International Journal of Nursing and Health Care Research

OPEN ACCESS

Wang P, et al. Int J Nurs Health Care Res 8: 1624

www.doi.org/10.29011/2688-9501.101624

www.gavinpublishers.com

GAVIN PUBLISHERS

Research Article

Application of Immersive Experiential Teaching Based on the "Learning Pyramid" in the Teaching of Orthopedic Surgery Cooperation for Nursing Students in the Operating Room

Ping Wang, Jin-Yan Li, Shao-Fan Wang, Liu-Yun Chen, Hua Yu, Hong Yang, Feng-Qiu Gong, Shu-Fen Liao*

The First Affiliated Hospital of Sun Yat-sen University, Guangzhou, China

***Corresponding author**: Shu-Fen Liao, The First Affiliated Hospital of Sun Yat-sen University, Guangzhou City, China

Citation: Wang P, Li JY, Wang SF, Chen LY, Yu H, et al. (2025) Application of Immersive Experiential Teaching Based on the "Learning Pyramid" in the Teaching of Orthopedic Surgery Cooperation for Nursing Students in the Operating Room. Int J Nurs Health Care Res 8:1624. DOI: https://doi.org/10.29011/2688-9501.101624

Received Date: 08 March 2025; **Accepted Date:** 13 March, 2025; **Published Date**: 17 March, 2025

Abstract

Objective: To explore the application effect of immersive experiential teaching based on the "Learning Pyramid" in the teaching of orthopedic surgery cooperation for undergraduate nursing students. **Methods:** Eighty undergraduate nursing students were divided into a control group and an intervention group with 40 students in each group according to their internship time. The control group adopted conventional teaching methods, while the intervention group adopted immersive experiential teaching based on the "Learning Pyramid". The scores of the clinical simulation learning immersion scale, orthopedic surgery cooperation theory, operational performance, and teaching satisfaction were compared between the two groups. **Results:** The total score and each dimension score of the clinical simulation learning immersion scale, as well as the theoretical and operational scores and teaching satisfaction, were significantly higher in the intervention group than in the control group ($P < 0.05$). **Conclusion:** Immersive experiential teaching based on the "Learning Pyramid" improves the clinical simulation learning immersion and teaching effectiveness of nursing students' early exposure to orthopedic surgery cooperation.

Keywords: Nursing students; Operating room; Learning pyramid; Experiential teaching; Immersive teaching

Introduction

The "Learning Pyramid" theory, proposed by American scholar Edgar Dale in 1946, is an active learning theory that promotes memory retention [1-7]. It illustrates the progressively increasing retention rate and learning efficiency of learning content achieved through different learning methods, ranging from listening, reading, audio-visual learning, demonstration, discussion, practice, to teaching others, arranged from the top to the bottom of the pyramid. The Immersion Theory, a psychological theory put forward by Professor Mihalyi Csikszentmihalyi from the University of Chicago, highlights the "optimal experience" of immersive learning and working [8]. It advocates that students perceive, understand, learn, and apply teaching content through personal experience [9]. By placing students in a situational classroom environment, the theory guides them to gain a whole-body cognitive experience through interactive drills and feedback in realistic clinical scenarios [8,10], achieving teaching goals such

as reinforcing nursing students' basic knowledge, establishing clinical thinking, and enhancing emergency response capabilities in complex situations [11]. This study combines the "Learning Pyramid" theory with the immersive experience teaching method, taking the representative and relatively standardized total hip replacement surgery in orthopedic surgery as an example, to conduct surgical cooperation teaching for undergraduate nursing students, achieving good results.

Participants and Study Design

Eighty undergraduate nursing students who were interns in the operating room of The First Affiliated Hospital of Sun Yat-sen University from February to September 2023 were selected as research subjects. Inclusion criteria: four-year full-time undergraduate nursing students admitted through the national unified college entrance examination; orthopedic sub-specialty internship in the operating room for 4 weeks; informed consent. Exclusion criteria: those who cannot participate in the entire internship due to personal or sick leave.

Forty undergraduate nursing students from February to April 2023 were set as the control group, and forty undergraduate nursing students from July to September 2023 were set as the intervention group. There were no statistically significant differences in gender, age, and entry assessment scores between the two groups of undergraduate nursing students ($P > 0.05$). (Table 1)

Group	Number of people	Gender		Age	Assessment score at entry
		Male	Female		
Control group	40	8	32	22.53±0.55	79.78±2.99
Intervention group	40	5	35	22.45±0.55	79.75±3.35
X^2/ t-value		0.827		0.606	0.035
P-value		0.363		0.546	0.972

Table 1: Comparison of general information between two groups of nursing interns.

Both groups of nursing interns underwent a 4-week internship in the operating room. Based on the nursing department's requirements for the operating room internship training of nursing interns, and considering the characteristics and complexity of orthopedic surgeries, a representative and relatively standardized total hip replacement surgery in orthopedic surgery was selected. Both groups of nursing interns were taught by the same teachers, and the quality control was managed by the orthopedic teaching and training team leader.

Method

Control Group: Conventional Teaching Method

A one-on-one clinical teaching model was adopted. The preceptors individually introduced the interns to the orthopedic sub-specialty operating rooms, surgical items, and equipment placement through verbal explanations on site. The interns were taught in the operating room, where they observed and participated in surgeries under the guidance of their preceptors. During the total hip replacement surgery, the preceptors provided knowledge explanations and demonstrations of orthopedic surgical procedures based on the actual surgical process.

Intervention Group: Immersive Experience Teaching Method Based on the "Learning Pyramid"

Designing the Teaching Plan

The "Learning Pyramid" is an active learning theory that promotes memory retention, with its layers progressing from "lecture, reading, audio-visual, demonstration, discussion, practice," and finally to "application" from the top to the bottom [12]. Immersive teaching emphasizes individual subjective experiences, is student-centered, stimulates students' interest and motivation in learning, places them in specific environments, and encourages active participation, experience, communication, cooperation, and exploration in learning activities to enhance learning effectiveness [8]. Based on the immersive experience teaching of the "Learning Pyramid," nursing students participate in clinical observations while following clinical instructors during surgical handwashing and preparation. Additionally, the teaching plan fully utilizes operating room clinical resources, flexibly applies diverse teaching methods, creates visual clinical orthopedic surgery scenarios for immersive drills. The detailed teaching plan is presented in Table 2.

From the top to the bottom of the Learning Pyramid (Knowledge retention rate)	Teaching Methods	Teaching Content	Study Hours
Lecture (5%)	Theoretical instruction, navigation of the orthopedic field environment	Introduction to orthopedic operating room rules and working environment	0.5
Reading (10%)	Teaching with colored surgical instrument atlas	Names and uses of total hip replacement surgical instruments	1
Audiovisual (20%)	Human skeleton model teaching	Hip-related anatomical and physiological knowledge, indications for total hip replacement	1
Demonstration (30%)	Clinical total hip replacement surgery cooperation scenario drill	Principles of total hip replacement, basic process of total hip replacement cooperation	2
Discussion (50%)	PBL group discussion		1
Practice (75%)	Collaborative group practice	Assembly method of external instruments for total hip replacement	1.5
Application (90%)	Interactive short video, feedback-based teaching	Transmission method of conventional orthopedic surgical instruments, basic process of total hip replacement cooperation	1

Table 2: Immersive Orthopedic Surgery Clinical Experience Teaching Plan Based on the "Learning Pyramid".

Implementing the Teaching Plan

Orthopedic Field Environment Navigation

The orthopedic education and training team leader first conducts centralized theoretical instruction in the form of multimedia lectures, introducing the overall situation of operating room orthopedic rules and regulations, surgical characteristics, environment, layout, and facilities. Subsequently, they lead the nursing students to visit the real environment, experience the clinical work atmosphere of orthopedics, and explain the distribution of orthopedic surgeries, functional zoning, and commonly used equipment.

Color Atlas Teaching of Surgical Instruments

In the early stage of teaching, referring to Feng Xin et al.'s [13] atlas production method, orthopedic instrument color atlases are produced according to different manufacturers and series, visually displaying the shape, structure, name, and quantity of the instruments. The orthopedic education and training team leader uses the atlas to explain the name, specification, and performance of each type of surgical instrument in the instrument pack to the nursing students to get early exposure and understanding of various commonly used orthopedic surgical instruments.

Human Skeleton Model Teaching

A professor of joint surgery uses human skeleton models to conduct visual teaching of hip-related anatomical and physiological knowledge to nursing students. Utilizing dynamic and intuitive demonstrations of hip flexion and extension in the sagittal plane, adduction and abduction in the coronal plane, and internal and external rotation in the transverse plane with the help of a human hip joint model, helps students deeply understand the anatomical structure and kinematic characteristics of the hip joint, laying the foundation for the next step of immersive surgical scenario drills.

Clinical Orthopedic Surgery Cooperation Scenario Drills

The orthopedic education and training team leader collaborates with the professor of joint surgery, constructing a realistic clinical cooperation scenario for total hip replacement surgery. The orthopedic education and training team prepares relevant items such as joint replacement instruments, external instruments, prosthetic trial models, and bone power systems based on the clinical requirements for real total hip replacement surgery. The professor of joint surgery performs key surgical steps such as femoral osteotomy, hip joint grinding, femoral canal opening, femoral reaming, installation and reduction of the trial model on a

1:1 real human skeleton model using an electric saw, hip joint file. The orthopedic education and training team leader explains the key points of nursing cooperation according to the corresponding surgical steps, demonstrates the correct assembly, transfer, use, and disassembly methods of conventional operating tables, external instruments, and tools for total hip replacement.

PBL Group Discussion

With teachers as the "leader", nursing students are guided to freely speak and ask questions about difficulties or problems discovered during the total hip replacement surgery scenario drills, and share the knowledge they have learned within the group. Teachers encourage nursing students to actively discuss differences and finally summarize.

Cooperative Group Practice

Nursing students are organized to partner up and practice the correct assembly, transfer, use, and disassembly of external instruments and tools through mutual observation and error checking. The orthopedic education and training team leader is responsible for hosting and controlling the scene, providing targeted comments to those who are not proficient in operation, and conducting re-guidance and re-demonstration.

Short Video Interaction

In the early stage of teaching, the orthopedic education and training team complete the production of three short videos, covering the key points of nursing cooperation operations in the pre-operative, intra-operative, and post-operative stages of clinical total hip replacement surgery. Each video is designed with 2-3 incorrect operations. Every nursing student is organized to take turns watching the short videos, identify incorrect operations in a timely manner and complete the correct operations on site. For students who fail to correctly judge and identify incorrect operations, the instructor will provide on-site guidance and demonstrate the correct operations.

Variables

Clinical Simulation Learning Immersion Scale:

After the completion of teaching, the self-learning ability evaluation scale for nursing students was adopted to assess the immersion level of nursing students in clinical simulation learning [11]. The scale consists of four dimensions: cognitive assimilation, emotional engagement, concentration, and acquired experience, with a total of 15 items. Each item uses a Likert 5-point scoring system, ranging from "strongly disagree" to "strongly agree" and scored from 1 to 5. The total score ranges from 15 to 75.

Theory and Operational Assessment:

Upon completion of the course, a unified set of assessment criteria were used to evaluate the theoretical knowledge and operational skills related to orthopedic surgery cooperation for nursing students. The self-made basic theoretical knowledge test paper covered operating room orthopedic rules and regulations, hip joint-related physiology and anatomy, external instruments, and hip joint prosthesis-related knowledge. The operational assessment focused on routine surgical table laying, surgical instrument transfer, and bone dynamic system installation as the main assessment items. Both theory and operational assessments had a full score of 100, with a passing score of 60 or above.

Satisfaction Survey

The satisfaction survey questionnaire, which designed by the orthopedic teaching and training team, included three aspects (teaching methods, teaching mode, and teaching effectiveness). Each item was rated on a 5-point scale from "very dissatisfied" to "very satisfied." Satisfaction was calculated based on the proportion of students who chose "satisfied" or "very satisfied."

Statistical Analysis

All the statistical analyses were performed with the IBM®SPSS® Statistics 25 software. Quantitative data were expressed as mean ± standard deviation, while qualitative data were described by frequency. Comparisons between groups were made using the t-test and chi-square test. The significance level was set at $\alpha = 0.05$.

Results

The total score and scores for each dimension of the Clinical Simulation Learning Immersion Scale were significantly higher in the intervention group compared to the control group ($P < 0.05$).

Group	Number of people	Cognitive assimilation	Emotional engagement	Focus	Acquired experience	Total score
Control group	40	22.10±1.78	9.78±2.20	10.80±1.70	9.68±3.06	52.35±4.41
Intervention group	40	23.98±3.58	12.05±1.95	12.05±2.46	12.05±2.51	60.13±9.28
t-value		2.968	5.129	2.645	3.796	4.779
P-value		0.004	<0.001	0.01	<0.001	<0.001

Table 3: Comparison of scores on the Clinical Simulation Learning Immersion Scale between the two groups of nursing students (scores, $\bar{x}\pm s$).

The theoretical and practical scores of the intervention group were significantly higher than those of the control group (P<0.001).

Group	Number of people	Theoretical Assessment	Operational Assessment
Control group	40	80.43±3.20	79.90±3.01
Intervention group	40	84.03±3.60	84.70±3.7
t-value		4.732	6.362
P-value		<0.001	<0.001

Table 4: Comparison of theoretical and practical assessment scores between the two groups of nursing students (scores, $\bar{x}\pm s$).

The intervention group reported higher satisfaction levels in terms of teaching mode, teaching method, and teaching effectiveness compared to the control group (P < 0.01).

Group	Number of people	Teaching mode	Teaching methods	Teaching effectiveness
Control group	40	31 (77.5%)	29 (72.5%)	31 (77.5%)
Intervention group	40	38 (95.0%)	40 (100.0%)	39 (97.5%)
t-value		7.314	12.754	7.314
P-value		0.007	<0.001	0.007

Table 5: Comparison of satisfaction levels between the two groups of nursing students (number of participants, %).

Discussion

Enhancing the Teaching Effectiveness of Early Exposure to Orthopedic Surgical Coordination Knowledge for Nursing Students through Immersive Experience Teaching Based on the "Learning Pyramid"

The Further Improvement of Nursing Services Action Plan (2023-2025) [2] prioritizes specialized nursing workforce development in critical areas such as operating rooms. Grounded in the Learning Pyramid theory [16], this study adopted multimodal pedagogical strategies (orthopedic environment navigation/surgical instrument atlas/PBL discussions/3D anatomical models) to facilitate progressive knowledge construction through multisensory engagement, tailored to undergraduate nursing students' cognitive profiles.

Results indicated significantly higher theoretical knowledge scores in surgical coordination for the intervention group versus controls ($P<0.001$), with superior performance in cognitive assimilation and concentration dimensions of clinical simulation immersion (both $P<0.05$). These findings demonstrate that immersive simulations drive knowledge internalization and reconstruction through high-fidelity situational replication [11], validating the foundational role of early specialized nursing education in clinical competency development [15].

Elevating the Teaching Effectiveness of Early Exposure to Orthopedic Surgical Coordination Skills for Nursing Students through Immersive Experience Teaching Based on the "Learning Pyramid" Studies indicate [5] that nursing interns often demonstrate limited initiative in operating room coordination practice. As a critical phase in professional skill development, traditional didactic teaching fails to establish clinical contexts, leading to reduced learning motivation [18], while innovative pedagogical approaches prove essential for improving comprehensive competencies [17].

This study implemented an immersive simulation program for total hip replacement coordination, integrated with short-video interactive feedback to strengthen the "experience-skill translation" pathway. Results revealed significantly higher orthopedic surgical coordination scores in the intervention group versus controls ($P<0.001$), with superior performance in emotional engagement and acquired experience dimensions ($P<0.05$). The findings suggest that high-fidelity surgical simulations facilitate affective interactions [11], while intrinsic motivation transforms clinical training beyond task completion, ultimately enhancing professional identity through reflective application cycles [6].

Conclusion

In this study, we pioneered immersive experience teaching based on the "Learning Pyramid" in orthopedic surgical coordination education for undergraduate nursing students. This approach enhanced their clinical simulation learning immersion, improved the teaching effectiveness of relevant theoretical knowledge and operational skills, and strengthened their role experience in operating room nursing professions.

We found that this teaching method demands high-quality teaching hardware resources and comprehensive qualities from instructors. Additionally, due to limitations in internship duration, format, and resources for undergraduate nursing students, even with immersive experience teaching providing opportunities for specialized surgical coordination practical operations, continuous, dynamic, and individualized practical operations and improvement guidance for real surgical coordination remain unachieved. Future efforts should focus on continuously exploring and improving operating room nursing education and training mechanisms for nursing students, promoting the professional development of clinical nursing and cultivating nursing talents.

Acknowledgments

Funding

This work was supported by The Teaching Reform Project of Guangdong Province "New Medical Science" Teaching Steering Committee and The Undergraduate Teaching Quality and Teaching Reform Project of Sun Yat-sen University. The authors wish to sincerely thank all of the participants without whom this study would have not been possible and editor teacher's assistance in reviewing and editing this article.

Ethical Approval

Ethical issues are not involved in this paper.

Conflicts of Interest

All contributing authors declare no conflicts of interest.

References

1. Guo L (2021) Operating Room Nursing Practice Guidelines [M]. Beijing: People's Medical Publishing House.
2. Notice on Issuing the Action Plan for Further Improving Nursing Services (2023-2025) [J]. Bulletin of the National Health Commission of the People's Republic of China. 2023: 5-8.
3. Wang YM, Xiong LJ, Gao XL, Fu WF (2015) A qualitative study on the core competency characteristics of specialized nurses in operating rooms [J]. Chinese Journal of Modern Nursing. 21: 316-317.
4. Giersbergen MY, Ozsaker E, Dirimese E, Alcan AO (2016) The Operating Room Experiences of Nursing Students: A Focus Group Study. J Perianesth Nurs 31: 146-153.
5. Zhang YY, Shen Y, Li JJ (2019) A qualitative study on the real experience of nursing interns in operating room cooperation [J]. Guangxi Medical Journal. 41: 662-665.
6. Zhu Y, Wang ZY, Fang ZP, Zhang YJ, Yan YS, et al. (2023) Research progress on nurses' professional calling [J]. Journal of Nursing Science. 38: 22-25.
7. Zhang X, Pan SQ, Ma Q, Sun XL, Du CX (2021) Application effect of TBL collaboration mode based on learning pyramid theory in teaching rounds of standardized training nurses in ICU [J]. Nursing Research. 35: 4294-4297.
8. Yu L, Zhou CF (2012) On the immersion teaching mode and practice in higher education in China [J]. Henan Social Sciences. 20: 78-80.
9. Wu P, Shen HY, Yang Y, Guo DH, Yang J, et al. (2022) The influence of immersive clinical experience teaching on the empathy ability of nursing students in operating rooms [J]. Journal of Nursing Science, 37: 45-47+75.

10. Li YX, Liu H, Chen LL, Luo Y, Wang YY (2021) Application of immersive dietary nursing education games in clinical teaching of gastroenterology [J]. Journal of Nursing Science. 36: 84-87.

11. Chen D, Zhu CK, Sun YY, Wang L, Bi DL, et al. (2023) Chinese translation and reliability and validity test of the clinical simulation learning immersion scale [J]. Journal of Nursing Science. 38: 12-15.

12. Li FQ (2016) Theoretical basis and instructional design of blended learning [J]. Modern Educational Technology. 26: 18-24.

13. Feng X, Tan J, Song Q, Lyu J (2015) Application of urological endoscopic instrument plastic atlas in instrument handover [J]. Journal of Nursing Science. 30: 9-10.

14. Singh A, Ferry D, Balasubramanian S (2019) Efficacy of clinical simulation-based training in biomedical engineering education. Biomech Eng J 141: 121011-121011-7.

15. Lu J, Shi TY (2015) Discussion on clinical teaching practice with improving professional competency of undergraduate nursing students as the core [J]. Nursing Research. 29: 2471-2473.

16. Jiang YL, Xu T (2014) Application and practice of learning effectiveness pyramid theory in flipped classroom [J]. China Educational Technology. 07: 133-138.

17. Shen Y, Li JJ (2016) Application of evaluation framework based on I-E-O model in operating room practice teaching [J]. Nursing Research. 30: 1852-1853.

18. Chen R, Li J, Chen F, Zhang J, Li X, et al. (2022) The influence of flipped classroom based on CDIO concept on the teaching effect of nursing students in operating rooms [J]. Journal of Nursing Science. 37: 70-73.