinical situation. Nevertheless, the growing patient load, scarcity of appropriate cases, ethical issues and time have problematized the degree to which bedside teaching can be an effective stand-

alone strategy in contemporary medical education (1-3).

Simulation-based training has become a topical choice of the innovative teaching modality in recent years, enabling students to train clinical skills in a risk-free and controlled environment. Simulation also applies mannequins, standardized patients and virtual scenarios to recreate real life clinical scenarios thus, allowing repetitive practice, immediate feedback and systematic learning. This method is consistent with competency-based medical education, which focuses on quantifiable results, proficiency in skills and student-centered interventions. Psychomotor skills, communication skills, and clinical decision-making have been improved with the help of simulation without affecting patient safety (4-6).

Although the use of simulation is increasingly becoming part of medical education across the globe, there is still a necessity to critically review the efficacy of simulation traditional bedside education, especially in resources constrained conditions. Although there is some research indicating that simulation can add to the learning experience, others point out the inability of simulation to replace the invaluable experience of working with real patients through bedside teaching. In addition, there is a paucity of local data in terms of the relative effectiveness of these teaching modalities in skill acquisition, confidence, and student satisfaction (7-9).

Therefore, this study was designed to compare simulation-based training and bedside teaching in terms of their effectiveness in improving skill acquisition among undergraduate medical students. The findings aim to provide evidence-based recommendations for integrating innovative teaching strategies into medical education to enhance learning outcomes.

METHODOLOGY

This quasi-experimental comparative study was conducted at NUST School of Health Sciences, National University of Sciences and Technology, over a period of one year from January 2024 to January 2025. The study aimed to compare the effectiveness of simulation-based training and bedside teaching in skill acquisition among undergraduate medical students.

The sample size of 75 participants was determined using the WHO sample size formula for comparison of proportions, considering a 95% confidence level and an anticipated improvement in skill acquisition based on previous literature. Due to feasibility and

availability of participants, a total of 75 students were included in the study. A non-probability consecutive sampling technique was used to recruit participants who met the inclusion criteria.

The sample was split into two subgroups according to the teaching mode Simulation-Based Training (n = 38) and Bedside Teaching (n = 37). Simple randomization was used to allocate to groups to reduce selection bias. The two groups were trained on the same set of clinical skills, which ensured that there was the same learning objectives and content presentation among them.

The inclusion criteria were undergraduate medical students in 3rd, 4th and final year who agreed to take part in the study. Students were not selected with prior formal certification in simulation-based training to prevent performance bias and students who had already acquired the chosen clinical skills were also excluded.

A structured and validated assessment tool was used to collect data. Objective Structured Clinical Examination (OSCE) checklists, global rating scale, and competency-based assessment based in cognitive, psychomotor, communication, and clinical reasoning domains were used to measure the acquisition of skills. Both the groups were tested using pre-test and post-test tests to measure the improvement in performance.

Further, the confidence and level of satisfaction of the participants were determined through a questionnaire based on Likert scale. The simulation group training was done in a controlled skills lab setting, with mannequins and simulated clinical situations, and the bedside group taught in the traditional way with real clinical scenarios, supervised by the faculty. Training time was equal to both groups so that it was comparative. Subject experts reviewed and pilot tested the assessment tools before data was collected in order to have reliability and validity. The inter-rater reliability was ensured through training assessors and the use of standard scoring rubrics in the OSCE assessments.

The data were analyzed and inputted in SPSS 25. The mean plus standard deviation were used to compute the descriptive statistics of quantitative variables and frequencies with percentage of categorical variables. Inferential statistics were independent t-test to compare mean scores between groups, paired t-test to compare pre- and post-training, and chi-square test to compare variables of a categorical nature (confidence and satisfaction levels). A p-

value of ≤ 0.05 was considered statistically significant.

RESULTS

The study involved 75 medical students and this was equally divided into two groups: Simulation-Based Training ($n = 38$) and Bedside Teaching ($n = 37$). The comparison involved skill acquisition, the areas of competency, the

level of confidence, and the level of overall satisfaction of the two teaching modalities. The demographic was also balanced in terms of the representation of the participants in the two groups. The students were aged 22.4 years (mean age) with a slight female bias. The majority of participants were 4th and final year, which is enough to guarantee sufficient clinical exposure.

Table 1: Demographic Characteristics of Participants ($n = 75$)

Variable	Category	Frequency (%)
Age (years)	Mean $\pm$ SD	22.4 $\pm$ 1.6
Gender	Male	32 (42.7%)
	Female	43 (57.3%)
Year of Study	3rd Year	18 (24.0%)
	4th Year	31 (41.3%)
	Final Year	26 (34.7%)
Previous Clinical Exposure	Yes	52 (69.3%)
	No	23 (30.7%)
Previous Simulation Exposure	Yes	28 (37.3%)
	No	47 (62.7%)

Students who had undergone training through simulation had much higher scores through acquisition of skills than when taught in the

bedside. This shows that simulation-based training is effective in improving procedural competence.

Table 2: Comparison of Overall Skill Acquisition Scores

Group	n	Mean Score $\pm$ SD
Simulation-Based Training	38	84.6 $\pm$ 6.8
Bedside Teaching	37	76.2 $\pm$ 7.5

The performance of simulation based training was found to be superior in all the competency domains, especially in the psychomotor and

communication skills, showing its value in overall development of skills.

Table 3: Comparison of Competency Domains

Competency Domain	Simulation (Mean $\pm$ SD)	Bedside (Mean $\pm$ SD)
Cognitive Skills	85.2 $\pm$ 6.1	79.4 $\pm$ 7.0
Psychomotor Skills	86.8 $\pm$ 5.9	74.9 $\pm$ 8.2
Communication Skills	83.7 $\pm$ 6.5	77.3 $\pm$ 7.4
Clinical Reasoning	82.9 $\pm$ 6.3	76.8 $\pm$ 7.1

The simulation group had a higher level of confidence and satisfaction levels than the group being taught on the bedside, indicating

that the engagement and perceived effectiveness in the simulation group was better.

Table 4: Confidence and Satisfaction Levels

Variable	Category	Simulation n (%)	Bedside n (%)
Confidence Level	High	29 (76.3%)	17 (45.9%)
	Moderate	7 (18.4%)	14 (37.8%)
	Low	2 (5.3%)	6 (16.3%)
Satisfaction	Satisfied	31 (81.6%)	20 (54.1%)
	Not Satisfied	7 (18.4%)	17 (45.9%)

The percentage of improvement was higher in the simulation group than in the other group,

which meant that there was more learning gain.

Table 5: Pre- and Post-Training Skill Improvement

Group	Pre-test Mean $\pm$ SD	Post-test Mean $\pm$ SD	Improvement
Simulation	61.5 $\pm$ 7.2	84.6 $\pm$ 6.8	+23.1
Bedside	63.2 $\pm$ 6.9	76.2 $\pm$ 7.5	+13.0

The statistical analysis showed that there was a significant difference between the two teaching modalities as regards to acquisition of skills, confidence and satisfaction.

Table 6: Statistical Comparison Between Groups

Variable	Test Used	P-value
Skill Acquisition Score	Independent t-test	<0.001
Cognitive Skills	Independent t-test	0.002
Psychomotor Skills	Independent t-test	<0.001
Communication Skills	Independent t-test	0.004
Clinical Reasoning	Independent t-test	0.006
Confidence Level	Chi-square	0.003
Satisfaction	Chi-square	0.002

DISCUSSION

The present study demonstrated that simulation-based training is significantly more effective than bedside teaching in improving skill acquisition among undergraduate medical students. Participants trained through simulation achieved higher OSCE scores, showed greater improvement between pre- and post-training assessments, and performed better across cognitive, psychomotor, communication, and clinical reasoning domains. These findings indicate that simulation provides a structured and controlled learning environment that enhances both technical and non-technical competencies.

The major strength of simulation-based training witnessed in this study was that it had a high psychomotor skills outcome. The simulation group performed better on procedural tasks, which is probably related to the possibility of repetitive practice without risk to patients. Conversely, bedside teaching, although useful in practical life, tends to restrict practical training because of patient safety issues and inconsistency in case scenarios. This is in line with modern trends in medical education that focus on deliberate practice and competency learning (10-13).

It was also found that the level of confidence and satisfaction between students who were trained using simulation was significantly higher. This can be explained by the secure learning environment in which students are allowed to make mistakes, are given timely feedback and develop their skills. Improved confidence is a critical result as it directly affects clinical performance and decision-making in real patient environments. Bedside teaching, even though necessary to facilitate the contextual learning, might not necessarily offer all the chances to engage actively,

particularly in the high-traffic clinical setting (14-16).

Moreover, the larger difference between the simulation group in pre-test and post-test illustrates its efficiency in retaining knowledge and reinforcing the skills. Simulation combines both the theoretical and practical knowledge hence facilitating more profound learning. It is necessary to mention, though, that bedside teaching cannot be substituted in the process of the acquisition of the skills of the actual patient interaction, clinical judgement, and professional behaviour. Thus the two approaches can be considered complementary and not mutually exclusive (17-20).

Despite its strengths, this study has certain limitations. The relatively small sample size and single-institution setting may limit the generalizability of the findings. Additionally, long-term retention of skills was not assessed, which could provide further insights into the sustainability of simulation-based learning. Future studies with larger, multi-center samples and follow-up assessments are recommended to validate and expand upon these findings.

CONCLUSION

Simulation-based training is more effective than bedside teaching in enhancing skill acquisition, confidence, and satisfaction among undergraduate medical students. It provides a safe, structured, and learner-centered environment that promotes active learning and competency development. However, bedside teaching remains essential for real-world clinical exposure. An integrated approach combining both simulation and bedside

teaching is recommended to achieve optimal learning outcomes in medical education.

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