Content available at: https://www.ipinnovative.com/open-access-journals

Journal of Education Technology in Health Sciences

Journal homepage: https://www.jeths.org/

Original Search Article

Telepresence robotics in clinical education: Enhancing student engagement and learning outcomes

Kirsten Davin[1]*, **Barbara M Doucet**[1], **Ricardo Altahif**[1]

[1]*Dept. of Occupational Therapy, Baylor University, Waco, Texas*

ARTICLE INFO

Article history:
Received 15-06-2024
Accepted 03-07-2024
Available online 27-07-2024

Keywords:
Telepresence robots
Clinical education
Occupational therapy
Student satisfaction
Self- confidence
Simulation design

ABSTRACT

Background: The evolution of healthcare education necessitates innovative tools to enhance learning experiences. Telepresence robots, integrated in a hybrid occupational therapy doctorate (OTD) program, offered a transformative approach by enabling real-time interaction and observation promoting interprofessional collaboration. This study evaluated the effectiveness of a telepresence robot to enhance the instruction of clinical skills during patient simulations.

Materials and Methods: A quasi-experimental design was used with student participants. Participants experienced two fieldwork courses: Fieldwork IA (FWIA) without the telepresence robot and Fieldwork IB (FWIB) with the robot. Data were collected using the Simulation Design Scale (SDS) and the Student Satisfaction and Self-Confidence in Learning Scale (SSSLS). Quantitative analysis included paired t-tests and non-parametric tests to compare scores between FWIA and FWIB.

Results: A total of 85 SDS and 79 SSSLS forms were analyzed. Average SDS scores were significantly higher for FWIB compared to FWIA (92.73 ± 6.52 vs. 82.87 ± 12.43, $p<0.001$). SSSLS satisfaction scores increased from 21.63 ± 2.92 in FWIA to 23.82 ± 1.87 in FWIB ($p<0.001$), and self-confidence scores improved from 33.34 ± 4.62 to 36.32 ± 3.69 ($p<0.001$).

Conclusion: Telepresence robots significantly enhanced perceptions of student satisfaction and self-confidence in learning. Students found the robots effective for learning clinical skills during simulations. These findings suggest that telepresence technology can improve students' engagement and learning outcomes in healthcare education.

1. Introduction

In the evolving landscape of healthcare education, technology plays a pivotal role in enhancing learning experiences and bridging gaps between theoretical knowledge and practical application. One such innovative technology tool is the telepresence robot, which has found significant utility in clinical education settings. Telepresence robots are sophisticated devices under remote guidance that are equipped with cameras, microphones, and wheels allowing transport and interaction in various environments. Consisting of a self-driving, two-wheeled base that supports an electronic tablet with videoconferencing capabilities, the telepresence robot is remotely controlled and able to navigate through areas and spaces, giving teachers a virtual presence in the room when not there in person. For healthcare instruction, this opens an exciting new opportunity for interprofessional and caregiver collaboration, for students to see and learn hands-on patient care, and for the instructor to provide guided information as if all were physically in the room.

Telepresence robots enable remote users to have a physical presence in a different location, thus facilitating real-time communication and engagement. In the context of clinical education, these robots can stream live sessions,

* *Corresponding author*.
E-mail address: kirsten_davin@baylor.edu (K. Davin).

https://doi.org/10.18231/j.jeths.2024.011

bringing diverse professional expertise into the clinical space without the constraints of physical travel. This capability is particularly beneficial in areas where a shortage of qualified professionals may exist, ensuring that all students receive quality supervision and enhancing learning opportunities through interprofessional education. For instance, telepresence robots allow students to observe and interact with professionals from various disciplines in real-time, such as during a live stream of a surgical procedure or a multidisciplinary team meeting, providing healthcare students with a holistic view of patient care.[1]

The benefits of telepresence robots in clinical education are numerous. These devices allow students to engage with professionals from various disciplines in real-time, fostering a deeper understanding of collaborative practice crucial for effective healthcare delivery.[2] Instructors and mentors can provide guidance and feedback from remote locations, ensuring continuous support for students during offsite clinical rotations.[3] Additionally, telepresence robots increase accessibility and flexibility by overcoming geographic barriers, making it possible for students to participate in clinical experiences in diverse settings regardless of physical location.[4] The ability to connect remotely allows for more flexible scheduling of clinical sessions, accommodating both student and faculty/practitioner availability that could help to reduce logistical constraints.[5] Immediate feedback and the ability to ask questions in real-time during clinical sessions can facilitate the learning process, leading to better performance and understanding of clinical practices.[6]

The incorporation of telepresence technology is rapidly becoming a valuable tool in healthcare settings within both clinical practice and clinical education. A telepresence robot used in a nursing education program allowed a nurse practitioner instructor to be virtually present while students performed simulated patient examinations; students and faculty found the robot to be acceptable and feasible for learning.[7] In Korea, undergraduate education students also responded positively to telepresence robot use during student teaching internships.[8] This type of device was studied specifically in occupational therapy practice where therapists could be remotely "present" with caregivers within the home setting.[9] The robot was found to be a useful tool for performing home safety evaluations, allowing therapists to resolve issues immediately through real-time conferencing and resulting in a more comprehensive home assessment.[10] Overall, literature is limited on the use of this technology in clinical applications, but potential benefits were noted; therefore, further research and exploration is timely and warranted.

Because methods of learning in healthcare curricula have been radically and possibly permanently changed in recent years, alternative innovative methods need to be explored to deliver instruction for hands-on patient care skills in a variety of environments. As healthcare education continues to evolve, the adoption of such innovative tools will undoubtedly play a crucial role in preparing students to meet the demands of modern clinical practice. This project explored the use of a telepresence robot within a hybrid occupational therapy curriculum during clinical simulations. The purpose was to determine if a telepresence robot was an effective design element that improved the student's self-confidence and perceptions of learning hands-on skills during a patient care training class. Additionally, we examined student perceptions as to whether the robot enhanced the instruction of clinical skills.

2. Materials and Methods

2.1. Study design

This study employed a quasi-experimental, one-group design to evaluate the effectiveness of telepresence robots in clinical education over two years of data collection. Participants were entry-level Occupational Therapy Doctorate (OTD) students enrolled in a 24-month hybrid accelerated program and represented a sample of convenience.

2.2. Equipment

The telepresence robot, a Double Robot 3, manufactured by Double Robotics (Burlingame, California, USA 94010) was equipped with an electronic tablet on a remotely controlled base, allowed faculty to observe and interact with students remotely, providing real-time feedback and guidance.

2.3. Procedures

The study was conducted across two courses: Occupational Therapy Fieldwork Seminar IA (FWIA) and Occupational Therapy Fieldwork Seminar IB (FWIB). The FWI courses included hands-on clinical activities, simulated patient experiences, and in-person student-faculty engagement conducted onsite at a local community college using their healthcare program facilities and equipment. The FW experience consisted of small student groups rotating between eight varied patient simulation scenarios, where students were required to perform initial evaluations, select assessment tools, and construct treatment plans for simulated patients within practice settings ranging from intensive care and critical cardiac care to home health and outpatient settings. FWIA occurred in March and FWIB occurred in May. The FWIA course was conducted without the use of the telepresence robot, and then the FWIB course used the robot. Faculty simulated the roles of a physician, medical team member, caregiver, or family member of the patient and would question the students in real time as they examined patients and inquired about the patient status, equipment needs, available assistance,

discharge recommendations and more. The telepresence robot was remotely controlled by occupational therapy faculty instructors to enter the simulation areas of each student group randomly. The robot allowed faculty to observe student interactions unobtrusively and simulate the roles previously described.

2.4. Instruments

Quantitative data were collected using two validated instruments: The Simulation Design Scale (SDS) and the Student Satisfaction and Self-Confidence in Learning Scale (SSSLS). The SDS is a 20-item tool designed to measure perceptions of simulation design elements, with raters using a 5-level scale to score the realism, information, support, problem-solving, feedback, and importance of each element.[11,12] The SSSLS is a 13-item tool that ranks student perceptions regarding their satisfaction and self-confidence in learning.[13,14] Both tools, developed by the National League for Nursing in 2005 for nursing simulations, were adapted for use in occupational therapy student simulations. Additionally, a final four-item questionnaire was administered to both students and faculty to gather qualitative feedback on their experiences with the telepresence robot.

Upon completion of FWIA and FWIB, the SDS and SSSLS instruments were administered to the students and then compared. Students created individualized codes used as anonymous identifiers so that test results could be paired for comparisons. A final four-item questionnaire was administered to both faculty and students after completing both courses to elicit qualitative information regarding the use of the telepresence robot.

2.5. Data analysis

Data analysis included compiling average scores on the SDS and SSSLS and comparing responses between FWIA (without the robot) and FWIB (with the robot) using paired t-tests. Non-parametric tests were employed when necessary. Qualitative data from the questionnaires were transcribed and analyzed by extracting common terms, phrases, and themes, which were then categorized as negative, neutral, or positive. The study was conducted in accordance with ethical standards and was approved by an independent ethics committee. Participants provided informed consent, and their confidentiality was maintained throughout the study. To achieve a power level of 0.80 using a two-tailed test and a desired effect size of 0.80, the sample size was calculated to be 15. With an expected 70 or more participants, the study had a robust sample size to detect differences between the conditions (with and without the telepresence robot).

3. Results

A comprehensive analysis of the data collected from the Simulation Design Scale (SDS) and the Student Satisfaction and Self-Confidence in Learning Scale (SSSLS) forms revealed significant findings regarding the impact of telepresence robots on student learning experiences.

A total of 85 SDS forms and 79 SSSLS forms were matched and analyzed. The average total scores on the SDS were markedly higher for Fieldwork IB (FWIB), which incorporated the telepresence robot, compared to Fieldwork IA (FWIA), which did not utilize the robot. For the SSSLS, the satisfaction, self-confidence, and total domain scores also showed a significant increase when the telepresence robot was used (Table 1).

Qualitative data gathered through a semi-structured questionnaire further supported these quantitative findings. Students expressed that the telepresence robot enhanced their learning experience by providing a more engaging and interactive environment. Many students highlighted that the real-time feedback and the ability to ask questions during simulations significantly improved their understanding and retention of clinical skills. Faculty members also observed that the telepresence robot allowed for more efficient supervision and provided opportunities for remote mentorship that would not have been possible otherwise.

4. Discussion

The study demonstrated that the use of telepresence robots in clinical education significantly enhanced student satisfaction and self-confidence in learning. Entry-level Occupational Therapy Doctorate (OTD) students reported high satisfaction with the use of a telepresence robot within their Fieldwork experience courses. Overall scores on the SDS and SSSLS instruments were significantly higher when the robot was incorporated into the learning experience. Students noted a stronger learning effect when the telepresence robot was used, indicating its effectiveness in teaching clinical skills during patient simulations.

These findings align with previous research indicating the positive impact of telepresence technology in educational settings.[7] The ability to observe and interact with professionals in a real-time, immersive fashion facilitated a more engaging and effective learning experience for students. The significant improvements in SDS and SSSLS scores suggest that telepresence robots can enhance the realism and clarity of learning objectives in clinical simulations. This is particularly important in healthcare education, where hands-on skills and real-time feedback are crucial for student development and competency.

The use of telepresence robots may also offer a viable solution for overcoming geographic barriers and logistical constraints in clinical education. It allows for a more flexible

Table 1: Impact of Telepresence Robots on Student Learning Experiences. For the SDS, N=85, for the SSSLS, N=79.

Scale	FWIA Mean ± SD	FWIB Mean ± SD	p-value
SDS Total Score	82.87 ± 12.43	92.73 ± 6.52	<0.001
SSSLS Satisfaction	21.63 ± 2.92	23.82 ± 1.87	<0.001
SSSLS Self-Confidence	33.34 ± 4.62	36.32 ± 3.69	<0.001
SSSLS Total Score	54.97 ± 6.80	60.14 ± 4.99	<0.001

The scores of the SDS and SSSLS each show a significant improvement when the telepresence robot was used

and accessible learning environment, which is crucial in the current educational landscape and highlights the need for innovative remote learning solutions.

Despite the positive findings, the study had some limitations. The participant group was relatively homogeneous, and the study was conducted at a single institution, which may limit the generalizability of the results. Additionally, the study focused on short-term outcomes, and further research is needed to explore the long-term impact of telepresence robots on student learning and clinical skill development.

Future research should explore the use of telepresence robots in diverse educational contexts and investigate the long-term impact on learning outcomes. Studies could also examine the cost-effectiveness of telepresence technology and its potential to enhance clinical education in under-resourced settings. The significance of this project has grown immensely, not only for our university but also for clinical education at large.

Telepresence robots provide an opportunity to invite nationally and globally renowned educators and content experts into the classroom in a true-to-life manner. These experts can view student activities, participate in hands-on lab immersions, and engage in Level I Fieldwork (FW) sessions, interacting with students in a dynamic, live format. The use of telepresence technology can lead to long-term savings in travel and reimbursement costs for faculty members, content experts, and specialists in the OT field. Additionally, telepresence robots allow for virtual mobilization within capacity-restricted environments, enabling greater inclusion and skill assessment during lab immersions and Level I FW sessions. Students can engage in point-of-view interactions with simulated patients, viewed in real-time for assessment and debriefing from any computer or mobile device.

The telepresence robot offers the opportunity to foster unparalleled interprofessional collaboration with community partnerships. Healthcare workers from the community can collaborate with students in simulated patient scenarios. This technology provides the opportunity for real-time access to observe live OT evaluations and treatment sessions in various community practice settings, including skilled nursing facilities, mental health facilities, and pediatric settings, where the presence of multiple students may negatively impact the therapeutic process. The telepresence robot allows for observation and participation in actual patient interactions while ensuring safe practice for both clients and students, including live demonstrations, the opportunity for equal access and excellent visibility, thus improving efficiency and time management in some environments. Moreover, the provision of feedback and debriefing to lab immersion and Level I FW students can be conducted via a less invasive method, enhancing the learning experience. The telepresence robot can also be used to mentor new faculty members in a non-invasive manner, helping to build their competence and confidence in teaching skills.[15] Overall, this project highlights the transformative potential of telepresence technology in enhancing the quality and effectiveness of healthcare education and future opportunities in this arena.

5. Conclusion

The study demonstrated that telepresence robots significantly enhanced student satisfaction and self-confidence in clinical education, aligning with previous research that underscores the positive impact of telepresence technology.[16,17] The findings suggest that telepresence robots can enhance the realism and clarity of learning objectives in clinical simulations, which is critical for developing hands-on skills and providing real-time feedback in healthcare education. Despite the study's limitations, such as the homogeneous participant group and single institution setting, the results indicate that telepresence technology is a promising tool for improving clinical education.

The implications of these findings are substantial, as telepresence robots can address geographic barriers and logistical constraints, making clinical education more accessible and flexible. This is particularly relevant in the context of the current educational environment, which has necessitated innovative remote learning solutions. Future research should explore the long-term impact of telepresence robots on student learning and clinical skills development in diverse educational settings. Additionally, examining the cost-effectiveness of this technology could further validate its potential benefits in enhancing clinical education, especially in under-resourced settings.

In conclusion, the integration of telepresence robots into a hybrid occupational therapy program significantly enriched the learning experience, providing a model that can be adopted by other educational institutions. This study

underscores the transformative potential of telepresence technology in healthcare education, highlighting its role in overcoming barriers, facilitating interprofessional collaboration, and improving the overall quality and effectiveness of clinical training. Future research should continue to explore and expand upon these findings, ensuring that telepresence technology is leveraged to its fullest potential in preparing students to meet the demands of modern clinical practice.

6. Sources of Funding

None.

7. Conflict of Interest

None.

Acknowledgments

The telepresence robot project was funded by the Teaching Exploration Grant from Baylor University's Academy for Teaching and Learning.

References

1. Cook DA, Hatala R, Brydges R, Zendejas B, Szostek JH, Wang AT. Technology-enhanced simulation for health professions education: a systematic review and meta-analysis. *JAMA*. 2018;306(9):978–88.
2. Kasuk T, Virkus S. Exploring the power of telepresence: enhancing education through telepresence robots. *Inf Learn Sci*. 2023;125(2):109–37.
3. Gonzalez L, Singh S. The Impact of Telepresence on Teaching and Learning. *Educ Inf Technol*. 2020;25(5):3803–15.
4. Charness N, Boot WR. Technology, Gaming, and Social Networking. In: Handbook of the Psychology of Aging. Elsevier; 2016. p. 389–407.
5. Nelson A. Implementation of a telepresence robot for remote medical consultation in a multi-disciplinary intensive care unit. *J Crit Care*. 2017;38:29–33.
6. Reamer FG. Distance and Online Social Work Education: Novel Accreditation Challenges and Opportunities. *J Soc Work Educ*. 2013;49(2):225–40.
7. Shaw RJ, Margory M, Jacqueline V, Nancy C, Michele K, Raymond B, et al. Telepresence Robots for Pediatric Clinical Simulations: Feasibility and Acceptability. *Pediatr Nurs*. 2018;44(1):39–43.
8. Han J, Conti D. The Use of UTAUT and Post Acceptance Models to Investigate the Attitude towards a Telepresence Robot in an Educational Setting. *Robotics*. 2020;9(34):1–19.
9. Lee M, Castaneda G, Romero S. Comparing Store-and-Forward Videos Versus Telepresence Robots to Conduct Remote Home-Safety Evaluations. *Am J Occup Ther*. 2019;73(4). doi:10.5014/ajot.2019.73S1-PO4041.
10. Lee M. Use of Telepresence Robots for Home Safety Evaluations: A Feasibility Study. *Ann Int Occup Ther*. 2020;3(3):119–26.
11. Simulation Design Scale (Student Version) [Measurement Instrument]. National League for Nursing; 2005. Available from: https://www.nln.org/docs/default-source/uploadedfiles/professional-development-programs/nln-instrument-simulation-design-scale.pdf.
12. Rudolph A, Vaughn J, Crego N, Hueckel R, Kuszajewski M, Molloy M, et al. Integrating Telepresence Robots into Nursing Simulation. *Nurse Educ*. 2017;42(2):1–4.
13. Student Satisfaction and Self-Confidence in Learning. National League for Nursing; 2005. Available from: https://www.nln.org/docs/default-source/uploadedfiles/default-document-library/instrument-2-satisfaction-and-self-confidence-in-learning.pdf.
14. Franklin AE, Burns P, Lee CS. Psychometric testing on the NLN Student Satisfaction and Self-Confidence in Learning, Simulation Design Scale, and Educational Practices Questionnaire using a sample of pre-licensure novice nurses. *Nurse Educ Today*. 2014;34(10):1298–1304.
15. Rodger K. Mentoring Clinical Teachers Using Mobile Telepresence Technology. *Nurse Educ*. 2019;45(1):2–4.
16. Donkin R, Askew E, Stevenson H. Video feedback and e-Learning enhances laboratory skills and engagement in medical laboratory science students. *BMC Med Educ*. 2019;19(1):310.
17. Smith RD, Jones PA. Student satisfaction and perceived learning with computer-based simulations in a prelicensure nursing program. *Nurs Educ Perspect*. 2019;40(3):174–9.

Author biography

Kirsten Davin, Assistant Professor https://orcid.org/0009-0001-1810-214X

Barbara M Doucet, Associate Professor https://orcid.org/0000-0001-7735-3910

Ricardo Altahif, Assistant Professor https://orcid.org/0009-0009-4233-4475

Cite this article: Davin K, Doucet BM, Altahif R. Telepresence robotics in clinical education: Enhancing student engagement and learning outcomes. *J Educ Technol Health Sci* 2024;11(2):50-54.