Evaluating competence and confidence using
simulation technology

BY LLYNNE C. KIERNAN, DNP, MSN, RN-BC

Abstract: This article discusses the role of simulation training in educating nurses and reducing clinical errors and describes a research project designed to determine the effectiveness of deliberate practice and simulation technology.
Keywords: Benner's Novice to Expert Theory, clinical competency questionnaire, deliberate practice, Dreyfus Model of Skill Acquisition, high-fidelity simulation, manikin simulation, objective structured clinical examination, simulation technology, simulation training, task trainer

NATIONAL BACCALAUREATE nursing programs have established benchmarks to ensure that education and clinical experiences are sufficient to produce competent professionals. Safety is an increasing concern because newly graduated RNs with less than a year of experience in patient care are involved in 49% to 53% of medical errors. Patient falls, medication errors, and failure-to-rescue incidents are among the most commonly documented errors involving new nurses.[1-3]

The goal of nursing programs is to develop knowledgeable professionals capable of providing safe, highly competent, and skilled patient care. Simulation training, an increasingly important tool in nursing education, is supported by both the National League for Nursing and the National Council of State Boards of Nursing.[4] This article discusses the role of simulation training in educating nurses and reducing clinical errors and describes a research project designed to determine the effectiveness of deliberate practice and simulation technology.

Hands-on and practical

Simulation provides realistic, student-centered learning opportunities.[5] Deliberate practice is the process of training students to perform specific tasks repetitively with immediate feedback to further improve those skills.[6] Repetitive practice with immediate critique from faculty and augmented electronic feedback embedded into a virtual reality simulator

allows students to become competent, reflect upon their skills, and enhance their performance.[7] It also gives students time to refine and improve their motor skills to perform tasks intuitively.[8] Practicing clinical skills promotes self-efficacy, which will aid students in transitioning the didactic content learned in the simulation lab to practical applications in the healthcare setting.[9]

Clinical evaluation of nursing students' skill and critical thinking is complex. Faculty members facilitate learning in the clinical environment, maintaining standards of practice and evaluating competency.[10]

Nursing faculties have a history with simulated environments and direct observation to train students and assess their skills.[11] Evaluating confidence, however, has largely been a subjective process with less targeted evaluation strategies. Self-efficacy is an important factor in clinical development, and research has shown that an individual's confidence is a predictor of competent performance in new situations.[9,12]

A new paradigm to reduce errors

Preventable medical errors in hospitals are the third leading cause of

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death in the US behind heart disease and cancer.[13] In 1999, the Institute of Medicine published *To Err is Human: Building a Safer Health System*.[14] This landmark report warned about the scope of medical errors and

significant gaps in quality.[14] Since then, healthcare providers, federal and state governments, and the public have been looking into why medical errors are so prevalent and searching for ways to reduce their incidence.[15]

Clinical education represents a new paradigm in healthcare as one of the most important ways to ensure safety and improve patient outcomes.[16] According to a 2012 national survey, clinical nursing faculties spend 69% of their time observing nursing students demonstrate clinical skills.[17] Nurse educators must prepare students to enter the complex healthcare environment with the knowledge required to provide safe patient care.[18] Simulation training is one means to that end.

Simulation and deliberate practice

In order to prepare nurses for the clinical setting effectively, educators need to employ evidence-based strategies. The effectiveness of simulation and deliberate practice in teaching, improving, and retaining clinical skills has been well documented. Learning clinical motor skills permanently changes the student's ability to perform proficiently, and retaining a skill requires practice.[8,19] The goal of deliberate practice is to instill in students the ability to apply strong and consistent interventions, as well as to practice and maintain clinical skills.[20] (See *Teaching tools*.)

Deliberate practice is a focused approach aimed at a well-defined goal, not the mindless repetition of a task.[6,21,22] The development of clinical competence and confidence requires nursing students to spend adequate time practicing in the simulation lab, receive immediate

Teaching tools[36]

High-fidelity simulation
This simulation experience is extremely realistic and provides the learner with a high level of interactivity. The high-fidelity simulator is a full-body manikin that imitates human body functions.

Manikin simulation
This approach relies on a life-sized human manikin simulator that represents a patient for teaching all skills from basic patient handling to some more advanced nursing skills including noninvasive BP measurement, and auscultation and recognition of normal and abnormal heart, lung, and bowel sounds.

Task trainer
A task trainer is a model that represents a part or a region of the body such as an arm or abdomen. These devices are used to teach manual skills to support procedural skills training.

feedback on technique and performance, and reflect on the experience.[6,20-22] Additionally, the practical implementation of deliberate practice principles, along with repetition of cognitive or psychomotor skills, rigorous skills assessment, and specific feedback, leads to improved performance.[23]

Increased self-efficacy is an important ingredient in promoting confidence as nursing students develop skill sets that translate into clinical settings.[9,24] An individual's confidence can be enhanced with simulation training, which leads to increased knowledge and encourages critical thinking.[12,25] To promote self-efficacy, nursing educators should support small learning groups with individual feedback and provide multiple opportunities for students to engage in deliberate practice.[9,12]

More sophisticated simulators

As the popularity of simulation training in nursing education has grown, we have experienced a prolific development of more sophisticated simulators.[4] A 2011 national survey reported that 91% of prelicensure nursing programs in the US are utilizing high- or medium-fidelity simulation.[12]

Although simulation training has taken on a larger role in nursing education, it is not fully integrated into skill development for practicing nurses.[26] The use of high- and medium-fidelity simulation was most frequently reported in the medical-surgical, obstetric, and pediatric specialty courses as of 2014.[27]

Basic clinical skills are typically taught in the early part of a nursing program. A 2011 meta-analysis of 53 studies demonstrated that clinical skills that were taught but not practiced resulted in a significant

Demographic data

Age	Number (n = 40)	Percentage	Mean
<25 years	31	77	20.65
25–36 years	7	18	31.43
37–50 years	2	5	44
Gender	**Number (n = 40)**	**Percentage**	
Male	8	20	
Female	32	80	
Ethnicity	**Number (n = 40)**	**Percentage**	
White	33	82.2	
Black	1	2.5	
Hispanic	1	2.5	
Asian American	1	2.5	
Pacific Islander	2	5	
Other	2	5	

skill deficit. Without practice or use for 1 year, researchers found that the average participant performs at 92% of his or her original skill level.[8]

Nurse educators know the value of hands-on practice for developing competency and proficiency in the fundamentals, and they are depending more on simulation training to provide learning experiences for nursing students.[28] Simulation is being used to instruct undergraduate nursing students on patient care as a repetitive, hands-on teaching tool.[5,29,30] More research is needed to show that simulation can be incorporated into nursing education.

Testing simulation technology

The authors initiated a project designed to test the effectiveness of deliberate practice, simulation technology, and educational sessions in developing nursing students' clinical competence and confidence. The project was based on the following research question: *Using deliberate practice and simulation*

technology, how does a comprehensive clinical skills assessment project affect competence and confidence in clinical skills for second-semester sophomore nursing students?

Project participants were baccalaureate students in the second semester of their sophomore year who used deliberate practice for clinical skill acquisition in a simulation skills lab. Students were afforded faculty guidance and supervision and had the opportunity to practice specific skills in the simulation lab before being evaluated for competency and proficiency.

First proposed in 1980, the Dreyfus Model of Skill Acquisition provided the framework for this project. Hubert and Stuart Dreyfus identified five stages of development:
• novice
• advanced beginner
• competent
• proficient
• expert.[31]

Patricia Benner first applied the Dreyfus model and stages to

nursing.[32,33] Each level builds upon the next as the student moves through the stages, gaining knowledge, skills, perceptions, intuition, and experience.[32]

The sample group was comprised of 40 adult (age 18 and older) nursing students, 8 males and 32 females, attending a baccalaureate school of nursing (SON) at a private university accredited by the New England Association of Schools and Colleges and the Commission on Collegiate Nursing Education. All participants had successfully completed Health Assessment and Mathematics for Medications courses, and each was enrolled in a Fundamentals of Nursing course at the time. The students were English-speaking and included various adult ages, ethnicities, and genders. (See *Demographic data*.)

Methods

Both a pretest–posttest design and an end-of-project summative evaluation were used for analysis. Additionally, a clinical competency questionnaire (CCQ) was administered for data collection in both the pretest and posttest phases. The CCQs represented two categories: nursing professional behaviors and skill competencies.[22]

Selected for high internal consistency and reliability, the CCQs used a 5-point Likert scale to measure self-reports of clinical competency from baccalaureate nursing students. The CCQ authors granted permission for use and modification of the questionnaire to conform to the study population.[34] (See *Clinical competency questionnaire*.)

Implementation

The project was designed to promote a culture of safety by increasing the clinical competence of nurses caring for hospitalized patients, and it took place in the Vital Simulation lab at the SON. Implementation began in the spring semester. The Fundamentals of Nursing course had three sections. Each met twice a week for 3 hours, totaling 48 hours of participation time for the students. Each

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Clinical competency questionnaire[34]

In the pretest and posttest phases, participants rated skill competencies and professional behaviors on a 1-5 Likert scale (see the key below).

Skill competencies:

- Performing and documenting patient health assessment
- Answering questions for patients or families
- Educating patients or families with disease-related care knowledge
- Developing care plan for patients
- Performing shift report using SBAR
- Performing hygiene and daily care routines
- Providing rest and comfort measures
- Assessing nutrition and fluid balance
- Assessing elimination
- Assisting activities and mobility, and changing position
- Providing emotional and psychosocial support
- Changing I.V. fluid bottle or bag
- Administering secondary I.V. antibiotic
- Administering I.M. and Z-track medications
- Performing subcutaneous injection
- Administering oral medications
- Performing sterile techniques
- Performing postural drainage and percussion, and administering oxygen therapy
- Placing and assessing nasogastric tubes, including documentation, gastric pH testing, aspiration precautions, flushing, administering medication and feeding (continuous, bolus, and gravity), and checking for residuals
- Assessing gastrostomy tube placement, feeding, and care, as well as evaluating and changing dressings as needed
- Performing wound dressing care.

Nursing professional behaviors:

- Following health and safety precautions
- Taking appropriate measures to prevent or minimize risk of injury to self
- Taking appropriate measures to prevent or minimize risk of injury to patients
- Preventing patients from problem occurrence
- Adhering to the regulation of patients' and families' confidentiality
- Demonstrating cultural competence
- Adhering to ethical and legal standards of practice
- Maintaining appropriate appearance, attire, and conduct
- Understanding patient rights
- Recognizing and maximizing opportunity for learning
- Applying appropriate measures and resources to solve problems
- Applying or accepting constructive criticism
- Applying critical thinking to patient care
- Communicating verbally with precise and appropriate terminology in a timely manner with patients and families
- Communicating verbally with precise and appropriate terminology in a timely manner with healthcare professionals
- Understanding and supporting group goals.

Key:
1. Do not have a clue
2. Know in theory, but not confident at all in practice
3. Know in theory, can perform some parts in practice independently, and needs supervision to be readily available
4. Know in theory, competent in practice, need contactable sources of supervision
5. Know in theory, competent in practice without supervision

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section had 12 to 14 students and 3 experienced faculty instructors, each of whom adhered to the clinical nursing skills and techniques from the required textbook for consistency in instruction.

The project was introduced on the first day of class, and paper copies of the pretest CCQ were administered in the clinical lab by the independent evaluation faculty team. The CCQ took approximately 10 minutes to complete. An informed-consent form was included with the survey cover sheet. The students' names were converted to corresponding identification numbers for the posttest.

The Fundamentals course covered clinical skills, including:
• hand hygiene
• vital signs
• donning and doffing personal protective equipment
• documentation
• body mechanics
• bathing and bed making
• safe medication administration
• mobility and positioning
• wound care and assessment
• nutrition and feeding
• parenteral nutrition
• gastrostomy tube placement, feeding, and care, as well as evaluating and changing dressings as needed
• nasogastric tube placement, insertion, documentation, gastric pH testing, aspiration precautions, flushing, administering medication and feeding (continuous, bolus, and gravity), and checking for residuals
• percutaneous endoscopic gastrostomy tube feeding and feeding pump programming.

After 8 weeks, the students completed a posttest CCQ and demonstrated an objective structured clinical examination (OSCE) in the simulation lab. An evidence-based clinical simulation scenario was used to evaluate the students' clinical skills for the OSCE, which tested competence and confidence in performing head-to-toe assessments, medication administration, surgical wound assessments, and complete documentation in the electronic health record.

The faculty instructors evaluated the students one-on-one for the final OSCE. Posttest data were collected for a total of 39 participants after one student's leave of absence during the semester.
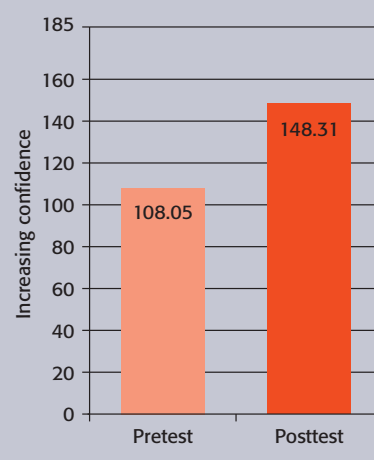
Results and limitations

The primary outcome was to improve the nursing students' self-report of perceived clinical competence and confidence. That goal was met during the 8-week implementation phase. The posttest measurement increased by 37.26% compared with the pretest measurement. (See *Comparative difference: pretest to posttest CCQ.*)

A confidence analysis showed eight students with perceived overconfidence who graded themselves higher than the faculty. One student was on par with faculty grading, and the remaining 30 students scored themselves lower than the faculty. (See *Group 1, 2, and 3 self-generated posttest CCQ scores and OSCE.*) A comparative difference indicated students underestimated their own clinical competence when compared to their OSCE score. (See *Comparative difference: CCQ posttest and faculty OSCE evaluation.*)

The students valued the clinical skills checklist for documenting their achievements, which helped to identify clear, achievable goals in a stepwise fashion. Structured tasks reduced perceptions of uncertainty,

The program demonstrated the use of simulation technology as an effective means of improving clinical competency, ultimately improving patient outcomes.

Comparative difference: pretest to posttest CCQ

Pretest: 108.05
Posttest: 148.31
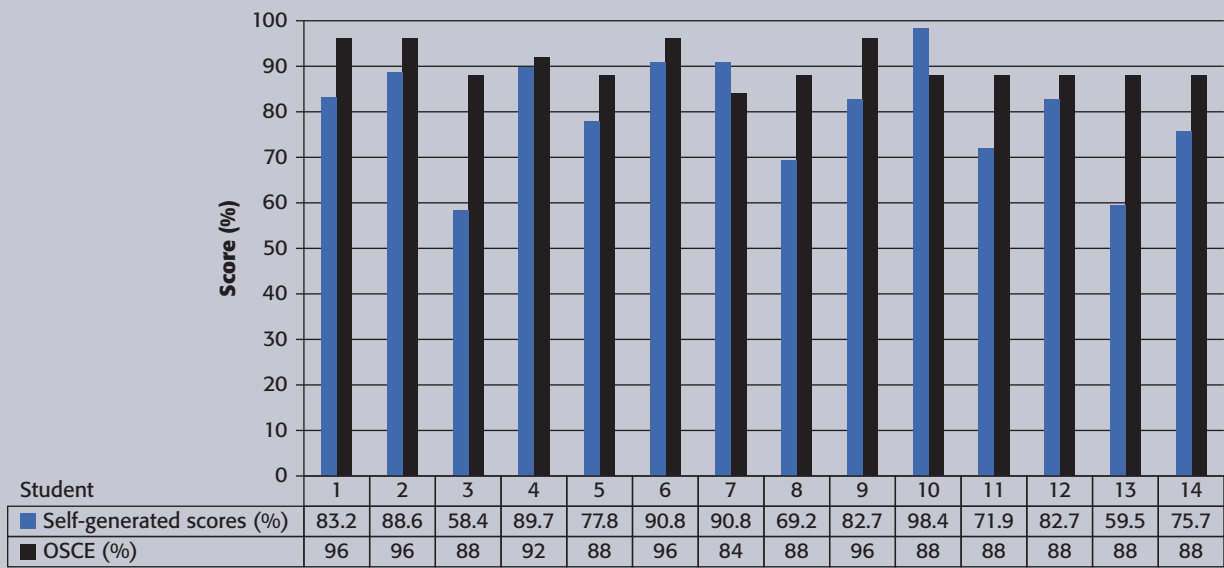
Increasing confidence (y-axis: 0 to 185)

corresponding to higher performance and satisfaction.[35]

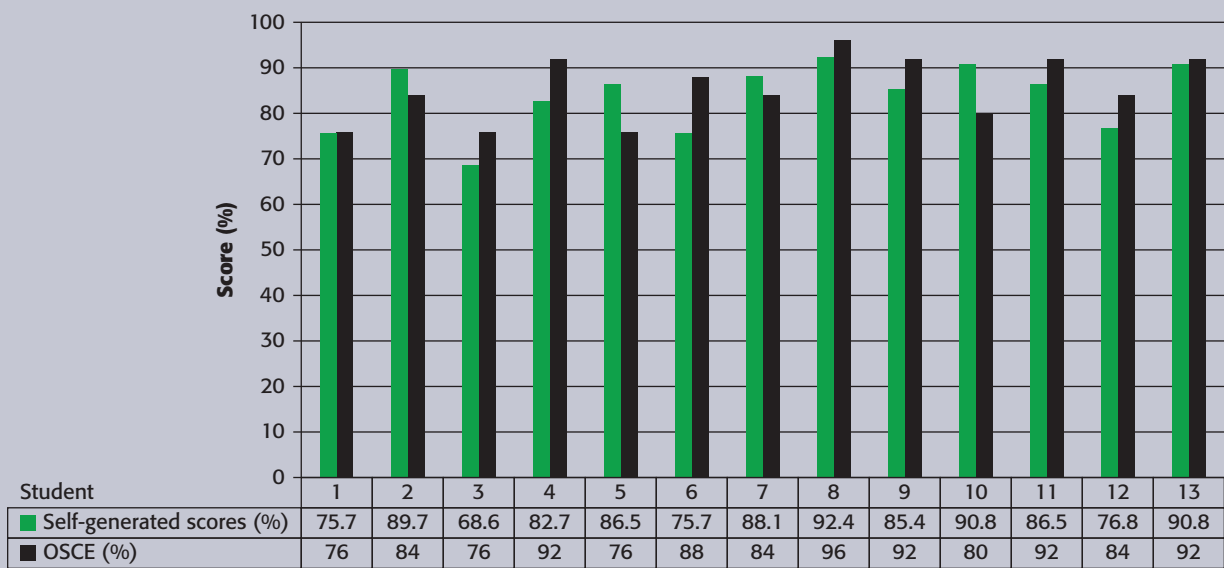Despite improved performance results, the project had several limitations. Given the small number of participants from only one university, the findings may not be generalized to nursing students in other settings or countries. Replicating the project with a larger sample size would provide additional evidence to support deliberate practice and simulation as an evidence-based educational approach.

Another limitation is the design of the CCQ instrument as a self-assessment tool, which measures perceived clinical competence and not the student's actual performance.[34] Additionally, as the same faculty that instructed the course
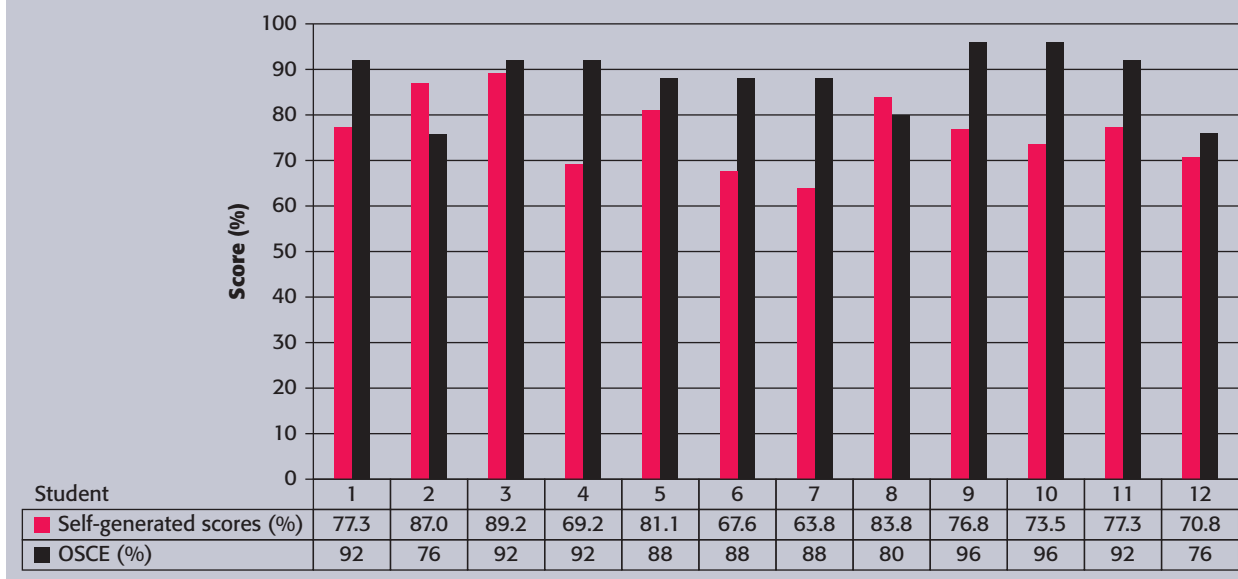
Group 1 self-generated posttest CCQ scores and OSCE

Student	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Self-generated scores (%)	83.2	88.6	58.4	89.7	77.8	90.8	90.8	69.2	82.7	98.4	71.9	82.7	59.5	75.7
OSCE (%)	96	96	88	92	88	96	84	88	96	88	88	88	88	88

Group 2 self-generated posttest CCQ scores and OSCE

Student	1	2	3	4	5	6	7	8	9	10	11	12	13
Self-generated scores (%)	75.7	89.7	68.6	82.7	86.5	75.7	88.1	92.4	85.4	90.8	86.5	76.8	90.8
OSCE (%)	76	84	76	92	76	88	84	96	92	80	92	84	92

Group 3 self-generated posttest CCQ scores and OSCE

Student	1	2	3	4	5	6	7	8	9	10	11	12
■ Self-generated scores (%)	77.3	87.0	89.2	69.2	81.1	67.6	63.8	83.8	76.8	73.5	77.3	70.8
■ OSCE (%)	92	76	92	92	88	88	88	80	96	96	92	76

graded the final OSCE, a lack of objectivity had the potential to be a limitation.

Comparative difference: CCQ posttest and faculty OSCE evaluation
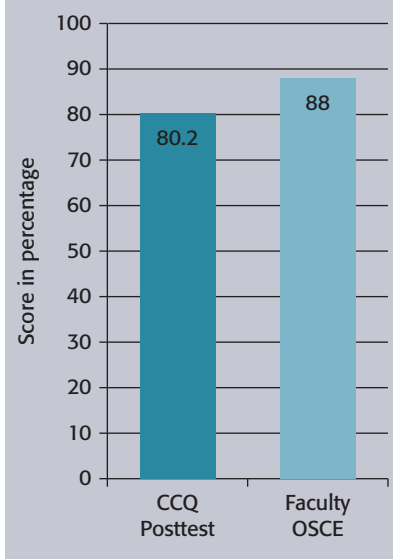
Implications for education and practice

A major practice implication is to advocate for a culture of patient safety. The program demonstrated the use of simulation technology as an effective means of improving clinical competency, ultimately improving patient outcomes. Dissemination of knowledge gained from this clinical program should improve patient safety. It should also help nursing faculty meet the demand for well-trained nurses while promoting safety.

In turn, students were provided education on the fundamentals of nursing. Faculty demonstration, close supervision, guidance, and the ability to practice specific skills in the simulation lab numerous times through deliberate practice before demonstrating competency and proficiency was highly effective. Additionally, the skills checklist is a tool that can further augment the learning process for nursing students in a simulated setting.

Continued research

Further research could include evaluating the clinical competence of new graduate nurses at 3, 6, and 12 months after graduation. According to Benner's Novice to Expert Theory, new graduates are limited in clinical experience and few are ready to perform safe and effective patient care.[22,32] Evaluating new graduates' clinical competence and correlating the data with their likelihood of remaining successfully employed as nurses over their first year could yield valuable information for employers and potentially valuable feedback for job placement programs at nursing schools. The overarching goal will be to use this feedback to understand the challenges novice nurses face in the clinical settings and better prepare students.

Conclusion

Innovative simulation technology can be used to assess nursing students' competence in clinical skill acquisition

and to document those skills on a checklist. An approach that included educational sessions, faculty demonstrations of clinical skills, repeated demonstrations of those skills, pretest and posttest CCQs, and an OSCE to evaluate clinical skills was effective. Feedback on student performance is an important aspect of deliberate practice and facilitates the development of clinical practice skills and confidence.

The project demonstrated the benefits of supporting clinical skill acquisition and documentation on a skills checklist. Nursing students who are exposed to a deliberate practice program in a simulation lab are highly likely to be competent and confident in safely performing those skills in the patient-care setting. Findings from this project also support the ongoing measurement of nursing students' clinical skills and their perceived confidence in those skills. ∎

Protection of Human Subjects

The University Institutional Review Board approval as an exempt status was obtained prior to implementation. Project participation was voluntary for nursing students. Participating in the pretest and posttest survey using the CCQ was voluntary for the participants. Faculty explained the purpose and procedures of the project to the sophomore baccalaureate nursing students and student questions were addressed.

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Llynne C. Kiernan is an assistant professor of nursing at the Norwich University School of Nursing in Northfield, VT.