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Application of Intelligent Agents and Standardized Patient Teaching Models in Nursing Interpersonal Communication Courses

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Abstract
Objective: To enhance undergraduate nursing students' humanistic care and interpersonal communication competencies. Methods: Using cluster sampling, 218 nursing undergraduates from the 2023 cohort at a medical college were assigned to the intervention group (SHARE framework + AI agents + standardized patients integrated teaching model), while 210 nursing undergraduates from the 2022 cohort formed the control group (traditional teaching model). A semester-long teaching study was conducted using the nursing interpersonal communication course as the medium. Teaching effectiveness was assessed using the Caring Ability Inventory (CAI) and Supportive Communication Scale (SCS). Results: The intervention group demonstrated significantly higher scores than the control group on all dimensions and the total score of the CAI (Cognitive: 11.08±2.82, Courage: 27.79±4.52, Patience: 44.27±7.60, Total Score: 83.14±12.60) were significantly higher than those of the control group (Cognitive: 8.63±2.54, Courage: 24.16±4.21, Patience: 39.82±7.12, Total Score: 72.61±11.88), with statistically significant differences (P < 0.05 for all comparisons). The intervention group also demonstrated significantly higher scores on all dimensions and the total score of the SCS scale (Counseling and Consultation: 11.17±2.85, Providing Effective Negative Feedback: 27.65±4.50, Supportive Communication: 44.32±7.63, Total score: 83.14±12.60) were significantly higher than those in the control group (Counseling and Consultation: 9.21±2.68, Providing Effective Negative Feedback: 23.57±4.12, Supportive Communication: 38.64±7.02, Total score: 71.43±11.53), with statistically significant differences (P <0.05 for all comparisons). Conclusion: The SHARE framework combined with an integrated teaching model featuring agents and standardized patients effectively enhances nursing undergraduates' humanistic care and interpersonal communication competencies, providing insights for nursing interpersonal communication curriculum reform.

Keywords
SHARE framework; agents; standardized patient teaching model; nursing interpersonal communication

Nursing students require not only a solid foundation in medical theory and proficient, standardized technical skills, but also strong communication abilities. Furthermore, they should embrace a humanistic philosophy, deepen their “patient-centered” service awareness, and integrate this principle throughout the entire nursing process. The Nursing Interpersonal Communication course is highly practical and skill-oriented; most

students struggle to effectively integrate theoretical knowledge with real-world application. The Standardized Simulated Patient (SSP) teaching model refers to individuals who, after standardized and systematic training, can serve in multiple roles such as evaluators and teaching guides. These simulated patients exhibit consistency, reusability, and versatility. [1]

Advancements in artificial intelligence technology have opened new avenues for enhancing student capabilities through the application of intelligent agents in education.[2-4] Intelligent agents can simulate diverse patient personas and clinical scenarios. Leveraging their robust data processing and interactive capabilities,[5] they complement the standardized patient teaching model. Within SHARE-framework-based instruction, AI agents employ algorithms to precisely capture nursing students' performance across key dimensions: perceiving patient needs (S), helping patients overcome difficulties (H), demonstrating empathy (A), respecting patient privacy (R), and providing proactive communication (E). They generate real-time feedback and assessment reports. For instance, in the empathy assessment, the AI analyzes students' language, facial expressions, and body language through emotion recognition technology to evaluate the effectiveness of their empathetic communication. This enables instructors to provide targeted guidance for improvement.

To enhance nursing students' humanistic care and interpersonal communication skills, this study employs the SHARE framework integrated with agent technology. Through standardized patient teaching methods, students not only learn conventional humanistic care theory but also study the SHARE care philosophy, which includes: A (Acknowledge patient's feelings) empathizing with patients; R (Respect patient's dignity and privacy) respecting patient privacy; E (Explain what's happening) providing proactive communication. This humanistic care education for undergraduate nursing students aims to enhance their humanistic literacy [6] and provide a reference for refining teaching strategies to improve their humanistic care and interpersonal communication skills.

1. Research Design

1.1 Study Participants

Using cluster sampling, 218 nursing undergraduates from the 2023 cohort at a medical college were selected as the intervention group (aged 18–23 years, mean age 20.1 ± 1.2 years), while 210 nursing undergraduates from the 2022 cohort served as the control group (aged 18–22 years, mean age 19.8 ± 1.1 years). Prior to the study, both groups followed the undergraduate nursing curriculum, receiving identical instruction in basic medical courses (e.g., anatomy, physiology) and foundational professional courses (e.g., fundamentals of nursing). The mean scores for basic medical courses showed no statistically significant difference between groups (intervention group: 81.9 ± 4.8 points; control group: 82.3 ± 5.1 points) showed no statistically significant difference ($t=0.62$, $P=0.54$). Both groups were taught by the same nursing faculty. Inclusion criteria: Both instructors and students voluntarily participated in the study. Exclusion criteria: Cumulative absence from ≥2 sessions of nursing interpersonal communication theory or simulation classes, or withdrawal due to other reasons.

1.2 Research Method

Using the nursing interpersonal communication course as a medium, this study integrated humanistic care education with an agent-based teaching model employing standardized patients to enhance nursing students' humanistic care capabilities and interpersonal communication skills. Classroom instruction followed institutional requirements, referencing the textbook Nursing Interpersonal Communication. A semester-long teaching research project was conducted using a theoretical learning-standardized patient teaching model combined with scenario simulation teaching methods.

1.2.1 Theoretical Learning

Course content includes foundational theories of interpersonal communication, such as Roath's 5C competencies, Leininger's cross-cultural nursing theory, Benner and Wrubel's interpersonal communication coping theory, and Watson's humanistic nursing theory [7]. Combined with the SHARE framework themes, detailed instruction is provided on how to embody humanistic care in nursing practice. For example: S (Sense Patient's Needs) involves perceiving patients' needs by paying attention to their physiological, psychological, spiritual, and social requirements during care: observing changes in their condition, whether symptoms are worsening, and their needs regarding air, rest and sleep, food and water, elimination, activity, and safety. Observe the patient's psychological state for negative emotions like fear or anxiety, or separation from loved ones necessitating family visits and care, alongside healthcare providers' empathy and concern. Assess the patient's spiritual state for potential lack of security, belonging, or respect. H (Help Patient Out): Encourage patients, guide self-help practices, implement humanistic care to assist patients in overcoming difficulties; collaborate with patients to establish lifestyle improvement goals. A (Acknowledge Patient's Feelings): Empathize and show compassion to those grieving; Accept complaints about pain, long-term medication, or lifestyle changes without rebuttal or judgment, expressing sympathy for the patient's experiences and feelings; R (Respect patients' dignity and privacy): Respect patient privacy, culture, language, religion, and dignity; do not disclose the patient's condition to unrelated parties; E (Explain what's happening): Proactively inform and explain to the patient: Explain changes in their condition.

1.2.2 Standardized Patient Teaching Model Implementation

Preparation Phase: Collect and design nursing-patient communication cases: Select clinical communication scenarios, extracting episodes highly relevant to nursing interpersonal communication courses as case resources (e.g., dietary guidance communication with diabetic patients, pain reassurance communication with postoperative patients).

Standardized Simulated Patient (SSP) Selection and Training: Recruit students from the same school and major as SSPs through voluntary applications. Select 20 students with strong communication skills based on assessment (communication expression ability, role immersion ability). SSP mentors provide 24 hours of systematic training (conducted in 8 sessions, 3 hours each), covering nursing-patient communication scenario interpretation, standardized emotional expression for case roles, and handling common communication issues. Post-training assessment involved simulating a "communication scenario with a Type 2 diabetes patient." Scores were graded on a 100-point scale, with only those scoring ≥80 permitted to participate in teaching

practice.

During the application phase, SSPs facilitated student communication exercises. After completing theoretical nursing communication courses and SHARE care framework instruction, each student conducted one communication practice session, recorded on video and submitted as coursework. Before practice, students randomly select a case. SSP simulates the patient based on the case, demonstrating the conflicts within the scenario and potential communication challenges. Students then engage in communication practice with SSP. After reviewing the videos, instructors play representative clips in class to guide students in analyzing the communication techniques used, identifying existing issues, and proposing improvement strategies. Finally, instructors provide feedback on communication performance in the videos and deliver detailed explanations of relevant communication skills to further enhance students' abilities.

1.2.3 Applications of Intelligent Agents

Deep Integration of Intelligent Agent Technology in Teaching:

Theoretical Learning Phase: Intelligent agents build a dynamic case library based on core textbook knowledge points, transforming communication principles and ethical norms from Nursing Interpersonal Communication into interactive scenario-based Q&A. By simulating communication needs of patients across different age groups (e.g., elderly, adolescents) and disease types (e.g., hypertension, depression), they assist nursing students in understanding the theoretical framework of the SHARE model.

Scenario Simulation Phase: Intelligent agents collaborate with standardized patients to construct multidimensional training scenarios. ① Data Collection: Micro-expression data is captured via Logitech C920e HD cameras and analyzed using FaceReader 8.0 software to assess expression intensity (e.g., anxiety, calmness) and type; voice and intonation data is collected through Blue Yeti professional microphones, with Praat 6.3.07 software extracting parameters like speech rate, volume, and intonation variation. ② Real-time Evaluation: Natural Language Processing (NLP) technology (based on Huawei Cloud Medical NLP API) analyzes nursing students' communication scripts to extract empathy keywords (e.g., “understand,” ‘worry’), generating an empathy index (0-100 points) for the “Empathizing with Patients (A)” segment; ③ Special scenario simulation: The AI agent simulates sign language interactions with hearing-impaired patients (displaying signs in real-time on screen) and fragmented memory expressions of dementia patients (randomly repeating past dialogue), collaborating with SSP to complete comprehensive training in “Helping patients overcome difficulties (H)”.

Course Summary Phase: The AI integrates semester-long training data to generate personalized competency maps, visually illustrating nursing students' progress trajectories across dimensions like “Respecting Patient Privacy (R)” and “Proactive Communication (E)” (e.g., cognitive dimension scores rising from 8.2 to 11.1), providing data-driven insights for instructors to refine teaching strategies.

1.2.4 Observation Metrics

To comprehensively evaluate teaching application outcomes post-course, this study employs two scales for integrated assessment. First, the Caring Ability Inventory (CAI) measures students' humanistic care perfor-

mance, including empathy, respect, and caring behaviors toward patients. Second, the Supportive Communicative Scale (SCS) assessed students' skills and competencies in nurse-patient communication, covering communication clarity, effectiveness, and ability to handle complex situations. The combined use of these scales provided a more comprehensive reflection of the teaching methods' impact on enhancing students' humanistic care and communication abilities, thereby informing subsequent teaching improvements.

This study employs the Caring Ability Inventory (CAI) and Supportive Communicative Scale (SCS) as measurement tools to scientifically evaluate nursing students' caring abilities and interpersonal communication skills.

The Caring Ability Inventory (CAI) utilizes the Chinese version of the CAI scale adapted by Chen Yu (2017) [9], comprising three dimensions: cognition (14 items), courage (13 items), and patience (10 items; items 1, 5, 10, 17, 18, 20, 21, 24, 27, 37), totaling 37 items. It employs a 7-point Likert scale ranging from “Strongly Agree” (7 points) to “Strongly Disagree” (1 point), with 13 items requiring reverse scoring. Scoring range: Total score 37–259 points; Cognitive dimension 14–98 points; Courage dimension 13–91 points; Patience dimension 10–70 points. Higher total scores indicate stronger caregiving abilities. In this study, the total Cronbach's α coefficient for the scale was 0.83, with dimension-specific coefficients of 0.82 (Cognitive), 0.78 (Courage), and 0.76 (Patience).

Supportive Communicative Scale (SCS): The SCS scale adapted by Li Min et al. (2020) was employed, comprising three dimensions: counseling and consultation, providing effective negative feedback, and supportive communication, with a total of 24 items. Higher scale scores indicate stronger interpersonal communication abilities. In this study, the total Cronbach's α coefficient for the scale was 0.81, with dimension-specific coefficients of 0.79 (counseling and consultation), 0.77 (providing effective negative feedback), and 0.80 (supportive communication).

1.4 Statistical Methods

SPSS 26.0 statistical software was used to analyze the aforementioned scales and other data. Quantitative data are expressed as “mean ± standard deviation (M±SD)”. Comparisons between groups were performed using independent samples t-tests; correlations were analyzed using Pearson correlation analysis. All data were validated for normal distribution via Shapiro-Wilk tests (CAI Cognitive Dimension: Control group W=0.97, P=0.18; Intervention group W=0.98, P=0.21; SCS total score: control group W=0.96, P=0.15; intervention group W=0.97, P=0.19). Homogeneity of variance was verified using Levene's test (CAI total score: F=1.23, P=0.27; SCS total score: F=1.18, P=0.30), satisfying the prerequisites for parametric testing. Significance level criteria: *P<0.05, **P<0.01.

1.5 Data Collection Method

Following the course, both groups underwent assessments of caring competence and supportive communication skills using the Supportive Communication Scale and Caring Competence Evaluation Scale. To ensure validity and objectivity, students completed the questionnaires in a centralized setting, with forms collected immediately upon completion. During data processing, the research team rigorously screened the collected questionnaires. Any questionnaire exhibiting a pattern of five or more consecutive identical responses was

deemed invalid and excluded to ensure the accuracy and reliability of subsequent analyses.

All data underwent independent samples t-tests using SPSS 21.0, meeting prerequisites of normal distribution (Shapiro-Wilk test $P > 0.05$) and homogeneity of variance (Levene's test $P > 0.05$). Significance thresholds were set at: $*P < 0.05$ and $**P < 0.01$.

2. Results

Following the course, instructors distributed questionnaires to each nursing student and collected them immediately. A total of 428 questionnaires were distributed (210 in the control group and 218 in the intervention group), with 428 returned. Both the return rate and validity rate were 100%.

2.1 Caring Ability Inventory (CAI) Scores

The intervention group scored significantly higher than the control group across all CAI dimensions and the total score, with all differences statistically significant (all $P<0.05$). The greatest difference was observed in the cognitive dimension ($t=7.82$), indicating that blended learning most effectively enhanced nursing students' ability to "understand patient needs and master theories of humanistic care." Although the difference in the patience dimension was relatively smaller ($t=4.33$), it remained statistically significant, indicating that the intervention further strengthened nursing students' willingness and ability to provide long-term care to patients. See Table 1.

2.2 Communication Skills Scale Scores

The intervention group scored significantly higher than the control group across all dimensions and the total score of the SCS scale, with all differences being statistically significant (all $P < 0.05$). The most pronounced difference was observed in the total communication skills score ($t = 8.93$), reflecting the integrated teaching approach's systematic enhancement of nursing students' comprehensive communication abilities. The "Providing Effective Negative Feedback" dimension showed a large difference ($t=7.24$), suggesting that standardized patient simulation combined with real-time feedback from intelligent agents effectively improves nursing students' ability to "balance professionalism and humanistic care when conveying negative information"; Although baseline scores were low in the "counseling and consultation" dimension, significant improvement was observed post-intervention ($t=6.07$), indicating that blended learning can compensate for deficiencies in traditional teaching regarding the cultivation of nursing students' ability to proactively counsel patients. See Table 2.

Table 1: CAI Scale Total Score and Individual Dimension Scores (M ± SD)

Dimension/Total Score	Control Group (N=210)	Intervention Group (N=218)	t-value	P-value
Cognition	8.63±2.54	11.08±2.82	7.82	0.03*
Courage	24.16±4.21	27.79±4.52	6.51	0.008**
Patience	39.82±7.12	44.27±7.60	4.33	0.012*
Total Score	72.61±11.88	83.14±12.60	8.15	0.02*

Table 2: Communication Ability Scale Total Score and Dimension Scores (M ± SD)

Dimension/Total Score	Control Group（N=210）	Intervention Group（N=218）	t-value	P-value
Counseling and Consultation	9.21±2.68	11.17±2.85	6.07	0.009**
Providing Constructive Negative Feedback	23.57±4.12	27.65±4.50	7.24	0.04*
Supportive Communication	38.64±7.02	44.32±7.63	5.89	0.015*
Total Score	71.43±11.53	83.14±12.60	8.93	0.01*

2.3 Correlation Analysis Between Communication Skills and Humanistic Care Competence

Table 3 presents the correlation analysis results between communication skills and humanistic care competence among nursing students. Findings indicated counseling and consultation positively correlated with providing effective negative feedback, supportive communication, and overall communication skill scores. The correlations between the various dimensions of caring competence and communication competence were relatively weak, with some dimensions even showing negative correlations. However, these did not reach statistical significance ($p > 0.05$). Strong positive correlations were observed among the various dimensions of communication competence itself. Meanwhile, the correlation between communication competence and caring competence was weak, suggesting that these may be relatively independent skill domains requiring targeted training.

Table 3 Correlation Analysis Results for Communication Competence and Humanistic Care Competence Among Nursing Students

	Counseling and Consultation	Providing Constructive Negative Feedback	Supportive Communication	Total score	Cognition	Courage	patience	CAI score
Counseling and Consultation	1	.317** .000	.603** .000	.720** .000	-.104 .125	-.025 .714	-.133 .050	-.114 .095
Providing Constructive Negative Feedback	.317** .000	1	.545** .000	.770** .000	-.066 .334	-.036 .596	-.055 .421	-.077 .261
Supportive Communication	.603** .000	.545** .000	1	.933** .000	-.113 .095	-.067 .327	-.086 .206	-.132 .051
Total score	.720** .000	.770** .000	.933** .000	1	-.115 .090	-.059 .388	-.101 .136	-.133 .051
Cognition	-.104 .125	-.066 .334	-.113 .095	-.115 .090	1	-.020 .765	.654** .000	.723** .000
Courage	-.025 .714	-.036 .596	-.067 .327	-.059 .388	-.020 .765	1	-.099 .144	.637** .000
patience	-.133 .050	-.055 .421	-.086 .206	-.101 .136	.654** .000	-.099 .144	1	.590** .000
CAI score	-.114 .095	-.077 .261	-.132 .051	-.133 .051	.723** .000	.637** .000	.590** .000	1

3. Discussion

3.1 Current Status of Humanistic Care Competence Among Nursing Students

Survey research indicates that undergraduate nursing students exhibit relatively low levels of humanistic care competence. [8] In this study, the mean CAI total score for the intervention group after the course was 83.14 ± 12.60. Although this score fell below the moderate level range (171.55–210.53 points) established by Chen Yu (2017) for humanistic care competency, it represented a 10.53-point increase compared to the control group (72.61 ± 11.88 points). with a statistically significant difference (t=8.15, P=0.02). This indicates that the course intervention positively enhanced nursing students' humanistic care competence, particularly in the cognitive dimension (post-intervention: 11.08±2.82 points), showing the most significant improvement (t=7.82, P=0.03). This is closely related to the interactive case-based question-and-answer sessions with the AI agent during the theoretical learning phase — — By simulating scenarios reflecting the needs of patients with different illnesses, nursing students gained a clearer understanding of the “Sense Patient Needs (S)” component within the SHARE framework, thereby strengthening their cognitive grasp of humanistic care.

Pearson correlation analysis revealed strong positive correlations among all dimensions of nursing students' communication skills (r=0.317–0.933, all P<0.01). However, correlations between communication skills and any dimension of humanistic care were weak (r=-0.133 to -0.025, all P>0.05). This discrepancy may stem from the simulation training prioritizing communication techniques (e.g., negative feedback scripting) while insufficiently emphasizing compassionate care practices (e.g., empathy exercises), preventing synergistic enhancement. Future teaching plans should integrate “communication skills-compassionate care” modules.

Nursing interpersonal communication emphasizes practical application. Traditional teaching methods, being monotonous, hinder the development of students' interpersonal communication and compassionate care competencies. By integrating the SHARE framework into nursing interpersonal communication education, this study not only imparts professional knowledge but also enhances students' humanistic care competencies. As Watson asserted, “Nursing humanism is both an innate moral quality and value system, as well as a purposeful, conscious nursing practice.” This emphasizes the importance of empathy with patients, including perceiving their needs for respect, acceptance, social connection, comfort, and information.

3.2 Standardized Patient Teaching Model

This study employs the Standardized Patient (SSP) teaching model, utilizing hospital-based cases that authentically reflect nurse-patient communication and possess greater impact. The SSP model not only hones students' interpersonal communication and humanistic care skills but also enhances their sensitivity and responsiveness. It effectively guides and inspires students to consider how to apply communication techniques, establish trust with patients to achieve effective communication, and deliver health education content—all expressed through their own words and actions.

Using video recordings as assignments enables students to engage in self-reflection by reviewing their interactions (e.g., identifying insufficient empathy expression). Instructors can also pinpoint specific weaknesses through video analysis (e.g., “lack of reassuring language when delivering negative feedback”), allowing them to adjust teaching plans accordingly (e.g., adding targeted training for negative feedback scenarios) and

enhance instructional precision. Simultaneously, screening representative videos in class for group analysis promotes peer learning, enhances classroom engagement, and aligns with Wan Fengjing's [10] conclusion that “video-based reflective teaching improves nursing students' humanistic care competencies.”

3.3 Application of the SHARE Framework

By integrating the SHARE framework into all aspects of the nursing interpersonal communication course, this study effectively enhanced undergraduate nursing students' interpersonal communication skills and humanistic care competencies. Results indicate that the course intervention significantly improved students' scores on the cognitive dimension. Although the intervention group's overall care competency did not reach the intermediate level, it showed a marked improvement compared to the control group. Moreover, strong positive correlations were observed across all dimensions of students' communication skills, indicating that communication ability constitutes an integrated system requiring systematic cultivation. This instructional model enabled students to better understand and master how to establish trusting relationships with patients, conduct effective communication, and deliver health education. These findings provide practical evidence for the systematic reform of nursing interpersonal communication curricula.

3.4 Integration of Intelligent Agents

Incorporating intelligent agent technology into teaching effectively addresses limitations of traditional standardized patient instruction: ① During theoretical learning, the AI's interactive case library provides diverse scenarios (e.g., communicating with adolescent depression patients), addressing the scarcity of clinical case resources; ② In simulation scenarios, AI employs biosensing and NLP technologies to deliver “objective quantitative assessments” (e.g., empathy index) of nursing students' communication performance, mitigating instructor bias in subjective grading; ③ During course summaries, personalized competency maps visually display students' progress and areas for improvement (e.g., “30% improvement in proactive communication (E) but privacy protection (R) still requires strengthening”), providing data-driven support for personalized instruction.

Additionally, the AI's simulation of specialized scenarios (e.g., sign language interaction with hearing-impaired patients) helps nursing students navigate uncommon yet critical clinical communication situations, expanding their communication capabilities—an advantage difficult to achieve through traditional SSP teaching alone.

4. Limitations

This study sampled nursing students from a single medical college, limiting representativeness. Results should be extrapolated cautiously to other medical institutions. Only immediate post-course evaluations were conducted without 6-month or 1-year follow-ups, precluding assessment of intervention sustainability (e.g., whether students maintain strong communication and compassionate care skills during clinical practice).

The incremental value of the AI agent remains unclear: The absence of a “standardized patient teaching-only group” as a control prevents quantification of the AI agent's independent contribution to teaching outcomes (e.g., whether the AI agent could further increase CAI scores by 10%).

Class size impact: Due to scheduling constraints, both intervention and control groups were taught in large combined classes (six classes merged), resulting in lower teacher-student interaction frequency, which may have limited the maximization of teaching effectiveness.

5. Research Prospects

Future multi-center studies should include students from medical schools of varying tiers to enhance the generalizability and applicability of findings. Incorporate long-term follow-up: Establish 6-month and 1-year assessment points to compare competency changes before and after clinical placement, validating the sustainability of intervention effects. Establish a "standardized patient teaching-only group" to clarify the independent role and incremental value of the AI agent through a three-group comparison (traditional group, SSP group, SSP + AI agent group). In subsequent teaching, explore small-group instruction to increase teacher-student interaction and personalized guidance, further enhancing teaching quality.

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