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Simulation-Based Learning for Second-Year Nursing Students Amid COVID-19 Pandemic: Knowledge Management Approach

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Abstract

Simulation-based learning can improve nursing students' critical thinking skills and encourage nursing theory implementation. This article aimed to share experiences of managing course specifications of nursing practicum and presented how to use knowledge management processes, acquisition of knowledge, storage of knowledge, distribution of knowledge, and use of knowledge, to develop simulation-based learning during the Covid-19 pandemic. Course specifications and learner activities could be prepared for such a pandemic in a short period through knowledge management processes. Hybrid Simulation-Based Learning was used in the field experience in Adult Nursing Practicum 1 for second-year nursing students which was conducted from 13 September to 31 October 2021. The result showed that simulation-based learning could be the first choice of teaching method during the pandemic situation and insufficient vaccination yet. The outcomes for all learners after teaching by simulation-based learning were satisfactory. The knowledge in this article can be an example for nurse instructors to develop their teaching in the field of nursing practicum by using simulation-based learning to improve students' learning outcomes, and using knowledge management processes to create simulation-based learning guidelines.

Keywords: Simulation-based learning, nursing students**,** knowledge management, nursing practicum

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Introduction

Coronavirus disease 2019 (COVID-19) is an emerging infectious disease caused by the novel coronavirus (Coronavirus 2019/SARS Cov-2). COVID-19 causes pathology in the respiratory system that leads to pneumonia conditions, with symptoms ranging from mild to severe acute respiratory syndrome (Dousari, Moghadam, & Satarzadeh, 2020). Those vulnerable to the disease are at risk of respiratory failure and even death. Besides, the COVID-19 pandemic affected work-life balance, economy, travel, and also education. For education, online teaching was taken place instead of classroom teaching because it was found that the social distancing practice could reduce the number of disease infections and deaths (de Souza Melo, et al, 2021).

Active learning improves cognitive skills, teamwork skills, leadership, and problem-solving skills. (Harris & Bacon, 2019), especially in the setting of higher education but also in the field of practicum of nursing students. Nursing courses consist of classroom, laboratory, and authentic learning. Authentic learning for nursing students was unlikely during the COVID-19 pandemic because the patients with medical conditions fell under the high-risk group (Conditions Centers for Disease Control and Prevention, 2021), as well as frontline health workers (Nguyen, 2020) and nursing students were also in the high-risk group. However, nursing students needed to finish their program on schedule following the master plan, and also having good learning outcomes. Those requirements were a challenge for the nursing instructors. In-field nursing practicum conducted during the COVID-19 pandemic needed to be flexible and effective. Simulation-based learning (SBL) was another strategy to support active learning and was believed suitable during the COVID-19 pandemic. SBL is a teaching technique for students' practice and learning that can be applied within many different disciplines and can transfer such simulation situations to real experiences (Lateef, 2010). SBL in a nursing education setting refers to various learning activities using simulators, not only handling mannequins, but also devices, persons, natural environments, and role-playing (Kim, Park, & Shin, 2016). SBL helps nursing students to have confidence, and nursing skills (Thanaroj, & Sueamak, 2019). SBL improves the specific and generic clinical performance competency, critical thinking, and human understanding of nursing students. (Shin, Sok, Hyun, & Kim, 2015).

The learning aims for in-field experience in Adult Nursing Practicum 1 were to promote the nursing students 1) to achieve the characteristics of holistic care and nursing practice based on the theory of adult patients with uncomplicated, acute, and chronic illness, and complex problems, but not in a crisis, and 2) to encourage the appropriate application of empirical evidence in nursing care, considering human and cultural diversity, human rights, morality, professional ethics knowledge, intellectual skills, interpersonal relations and numerical analysis skills, communication, information technology skills, and professional skills. Due to the COVID-19 pandemic, the academic administration committee of Barommarajonni College of Nursing, Songkhla agreed to manage course learning using SBL in field experience specification in Adult Nursing Practicum 1 for the second-year nursing students. Even though High-Fidelity Simulation Learning is a high-performance mannequins that can simulate multiple human functions such as breathing, pulse rate, and heartbeat, Hybrid Simulators Learning can also be a good learning scenario designed by instructors and could create the situation of human interactions, reactions, and body language as well as clinical data such as blood pressure, and lung sounds (Brown, & Tortorella, 2020). A cost-effective Hybrid Simulation Learning was an alternative for nursing students' training, compared to High-

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Fidelity Simulators Learning which cost upwards of tens of thousands of dollars (Amerjee, Akhtar, Ahmed, & Irfan, 2018). For this urgent situation and with limited resources, the author served as the course's manager and prepared the in-field experience specification for nurses' students using Hybrid Simulation Learning. This Hybrid Simulation Learning consisted of a scenario, case study, human actors, and simulated body parts. Because of the short period of preparation in the pandemic situation, the instructor team needed to brainstorm for creating learner activities using knowledge management processes. Knowledge management improved the performance of educational institutions and encourage success in a rapidly changing education world (Shaghaei, & Turgay, 2014). Thus, this article aimed to illustrate the effectiveness of using knowledge management processes in creating simulation-based learning for managing nursing practice courses leaning amid the COVID-19 pandemic and to improve student's learning outcomes through simulation-based learning.

Methods

The target group population was second-year nursing students and the instructors who taught subject in-field experience in Adult Nursing Practicum 1 of the Boromarajonani College of Nursing, Songkhla. A knowledge management approach was used to develop the course learning.

For the course learning evaluation, the standard measurement for learning outcomes, the Thailand Qualification Framework (TQF) of Borommarajonni Colledge of Nursing, Songkhla, was used to evaluate the student's learning outcomes. Also, the outcomes-based assessment, the pretest, and posttest with four authentic essay test items were used to evaluate the students' cognitive skills. The qualitative research study (The title of the research report: The Nursing Students' Perception Using Hybrid Simulation), and the Standard Learners' Satisfaction Questions Scale of Borommarajonni Colledge of Nursing Songkhla were used to evaluate the student's satisfaction.

A theoretical concept of knowledge management

The four concepts of knowledge management processes, researched by Gonzalez and Martins (2017), consisted of acquiring knowledge, storing knowledge, distributing knowledge, and using knowledge.

Knowledge acquisition is knowledge-seeking after an important issue is identified. Both tacit and explicit knowledge can be sought from person to person or from a group of persons. This process is the accumulation of knowledge that might be received from intra-organization and extra-organization experts.

Storing knowledge can be the physical memory storage system in software and/or informal storage such as rules, culture, or values. Thus, information technology is an important tool for storing the received knowledge, and sometimes knowledge can transfer to the culture of the workers in the organization.

Distributing knowledge was the sharing of new information to create a piece of new knowledge and understanding. This process can be called the "sharing process." The sharing process might occur from self-learning, group, and/or social sharing and learning. The sharing process may be learning with relevant knowledge or exchanging experience between the internal organization and external organization.

Knowledge use was the process of accessing and using the knowledge stored informally and formally in the memory system of an organization. The organization facilitates accessing knowledge by the workers so that the novice can access and use such knowledge.

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Developing course learning of the field experience specification in Adult Nursing Practicum 1 by knowledge management processes

For knowledge acquisition, the knowledge management (KM) committee of the academic department of the Boromarajonani College of Nursing, Songkhla facilitated the KM team to seek knowledge of SBL from several sources both inside and outside the department. Seeking the knowledge started with identifying the necessary issue: SBL and teaching knowledge. Underlying that issue, the knowledge of creating the scenario; scenario-based teaching; debriefing; and also preparing the instructors, the students, and the laboratory room, Were urgent issues before the beginning of the semester. Both tacit and explicit knowledge was sought from senior instructors who had experience in SBL teaching in this institution, and from other campuses. All instructors of the Boromarajonani College of Nursing, Songkhla, were trained how to use the SBL technique for teaching by trainers from the Society for Simulation in Healthcare. After knowledge sharing, all teachers became aware of how to teach effectively using SBL. The instructors in the field of adult disease can create their scenarios by themselves, and these scenarios were approved by the appropriate group of professionals. ***For storing knowledge,*** after seeking knowledge of the SBL teaching method, the scenario running processes, students, and laboratory room preparations were noted, approved, and validated by the instructor team, then stored in the handbook so that the instructors who will teach next year can use those. Google Drive sharing of online storage was used to retain the handbook and scenario cases for instructors so that all instructors can consult them. ***For distributing the knowledge***, the instructor group who taught in Adult Nursing Practicum 1 had meetings, shared knowledge, learned, and discussed to develop the scenarios and SBL processes. In the distribution of knowledge to other colleges, the SBL was presented to other nursing colleagues in the forum of a knowledge management contest. ***For knowledge use***, the SBL knowledge was used after all teachers received the guidelines and handbook by email and could access it via Google Drive from the course learning manager. This SBL knowledge was used by all teachers who taught under the in-field experience specification in Adult Nursing Practicum 1 for second-year nursing students in the summer semester of the year 2021.

The evaluation system consisted of a formative assessment during scenario activity and a summative assessment with post-test and learning outcomes evaluation by TQF.

The theoretical basis of SBL

Jeffries Simulation Framework (Jeffries, Adamson, & Rodgers, 2016) for Simulated Participant Methodology Theory has been widely used for SBL studies. The seven core elements for SBL were, as follows: ***Context*** identified the necessary framework for developing simulation. The context is a consideration of the purpose, physical location, and evaluation criteria of the learning outcome. ***Background*** supporting curriculum determined the learner's expectations and goals for the simulation, and the necessary resources for the simulation. ***Simulation design*** consisted of specific learning objectives, types of equipment, learner role assignments, learners' activities, simulation flow, and pre-briefing/debriefing strategies. The simulation experience is the learning process of learners interactive, learner-centric, experiential, and collaborative. ***Simulation experience*** is the dynamic interaction between teacher and students by pre-briefing, simulation progression, cues, and debriefing to encourage learner engagement and psychological adjustment within the simulation experience. ***Facilitator and education strategies*** are the strategies of the teacher to be the facilitator for the learner in

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their simulation experience. "Facilitation" means guiding the student to achieve learning outcomes through the teaching strategies during scenario activity and during the debriefing processes, such as adapting the time duration of the situation.

Pre-briefing and Debriefing techniques, **"**Pre-briefing" means, a briefing before simulating to prepare and orient students to the simulation experience. The instructors must provide students with an adequate orientation to create a psychologically safe environment (McDermott, Ludlow, Horsley, & Meakim, 2021). "Debriefing" happens after SBL and is one of the most effective components and the keystone of the learning experience in the clinical simulation setting. Debriefing means, the intentional discussion following the simulation experience that allows the students to clarify their understanding of their activities and thought processes to promote learning outcomes and enhance future clinical performance in real situations (Abulebda, Auerbach, & Limaiem, 2019). ***Participants*** referred to the learners' characteristics. The learners ' characteristics such as self-confidence, anxiety, age, and gender affect their learning experiences, so the teacher must prepare the students before the scenario runs. ***Outcomes*** can be the students' outcomes, the system's outcome, or the patient's outcomes (Jeffries, Adamson, & Rodgers, 2016)

Implementation

Based on the theory-based and knowledge management processes that were performed, the course manager supervised the learning and teaching processes using simulation-based learning in-field experience specification in Adult Nursing Practicum I for the second-year nursing students of Barommarajonni Colledge of Nursing, Songkhla, see Figure 1.

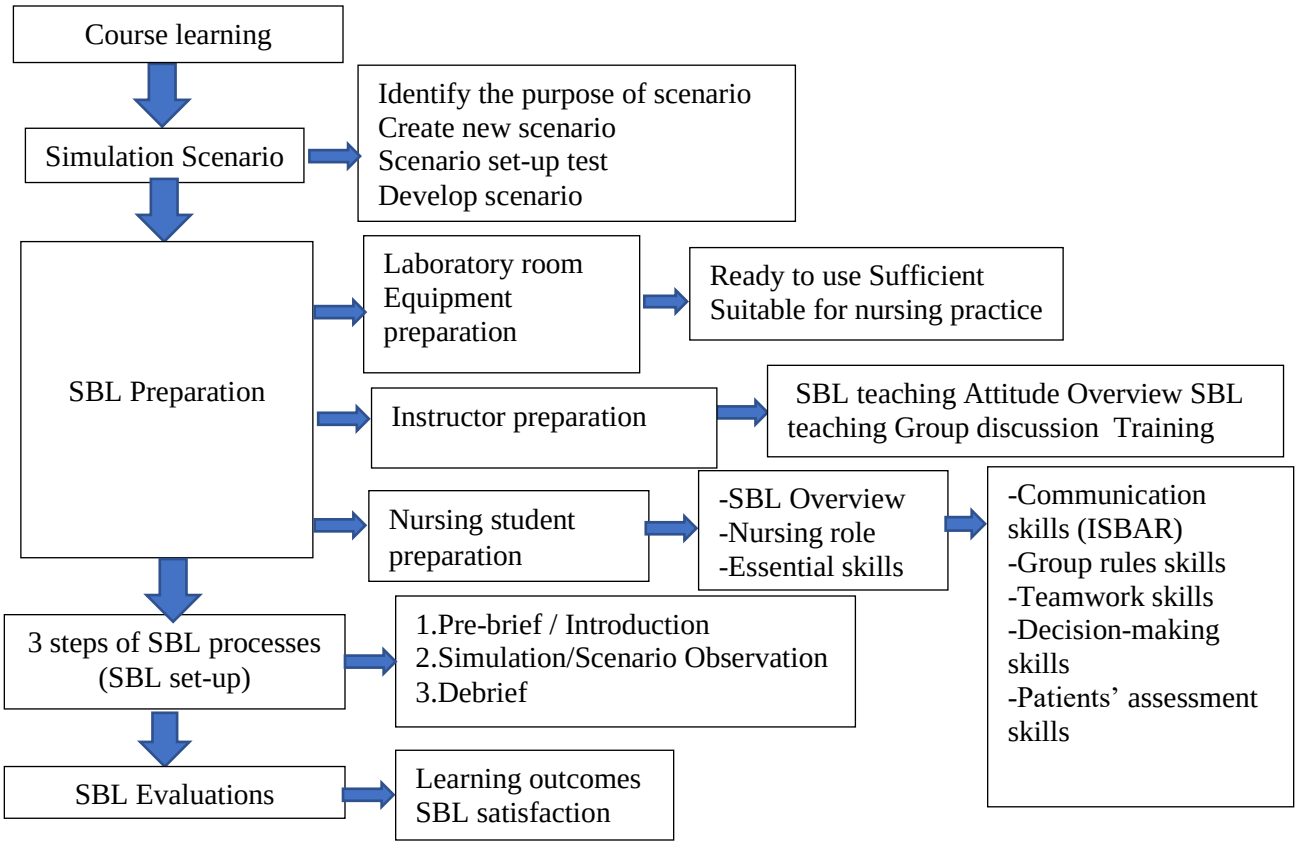

Figure 1 Simulation-Based Learning Processes in Adult Nursing Practicum 1

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SBL processes in Adult Nursing Practicum 1

The aims of the subject in-field experience specification in Adult Nursing Practicum 1 were to achieve the nursing students' characteristics of holistic care, and nursing practice based on the theory of adult patients with uncomplicated, acute, and chronic illness problems, and complex problems, but not in a crisis. Nursing students can appropriately apply empirical evidence in nursing care, care with humanization, and cultural diversity, and adhere to ethics and human rights. This field consisted of case studies for clinical teaching, the emergency case scenario in the Emergency room (ER), the non-urgent case scenario in Out-Patient Department (OPD), and the chronic case scenario in the In-Patient Department (IPD). The instructors agreed to create scenario cases covering all objectives of learning outcomes. The scenario cases were covering the situations of medical, surgical, and orthopedic nursing care as follows: Anaphylaxis, Diabetes Miletus with Hyperglycemia, Upper Gastrointestinal Bleeding, SARS-CoV2, Severe, Diarrhea with Electrolyte Imbalance, Chronic Renal Failure with Anemia, Urinary Tract Infection with Sepsis, Systemic Lupus Erythematosus (SLE), Burns, Fracture Femur, Spinal stenosis, Breast Cancer, Appendicitis, CA colon, Total Knee Arthroplasty, Gallstone with Cholecystitis. Creating each scenario concerned the taxonomy of education and domains of learning outcomes. Developing these scenario cases followed the objective of the course learning. The identification of purpose of each scenario was to encourage the students to achieve the learning outcomes. Identification of the objective of each scenario was guided by the SMART method (Sensible & Specific, Measurable, Attainable & Assignable, Reasonable & Realistic, and Time available) (Haughey, 2014).

For SBL Preparation, by using the laboratory room and the equipment received permission from the directors of Barommarajonnani College of Nursing, Songkhla, sixteen classrooms were created for Hybrid Simulation Learning. The equipment was explored and prepared by the learning manager, instructors, and laboratory manager. The instructor group practiced and discussed before teaching. The students were prepared before their study with SBL about the overview of the course, and essential skills of the students were communication skills by using the ISBAR principle (Identify, Situation, Background, Assessment, and Recommendation) recommended by Burgess, van Diggele, Roberts, and Mellis, (2020). The students received an explanation about group rules skills, teamwork skills, and clinical decision-making skills from instructors. Also, the students were taught how to use their clinical skills to assess all critically unwell patients such as using the ABCDE (Airway, Breathing, Circulation, Disability, Exposure) approach (Peate, & Brent, 2021).

The instructors were trained to take the roles of facilitators in scenarios running processes by trainers from the Society for Simulation in Healthcare. There were three processes in the scenarios running that were 1. Pre-briefing / Introduction 2. Simulation/Scenario Observation, and 3. Debrief. The course's manager divided 127 students into 16 groups, each group with eight students per teacher. During teaching with SBL, the instructor of each group divided his or her group of eight students again into two groups of four each. While the first group was in an active scenario, the other was in an observation group, and in the next situation, both groups of students switched roles as actors and observers.

Pre-brief / Introduction, the instructors reviewed learning objectives for their students in each group, introduced the situation, and introduced the students' roles, including assessing the patient's problems, history taking, physical examination, and reporting using ISBAR.

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Simulation/Scenario Observation: The instructor's role was to observe and record the student's behavior. Instructors serve as facilitators to encourage a learning environment. The instructors could also act as patients, physicians, and patients' relatives, also provided supportive advice while the students have problems, as well as assess their learning in discussion sessions and draw conclusions. For students' roles, the students divided the duties and roles among themselves and played an assigned role. For example, being a team leader to manage and report patient symptoms to the doctors according to the "ISBAR" principle. Being a team member in assessing the patient's condition using the ABCDE principle. Students needed to identify patients' problems and make decisions in nursing processes to solve patients' problems by priority.

Debriefing, Instructors help students summarize learning results to help students understand experiences by analyzing their ideas, feelings, and activities performed in the situation. The step of debriefing was 1) the descriptive phase: This phase is the cooling down of the emotion of the students to diffuse and decompress (blow off steam), and use open-ended questions to explore how learners felt and to review the facts of the event. In this phase, the instructors let the students show their emotions and feelings that they recalled during scenario running by using open-ended questions. 2) Analysis phase (Understanding): This phase was regarding preview topics/learning objectives, exploring, discussing, and inquiring such as what happened? Why did it happen? In the Analysis phase, the instructors let students reflect on their knowledge and explain the reasons for doing the activity at every stage of the scenario to accurate and complete their practice experiences such as assessing the patient's symptoms, data analysis, and providing accurate and appropriate nursing care. After the students reflected on their learning, the instructors concluded the lesson by referring to the learning objectives to encourage the students to achieve their learning outcomes. 3) Application phase (Summary): This phase might call "Take home messages". An implementation learning experience to a future encounter by giving students questions. In this phase, the instructors let their students think and reflect on the implementation of the scenario's lesson to a further authentic situation by asking open-ended questions. These three-phase details guideline was noted in each scenario for instructors.

Results

The course evaluation: the four items of the authentic essay tests were used to evaluate the students' analytical thinking. The authentic essay test was validated by a group of instructors, and item difficulty and item discrimination was tested by the students. The item difficulty and item discrimination were fine. The item difficulty of four items of authentic essay tests were 0.81, 0.55, 0.77, and 0.82, respectively. The item discrimination of four items of authentic essay tests were 0.25, 0.48, 0.37, and 0.18, respectively. The Wilcoxon Signed Ranks Test was used to compare mean scores of the cognitive skills before and after simulation-based learning. The finding showed that the mean scores of the students after learning (μ=7.51, SD=0.87) were higher than before learning (μ=7.46, SD=2.94) significantly (p=0.03). The limitation of this psychometric properties test and the reliability of this test were; the testing was conducted by students online. Thus, the quality of the items tested might be unreliable. Accordingly, the items for the student's test should be developed and tested again in the next semester.

The Thailand Qualification Framework of Borommarajonni Colledge of Nursing, Songkhla, was used to evaluate the learning outcomes of the students. The independent t-test was used to compare the mean scores of each skill between the second-

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year students in the academic year of 2020 and 2021. The mean score of intellectual, problem-solving, and nursing planning skills in the year 2021 ($\bar{x}$=19.01, SD=2.88) was lower than in the year 2020 ($\bar{x}$=25.57, SD=1.57) significantly ($p<0.05$). The mean score for interpersonal relations and responsibilities skills in the year 2021 and the year 2020 was not significantly different. The mean score of numerical analytical thinking and use of communication technology skills in the year 2021 ($\bar{x}$=1.77, SD=0.13) was higher than in the year 2020 ($\bar{x}$=1.68, SD=0.08) significantly ($p<0.05$). The mean score of professional nursing skills in the year 2021 ($\bar{x}$=32.58, SD=5.52) was lower than in the year 2020 ($\bar{x}$=34.76, SD=1.88) significantly ($p<0.05$). The limitation of this comparison was the scores came from the different instructor teams and the students.

Learners' satisfaction

The Standard Learners' Satisfaction Questions Scale of Borommarajonni Colledge of Nursing Songkhla was used to evaluate students' satisfaction. The mean score of students' satisfaction in SBL was at a high level ($\bar{x}$=4.57, SD=0.63).

In our qualitative research using in-depth interviews and focus groups could be used to evaluate the learners' satisfaction with Simulation-based learning, as follows.

1. The nursing practicum from SBL allowed the students to encounter a variety of disease situations in each human organism system, and to review knowledge before entering the scenarios. This enabled students to properly solve problems in the case study, which corresponds to applying the principles of nursing care to various diseases. Practicing with SBL offers experience before having the final exam.

2. The students learned how to face problems. This required nursing students to utilize problem-solving skills and decision-making skills to make decisions in realistic situations. SBL helped students practice prioritizing proper nursing problems.

3. The students learned the process of working as a group or as a team with multidisciplinary professionals. The students learned how to plan and provide the appropriate nursing care.

4. This preparation for students before going to practice helps not only reduce the risk of incidents that are unfavorable to patients but also the quality of life of students and the patients.

5. It is a process that allowed students to learn within a situation. It provided opportunities for students to participate. It enabled the students to gain a variety of experiences that required the use of many skills. It was an appropriate way to conduct applied teaching amidst the COVID-19 pandemic.

Discussion

This article showed the effectiveness of the knowledge management processes for managing the field experience in Adult Nursing Practicum I using Simulation-based learning amid Covid 19 pandemic which was under the situation of the limitation of equipment, time, and learning tools (scenario, measuring, classrooms, and laboratory). Knowledge management proved a benefit to developing an organization and also human resources. There was found that knowledge management had positive relationships with education organizations and learning organizations, and also the stronger learning organization tended to improve organizational performance (Al Ahmar, Rofiq, & Hadiwodjojo, 2015).

For SBL on learning outcomes, the results showed that the mean scores of the cognitive skills domain of students after receiving SBL were better than before receiving the SBL. The students had more

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confidence and achieved all learning outcomes (intellectual, problem-solving, nursing planning, interpersonal relations, and responsibilities, analytical thinking, use of communication technology, and professional nursing skills). This present result was congruent with many studies, for example, the study by Saithanu, Luprasong, and Thanee (2019), studied the effects of simulation-based learning for preparation of midwifery practicum on knowledge, satisfaction, and self-confidence of the fourth-year nursing students and found that the mean score of knowledge and self-confidence of the students after using simulation-based learning were significantly higher than before using simulation-based learning. Chabuakam, Phisaiphanth, and Sangsai (2022) studied the effects of simulation-based learning on nursing students' perceived self-efficacy and injection skills and found after receiving SBL, the nursing students had scores of injection skills, and performance higher than before receiving SBL. Also, the study of Oh, Jeon, and Koh (2015) evaluated the effects of simulation-based learning using standardized patients in nursing students on 18 studies with a total of 1326 nursing students and found that the simulation-based learning had beneficial effects on the cognitive, affective, and psychomotor domains of learning (knowledge acquisition, communication skill, self-efficacy, learning motivation, clinical competence, and critical thinking).

After comparing the mean score of students' learning outcomes between the students in the academic year of 2020 (SBL+Authentic) and 2021 (Only SBL), the mean scores of students' skills in the academic year of 2021 had lower than students in the academic year of 2020 in many skills regarding intellectual, problem-solving, nursing planning, and professional nursing skills, except for the interpersonal relations and responsibilities skills, and numerical analytical thinking and use of communication technology skills. This might be because learning processes during 2021 were only active in the SBL laboratory room due to the COVID-19 pandemic. Thus, SBL might be more effective by adding diverse teaching methods. This present finding indicated that using SBL for the nursing student preparation before the authentic practice was preferable effect to using SBL only. However, SBL only can be chosen especially, when the instructor's team considers that the nursing students can not practice in real situations and they have another field experience specification for nursing practicum in the next semester.

Conclusion

SBL is effective active learning for instructors to encourage learning outcomes of students, especially for the in-field experience specification in a nursing practicum. The students can practice basic to advanced nursing skills before practicing in real situations that are a risk for them and their patients. SBL supports a patient safety policy and safety goal of the hospital. Even though SBL can develop learning outcomes, nursing students need both the authentic, real life situation and SBL in tandem to improve their basic techniques, nursing skills, humanized care, communication skills, and multidisciplinary teamwork skills.

Limitations/implications

The limitations of this course's management were that some pieces of equipment and the laboratory room not quite virtual. The solution was to report the evaluation results to the Academic Executive Committee to improve teaching efficiency on the topic of the sufficiency of learning support resources.

Implications of this study and suggested next steps include:

1. Supporting research or innovation in teaching and learning management by using

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simulations under the knowledge management process. This allows results to be clearly and reliably assessed.

2. Instructors' manager of the course learning and the instructors' team work together to plan teaching and learning by using simulation-based learning. They should prepare sufficient equipment so that learners can practice skills and learn effectively.

3. A measurement tool for the learning outcome should be developed. Also, the pre-test and post-test outcome-based assay items should be tested again in the next semester.

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