Research Article

Investigating the Effects of Simulation-Based Teaching on Learning Domains Designed for Physiotherapy Students

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ABSTRACT

Introduction: Simulation-based teaching is a technique for imitating a situation's behavior or process via a suitable analog situation for training or teaching purposes. Simulation-based teaching is widely used in various domains; however, there is limited literature on evaluating the role of simulated-based teaching in physiotherapy. This study investigates the effect of simulation-based teaching on learning domains for traumatic brain injury topics framed for final-year physiotherapy students.

Materials and Methods: A total of 51 final-year physiotherapy students were randomly selected and allocated into two groups. Group A (n=25) includes didactic with PowerPoint presentation teaching session. Group B (n=26) includes simulated-based teaching sessions. There were eight simulators selected and trained for the Ranchos Los Amigos stages. The students were assessed using a self-designed pre-post multiple-choice questions (MCQ) test for knowledge and a clinical evaluation exercise for affective and psychomotor skills.

Results: This study showed that group B significantly improved in the pre-post self-made MCQ test (t=17.34, P=0.00), and in the clinical evaluation exercise, group B performed 43.66% better than group A.

Conclusion: The study concludes that simulation-based teaching significantly improves cognitive, affective, and psychomotor skills compared to traditional methods for traumatic brain injury topics framed for final-year physiotherapy students.

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Introduction

In undergraduate bachelors of physiotherapy, clinical education constitutes approximately two-thirds of the program. Students spend more than 3000 h supervising practical and clinical training with patients throughout the program. This professional practice component is required for program accreditation by the Governing Council [1]. Clinical training comprises all formal and practical "real-life" learning experiences for students to apply classroom knowledge and skills in the clinical environment. Experiences include short, and long-duration supervised practical and clinical training. They provide a variety of learning experiences to include comprehensive care of patients across the lifespan and related activities. Traditional and main clinical education relies on the availability of a diverse range of patients. Students exposed to varying scenarios depend on the patient's clinical features during their clinical placements. Individual learning experiences vary from student to student. Meanwhile, students may get inadequate exposure to high-risk patients, rare conditions, and variable clinical presentation of patients, leading to missed learning, opportunistic, unstructured, and diversified [2]. Additionally, physiotherapy in neurological conditions and clinical placements are limited due to inadequate space, infrastructure, and a lack of certified neuro-physiotherapy practitioners as educators; therefore, students lack in developing competency in neuro-physiotherapy practice [2, 3].

Students often lack skills, precision, and patience in neuro physiotherapy clinical learning due to a wide range of neuro origin symptoms, long-term specially abled patients, and application of treatment approaches. Traumatic brain injury (TBI) is one such topic. In cases with TBI, there is a wide range of clinical representations of brain dysfunction due to an external force that injures the brain. It is classified based on severity, mechanism, and other features, such as location, that result in physical, cognitive, social, emotional, and behavioral symptoms, and the outcomes often range from permanent disability to death. The management mode relies significantly on cognitive, physical, and vocational rehabilitation after survival. The Rancho Los Amigos (RLA) scale describes brain injury patients' cognitive and behavioral patterns as they recover from injury. RLA scale consists of 8 cognitive function recovery stages post TBI, from complete assistance to modified independent stages. Each stage is interlinked and follows different measures for rehabilitation. A common difficulty students face is clinically understanding RLA stages and implementing and customizing physiotherapy interventions per patients' cognitive stage with appropriate outcomes. The didactic education method is widely used and adopted by the education system; however, it does not satisfy the learning needs of all students as it becomes unvarying for learners to listen to lectures due to minimum interaction between learners and teachers. It also lacks in developing interest in practical-based topics. The most commonly used teaching-learning method in health care combines didactic-based teaching and audio-visual mode implementation in PowerPoint presentations and videos, including TBI. However, students lack decision-making skills and assessment-based management as these stages are interlinked. The traditional teaching method has some practical lacuna, which clinically alters the decision-making and framing of physiotherapy management for each RLA stage. The practical application of all RLA stages and interventions depends on patient availability. It is not possible to have all the RLA stages during topic delivery.

Simulation is a technique of imitating the behavior of some situation or process via a suitable analog situation or apparatus for training or teaching. It provides a direct but mock application of theoretical knowledge into practicality. Stimulation-based education effectively teaches hands-on skills training [3-5] and interdisciplinary education [6, 7]. Applying simulated-based education in medical conditions, such as TBI, is expected to fulfill all evolved lacunae using traditional methods. This study investigates the effect of simulation-based education on learning domains for TBI topics framed for final-year bachelor of physiotherapy students.

Materials and Methods

The module was prepared and discussed with the subject expert, departmental heads, and colleagues. Eight simulators were selected based on their acting skills showcased during the annual institutional cultural program. The study details were also explained. Meanwhile, 51 final-year physiotherapists were established, the study details were presented, and a written consent form was obtained from stimulators and students where students agreed not to interact with other group peers regarding the TBI module. The students were randomly allocated into two groups, using the odd-even number method as per their muster roll, and were blinded to the teaching method. A total of 25 students in group A received didactic teaching methods, and 26 students in group B received simulation-based teaching.

Teaching sessions were designed in two halves of the day, where group A received a module session in the first half of the day (morning half) followed by hospital clinical exposure. In contrast, group B had hospital clinical exposure posting followed by a module session in the second half of the day (afternoon) to minimize student interaction. After the second half of the day, students were dispersed home. A pre-test was designed for both groups before the teaching session commenced, consisting of 50 multiple-choice questions (MCQ). This was considered as the baseline score.

Group A

Group A received didactic teaching, module-based assignments, and a solving session on TBI using PowerPoint presentations and teaching videos. The teaching duration was 2 h per day for 4 days. The educator divided the module into the introduction, classification of clinical manifestation, RLA stage, clinical examination, RLA stage and other examination scales, and medical and physiotherapy management (total=8 h).

Group B: Stage I

Human simulator training workshop

A two-day workshop training was conducted in a skill laboratory demonstration room for eight selected simulators (standardized patients). A brief theoretical knowledge was given regarding the salient features of 8 RLA stages. Demo videos of patients were shown, and individual training was provided. Each simulator was allotted one stage, and they had to enact that RLA stage. Simulators were instructed to be over-expressive and less talkative. Sufficient time was given to practice to get the proper outcome.

Group B: Stage II

Group B received the same educator's simulated teaching session for the TBI module, where simulators represented each RLA stage and explained stage-wise physiotherapy management. Teaching duration was 2 h per day for 4 days (total=8 h). Post-test MCQ was conducted by the end of the last teaching session. The mini-clinical evaluation exercise (CEX) was performed by a subject expert blinded to the teaching method received by students. Obtained scores were recorded and analyzed. Descriptive written feedback was obtained from both groups.

Outcome measures

Multiple choice questionnaires

To assess the cognitive (knowledge) domain, two sets of self-prepared pre-test and post-test MCQ were formulated and validated by subject experts in the field and departmental colleagues. Both sets had 50 MCQs. The allocated time duration for the pre-test was 60 min. To avoid repetition and bias in the post-test, 40% of questions were changed, and the other 60% were randomly placed in changed order compared to the pre-test.

Mini clinical evaluation exercise

To assess the affective and psychomotor domains of learning, the mini CEX was employed. The mini CEX has seven components (each carries nine marks), hence equaling the total score of 63 marks (Table 1). It was conducted by a subject expert who was appointed as examiner. The entire session duration was 9 min, divided into 7+2 min, where in the first 7 min, the examiner only observes the candidate's performance regarding clinical findings and physiotherapy management. The examiner gave a 2-min feedback at the end of the session. The scores were recorded for each student.

Statistical analysis

Statistical analysis for the present study was done using the SPSS software, version 21.0.1. The statistical measures for the baseline data, such as Mean±SD, and the significance test using the unpaired t-test for the available data. The outcome measures pre and post-scores of questionnaires were done using the paired t-test, considering the $P<0.05$ as statistical significance. Also, the mean average was taken for all the components of mini CEX.

Results

Demographic characteristics

The mean age of all the subjects in group A was 21±0.79 years, and group B was 21±0.56 years. There was no significant difference in the age of both groups ($P=0.89$). There were 51 students who participated in the study. The gender distribution in group A was 4 males and 21 females, while in group B, there were 2 males and 24 females. Repeaters and absentees were not included (Table 2).

The comparison between pre-test and post-test scores was answered by physiotherapy students (Table 3).

Table 2. Demographic information of participants (n=51)

Components	Mean±SD		t Value/x Value	P
	Group A	Group B		
Age (y)	21±0.79	21±0.56	2.062	0.89*
Gender (male/female)	4/25	2/26	0.36	1.03**
Repeater student (n=00)	00	00	-	-

SD: Standard deviation.

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*t value, **x value.

The mean pre-test scores of group A and group B were 22.8(2.86) and 21.3(3.98), respectively. Meanwhile, the post-test scores of group A and group B were 33.7(4.12) and 41.1(3.65), respectively. There was a significant difference in the pre-test and post-test of group B compared to group A, with a mean difference of 19.80±3.85, a t of 5.438, and a P of 0.001 (Table 3).

The component scores using the mini CEX assessment are provided in Table 1. All the components in the mini CEX for group B showed statistical significance compared to group A, with a t value of 13.13 and P=0.00 (Table 1).

Discussion

This study investigates the effect of simulation-based teaching on learning domains for TBI topics framed for final-year bachelor of science physiotherapy students. There was no significant difference in the pre-test MCQ score of both groups, suggesting topic knowledge was at the same level. There was a significant improvement in the post-test MCQ score of both groups, suggesting improvement in the knowledge domain about TBI post-teaching session. Improvement in didactic teaching methods provides the required theoretical knowledge to students. Here, the teacher is the source of information where they share knowledge, experience, ideas, feelings, and writing skills for the particular topic. The use of audio-visual aids helped in better understanding and clarified the topic. The combination of didactic and audio-visual aids showed improvement in the knowledge domain as the deficiency of one teaching aid is compensated by the other. Similar results were obtained in a better understanding of combining traditional methods with audiovisual aid in the medical field [9]. Improvement in simulation-based teaching could be because it gives opportunities to simultaneously understand theoretical and practical approaches to topics. It made students easy to understand and gave a mock experience of the topic case scenario. Similar results were obtained when an artificial case and environment were created, which gave in-depth knowledge and experience with standardized patients and made them more confident to face real-life medical situations [10].

On comparing the mean difference, simulated-based teaching methods showed significant results to didactic teaching methods, suggesting simulated-based teaching methods showed better improvement in the cognitive domain of learners. This could be because the artificial depiction of complex clinical RLA stages gave a more practical approach that helped develop experience-based learning, communication skills with standardized

Table 3. Comparison between pre-test and post-test multiple choice questions scores of students

Group	Mean±SD		
	Pre-test	Post-test	Mean Difference
Group A	22.8±2.86	33.7±4.12	10.9±2.36
Group B	21.3±3.98	41.1±3.65	19.8±3.85
t	1.918	5.438	3.691
P	0.726	0.001	0.002

SD: Standard deviation.

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Table 1. Component scores using the mini clinical evaluation exercise assessment

Mini Clinical Evaluation Exercise Components	Score Obtained Average		t	P
	Mean±SD			
	Group A	Group B		
Medical interview skills	3.3±1.20	7.8±1.34	12.99	0.00*
Physical examination skills	2.7±1.00	6.9±0.52	8.52	0.00*
Communications skills	1.4±0.81	7.7±0.61	4.18	0.00*
Counselling or information-giving skills	3.1±1.54	7.6±1.20	10.74	0.00*
Clinical judgement	3.4±1.31	8.1±0.41	15.93	0.00*
Organization of treatment	2.9±1.73	8.9±1.76	13.13	0.00*
Overall clinical competence	3.1±1.54	7.6±1.20	10.74	0.00*
Total	21.3±2.84	41.5±1.89	13.13	0.00*
Mean percentage	35.5%	79.86%	-	-

SD: Standard deviation.

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patients, and knowledge about the topic. It focuses on active and interactive learning, whereas the didactic teaching approach is more passive, with minimal opportunities for experienced-based interaction about the issue. Similar results were obtained where simulation-based teaching showed better improvement in knowledge for critical care management and mental health status than lecture-based teaching [11]

On comparing both the groups, we obtained average scores of all components of mini CEX in the simulated learner group that was higher than the didactic learner group, suggesting all three learning domains showed better improvement in the simulated-based teaching group than others. This could be because simulated-based teaching methods is an immersive form of teaching that evokes realistic situation that engages students on emotional aspects with a real-life patient scenario in a completely interactive manner that enhances students' learning, understanding of the subject, performance, skills transfer, and reduction of error. These simulators, standardized patient talks, breathes, blinks, and moves like a real patient, helped students self-assess and improvise on their mistakes and decision-making skills, which is essential for the physiotherapy management phase. The didactic learner group students' facial expressions showed confused responses in the understanding stages, and they made faulty clinical decisions while compiling physiotherapy management. This could have happened as they did not face any mock experience during the learning-teaching phase. Simulation-based teaching has proved to reduce risks to patients and learners and be effective in undergraduate and postgraduate education and faculty development.

Simulation can be used in the rehabilitative care setting to improve students' confidence in performing rehabilitation clinical skills [12] and maneuvering. It also improves communication skills [13] and the quality of care given to patients with chronic diseases [14]. Employing medical simulation techniques can help move medical training from the old model of "see one, do one, teach one" into a "see one, practice many, and do one" model of success. One of the study's limitations was that the proportion of females was more compared to males in both groups. Learning styles adopted by both genders differed, which could have influenced the findings; hence, future studies should consider an equal gender equation.

Conclusion

This study concludes that simulation-based teaching significantly improved in all learning domains (cognitive, affective, and psychomotor skills) compared to traditional didactic sessions for the TBI module framed for final-year physiotherapy students. Simulator-based teaching and learning can act as a building block to transfer theoretical knowledge to clinical skills by implementing it in physiotherapy, improving the clinical competency of physiotherapy students.

Ethical Considerations

Compliance with ethical guidelines

This study obtained ethical approval from MGM Institute of Health Sciences (Code: IECB/MGM/COP/2021/89).

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Authors' contributions

Results interpretation: Vrushali Panhale; Draft manuscript preparation: Tushar Palekar and Vrushali Panhale; Review and final approval: All authors.

Conflict of interest

The authors declared no conflict of interest.

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