

Exploring the Feasibility of Using Knowledge Surveys to Increase Student Knowledge, Clinical Skills and Assess Student Perceptions

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Abstract: This study explored the feasibility of using knowledge surveys in a pre-licensure professional nursing program using cognitive and behavioral outcomes. This study illustrates the incorporation of profession-specific competencies. It introduces the KS as a potentially valuable educational tool for a blended learning approach in higher education programs that include simulation learning.

Keywords: student confidence; educational assessment; nursing education; nursing students; simulation evaluation tool; Dunning-Kruger effect; End-of-Life simulation

Since introducing the quality and safety in nursing education competencies (QSEN) (Cronenwett et al., 2007), faculty focus has shifted, enabling students to take ownership of their learning (Onda 2012; Wirth & Perkins, 2005). Learners gain knowledge through various learning strategies using technologies (Donovan et al., 2018). Students are highly motivated when blended learning practices are utilized (Brown, 2016; Coyne et al., 2018). Students can practice applying knowledge, skills, and attitudes (KSAs) in environments supporting higher-level reasoning. Such learning practices are essential in preparing students to care for patients experiencing complex health conditions, such as deterioration, intensive care, and end of life (EOL) care (Cant & Cooper, 2014; Kim, 2018; Lee et al., 2017; Sapiano et al., 2018). Knowledge surveys (KSs) coupled with high fidelity simulation (HFS) are potentially valuable blended learning approaches designed to prepare prelicensure students to apply and practice end-of-life nursing care knowledge and principles.

Background

The KSs for this study builds upon the seminal work of Nuhfer (1996) and others (Nuhfer & Knipp, 2003; Wirth & Perkins, 2005). KS items follow Bloom's taxonomy, facilitating course organization, encouraging metacognitive development in students, and ensuring all course objectives are addressed at an appropriate level of difficulty. KSs capture students' perceptions of anticipated exam performance through a self-assessment of ability to correctly answer a KS item stem rather than providing an answer. KS administration can occur before course instruction or throughout the semester. Upon reviewing KS results, faculty can tailor course instruction more precisely, devoting additional instructional time to those areas where students are less confident. Creating KSs encourages the budgeting of sufficient class time to cover course content. Finally, the item stems of the KS encourage students to spend additional time reviewing the content areas where they rated themselves less confident, thereby promoting metacognitive development (Nuhfer, 1996; Nuhfer & Knipp, 2003; Wirth & Perkins, 2005).

KSs have been used to assess student perceptions in the natural sciences (Favazzo et al., 2014; Karatjas, 2013; Lindsey & Nagel, 2013; Lindsey & Nagel, 2015; Webb & Karatjas, 2018) and social sciences (Bahati et al., 2017; Luce & Kirnan, 2016). Several authors reported perceived knowledge improvement among students (Bahati et al., 2017; Favazzo et al., 2014), or the tendency toward an *over* or *under* estimation of knowledge when rating perceptions (Karatjas, 2013; Lindsey & Nagel, 2015; Luce & Kirnan, 2016; Webb & Karatjas, 2018).

These surveys capture students' perceptions of their ability to answer exam questions correctly. However, recognizing that incompetence may herald poor performance is essential. Individuals possessing well-developed metacognition estimate knowledge appropriately, identify accurate judgment(s) and concede when committing critical errors. Conversely, when individuals lack metacognition, they exhibit the Dunning-Kruger effect (Kruger & Dunning, 1999). This phenomenon occurs when individuals rate themselves most knowledgeable; however, their performance is substandard. Also, Dunning et al. (2004) suggested inaccurate self-assessment happens when individuals lack information or are indifferent to the available data that contributes to precise evaluation.

Furthermore, when observing peers' better performance, low performers persevere in believing that their performance is satisfactory. Those whose exam scores are in the bottom quartile cannot accurately evaluate their peers' competence (Kruger & Dunning 1999). Faculty play a critical role by providing timely, constructive feedback and giving students opportunities to improve metacognitive skills (Mills, 2016; Zell & Krizan, 2014). Even when receiving constructive feedback, students may not understand the feedback or recognize areas for improvement. King and Kitchener (2004) posit that a student's ability to make judgments about their knowledge develops over time during the transition from late adolescence through adulthood. Therefore, variability in student self-assessment may occur in the traditional college-age population.

It is an expectation that students in health professions complete self-assessments. However, this skill is rarely taught to students or tested (Hadid, 2017). Developing metacognition among students, using constructive faculty feedback and introducing KSs as part of a blended approach to learning allows practice with self-assessment. The pre-post KS was introduced as an intervention to assist nursing students in improving their self-assessment and metacognitive skills. After completing the pre-KS self-assessment, students could focus upon the content areas requiring additional study or practice clinical skills as they prepared for a simulated learning experience with a trained volunteer serving in the role of a standardized patient.

Study Framework

The Situated Cognition Learning Framework paves the way for nurse educators to develop and facilitate high-fidelity simulations (HFSs). The framework principles include: (a) Thinking and learning as measures of knowledge make sense only within particular situations. (b) People act and construct meaning within communities of practice. (c) Knowledge depends upon the use of various artifacts and tools, and (d) Situations make sense within a historical context. The framework components include *ingredients or tools* [Artifacts], *people* [Community], and *activity* [Participation] (Paige & Daley, 2009). The KSs served as the artifact for the study, as participants self-assessed their knowledge from previous coursework or life experiences. Also, the KS enabled cognitive recall, served as a learning guide for understanding lecture materials and prepared students for the HFS. The community aspect was provided to students with interactions with the patient, family, and other health providers during the HFS. The participation aspect was the HFS activity, providing students with a simulation encounter within a realistic clinical context.

Methods

Aim and Design

The study had three aims:

1. To determine the feasibility of implementing a KS designed to capture the cognitive outcomes achieved on a written exam and the behavioral outcomes demonstrated through a simulation activity.
2. To explore the effectiveness of a KS for increasing students' knowledge and clinical skills as part of a high fidelity simulation.
3. To ascertain the accuracy of students' perceptions of their knowledge and clinical skill ability.

The study was a time-limited, exploratory randomized pre-test, post-test design (See Figure 1).

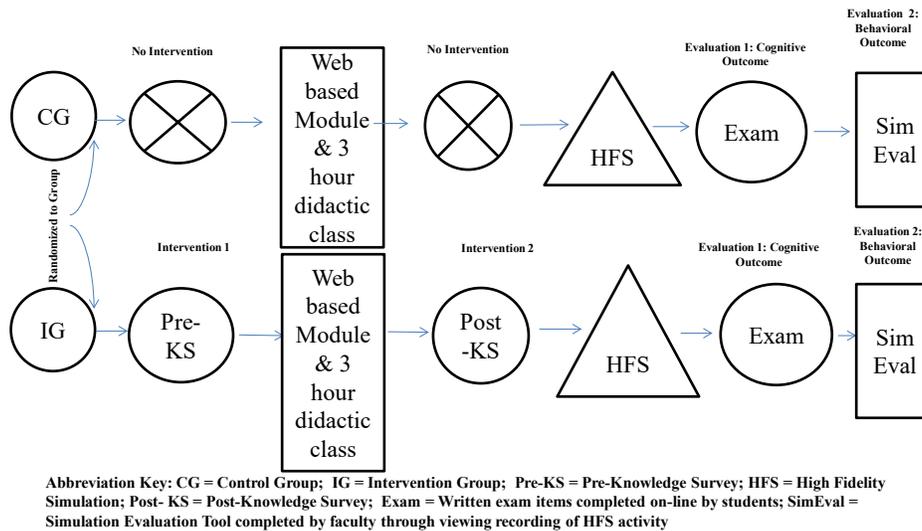


Figure 1. Model of research design using knowledge surveys with nursing students.

Research Questions

Two research questions were addressed in this study:

1. Does using a pre-post KS increase student knowledge and clinical skill in preparation for a high-fidelity simulation compared to standard teaching techniques?
2. What is the relationship between pre-licensure nursing students' perceptions of knowledge and clinical skills on post-KS scores, exam scores, and simulation evaluation scores?

Setting and Sample

The study was completed at a School of Nursing in the Midwestern United States of America. A convenience sample of 27 senior baccalaureate pre-licensure nursing students was recruited from a population of 122 students.

Recruitment

Study information was distributed through university email, course announcements, and a face-to-face discussion during a live class session. Students at a branch campus received identical information via ITV. Students were encouraged to express interest in the study by completing a sign-up sheet. Also, video consent forms were distributed to all students. A faculty member at the branch campus assisted in distributing materials and collecting consent forms. Follow-up emails were sent to qualified participants regarding the study completion protocols.

Instruments

The instruments created for this study included two interventions (pre-post KSs) and two post-intervention evaluations. New behavioral KS items were adapted from Jarzemsky et al. (2010), illustrating how students can learn the KSAs related to the QSEN competencies using HFS. The cognitive KS items were drawn from previous test questions and course activities, and the pre-post-KS item stems were identical. Course faculty reviewed the KSs for content validity. Because there are no behaviorally-based KSs of this type available for comparison in the literature, reliability was not tested.

The three-part scale responses for the cognitive items follow the work of Wirth and Perkins (2005). Participants rated their ability to select a correct answer to an item if graded. The three-part scale responses for the behavioral items were adapted from Wirth and Perkins (2005) and Nuhfer and Knipp (2003) to match the clinical skills students were expected to perform during the HFS, allowing participants to rate their ability safely perform skills. Each KS item contained the same response choices provided in Table 1.

Table 1. Pre- and post- knowledge survey response choices.

Response Choices for Cognitive Items

- a. I do not understand the question. I am not familiar enough with the terminology or am not confident that I can answer the question well enough for grading purposes at this time.
- b. I understand the question, and I am confident that I could answer at least 50% of it correctly, or I know precisely where to find the necessary information and could provide an answer for grading in less than 20 minutes.
- c. I am confident that I can answer the question sufficiently well enough for grading at this time.

Response Choices for Behavioral Items

- a. I do not understand what clinical skill is needed. I am not familiar enough with the terminology or am not confident that I can attempt or perform the clinical skill with satisfactory competency and safety at this time.
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- b. I understand what clinical skill is needed, and I am confident that I could attempt or perform the skill with some aspects of safety and competency at this time.
 - c. I understand what clinical skill is needed well enough to perform it safely and with competency at this time.
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The post-intervention evaluations included written examination items (Exam) and a Simulation Evaluation Tool (SimEval). The purpose of the Exam was to evaluate the relationship between students' perceptions of knowledge on the post-KS compared to results on a written exam. The Exam included multiple-choice and matching test items aligned to the cognitive items of the KS. The purpose of the SimEval was to evaluate the relationship between students' perceptions of their ability to perform clinical skills on the post-KS compared to their actual skill performance during a HFS. The items in the SimEval tool were identical to the behavioral items of the KS; however, the rating choices were adapted for use by a faculty evaluator (see Table 2).

Table 2. Behavioral item rating choices for faculty evaluator using the SimEval.

Behavioral Item Rating Choices for Faculty Evaluator

- a. Student does not perform the clinical skill with satisfactory competency and safety.
 - b. Student attempts or performs the clinical skill with some aspects of safety and competency.
 - c. Student performs the clinical skill with satisfactory competency and safety.
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The Study

An EOL HFS was integrated into a senior-level medical-surgical nursing course. A 48 item pre-KS was completed during the first week of the course. The post-KS was conducted in two parts. First, the behavioral items (14) were completed during week two before the HFS. Second, the cognitive items (34) were completed at mid-semester. The pre-post-KS survey was administered via Qualtrics Research Core (Qualtrics, Provo, UT). The Exam was administered online within the learning management system before the mid-semester exam. In addition, the faculty completed the SimEval tool after reviewing the HFS audio/video recordings.

Ethical Considerations

The IRB: Human Subjects Committee for the University determined that the study was exempt from review under United States federal guidelines 45 CFR Part 46.101(b) category #2, surveys/interviews; standardized educational tests; observation of public behavior (no. 1307E39902).

Analysis

Data analysis was completed using IBM SPSS Statistics for Windows, Version 25 (IBM Corp., Armonk, NY, USA). Five analyses were conducted for research question one. The first analysis compared the Exam scores of the control group (CG) to the intervention group (IG). This was accomplished with a cross-tabulation contingency table using chi square and the calculation of Phi to examine the effect size. The criteria used for effect size were: 0.10 (small); 0.20 (medium); and, 0.50 (large). The second analysis compared the IG post-KS (behavioral) scores to the CG SimEval scores. The criteria used for effect size were 0.10 (small); 0.30 (medium); and, 0.50 (large). The last three

analyses included the *t-test* for paired samples. These analyses included the IG pre-KS scores compared to the IG post-KS scores, the IG post-KS scores compared to the IG Exam scores, and IG post-KS scores compared to IG SimEval scores. Statistical significance (SS) was set at a p -value $\leq .05$.

For research question two, non-parametric tests were utilized for the data analyses as well as the McNemar test. SS was set at a p -value $\leq .05$. The measurement of the phi coefficient served as the measure of association for the 2 X 2 table. For effect size, $\phi < 0.10$, was “trivial”; $\phi > 0.10$ but < 0.30 , was “small”; $\phi > 0.30$ but < 0.50 , was “medium”; and, $\phi > 0.50$, was “large” (Elliott & Woodward, 2016).

Results

The study results include a description of study participants, a table outlining the demographic survey results and a figure illustrating the random allocation to groups. Each study aim is addressed, with tables showing each research question's results and an overview of study findings.

Participant Description

Most participants were aged 21-30 years and Caucasian, highlighting little diversity. Participants were randomly allocated to the CG or IG (see Figure 2). CG participants reported more Bachelor/Baccalaureate degrees, with a majority reporting a GPA of 3.5-4.0. Otherwise, differences between the groups were minimal. The demographic survey results are presented in Table 3.

Table 3. Results of demographic survey.

| Survey Component | Information Summary | | |
|----------------------|------------------------------------------------|---------------|--------------------|
| | | Control Group | Intervention Group |
| Participants | | n (%) | n (%) |
| Age | 21-30 years | 12(70) | 9(91) |
| | 31-36 years | 5(30) | 2(9) |
| Race/Ethnicity | Caucasian | 16(94) | 9(82) |
| | Asian | 1(6) | 2(18) |
| Education background | High School Diploma/Some College | 10(59) | 8(73) |
| | Technical/Community College Degree/Certificate | 0(0) | 3(27) |
| | Bachelor/Baccalaureate | 7(41) | 0(0) |
| GPA | 3.0 – 3.4 | 1(6) | 3(27) |
| | 3.5 – 4.0 | 16(94) | 8(73) |

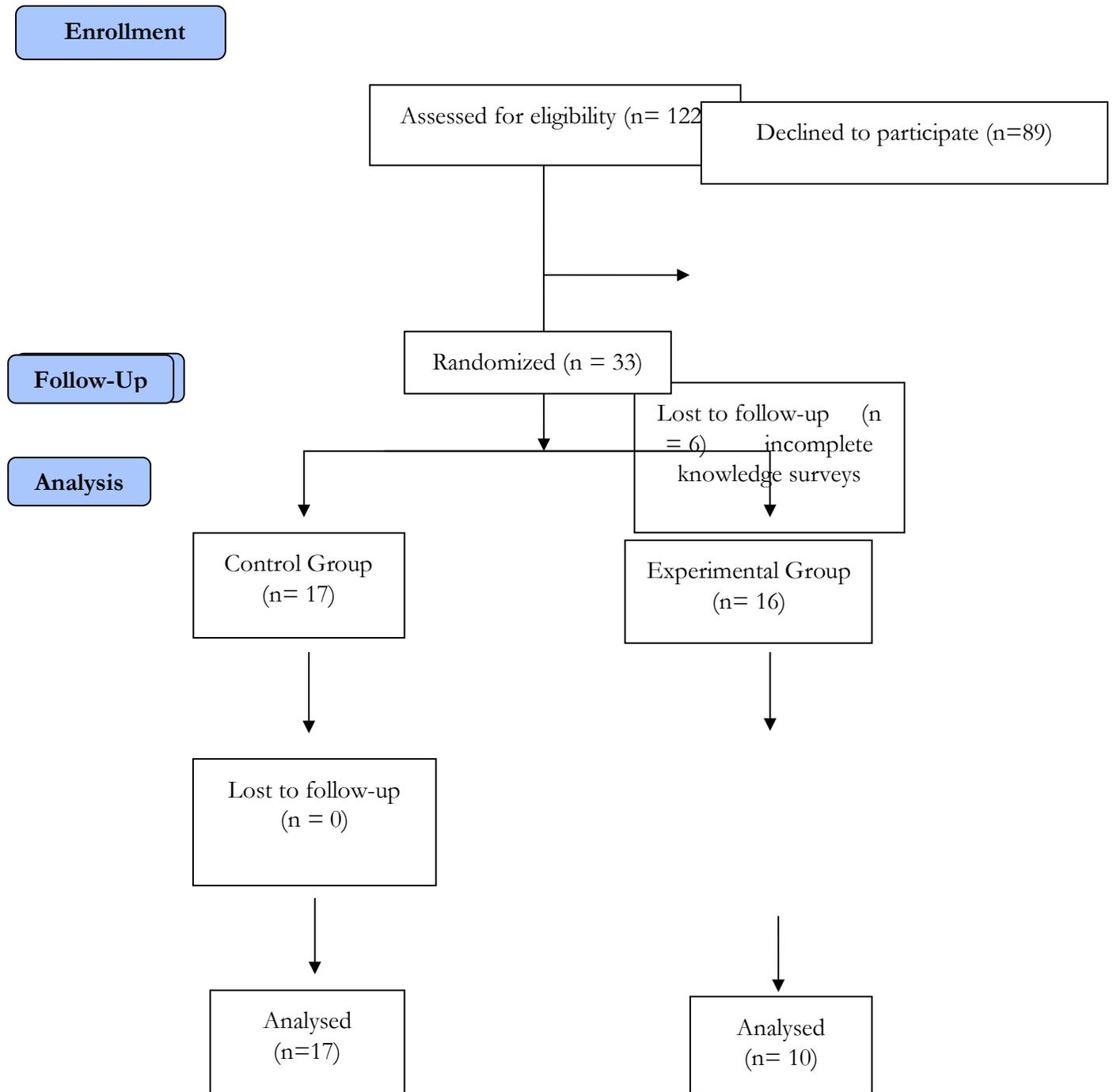


Figure 2. Flow Diagram of Participants.

Research Question 1

Does using a pre-post KS increase student knowledge and clinical skill in preparation for a high-fidelity simulation compared to standard teaching techniques? The analyses, purpose and summary of findings are found in Table 4.

Table 4. Results of data analysis research question 1.

| Analysis Number/Description | Purpose | Analysis Summary |
|---------------------------------------------------------|------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1. CG Exam scores compared to IG Exam scores. | Identify the impact of the KSs on student Exam scores. | 7% of items revealed no SS difference between the CG and IG's ability to answer Exam items correctly. However, 93% of survey items showed SS, with the following effect sizes: 9% large, 4% medium, and 88% small. |
| 2. IG post-KS scores compared to the CG SimEval scores. | Identify the impact of the KSs on the performance of clinical skills. | All items were SS with the following effect sizes: 42% large, 50% medium, and 8% small. |
| 3. IG pre-KS scores compared to the IG post-KS scores. | Determine whether the KSs increased knowledge and clinical skills. | Self-assessments revealed a perception of improvement for 93% of items. However, only 57% were noted as a SS improvement. |
| 4. IG post-KS scores compared to the IG's Exam scores | Determine whether the KSs increased students' ability to select a correct Exam response. | Self-assessments revealed overconfidence for 80% of the Exam items, while responses remained static for the other 20%. |
| 5. IG post-KS scores compared IG SimEval scores. | Determine whether the KSs increased students' ability to demonstrate skills safely. | Overall, 83% of survey items were not SS. Self-assessments revealed an underestimation of ability resulting in a better than expected performance (42%). Conversely, those who overestimated their ability performed more poorly than expected (58%). |

Research Question #1 Findings. Compared to traditional teaching techniques, the pre-post KS did not significantly increase student knowledge or improve clinical skills in preparation for an HFS. Of particular interest is that student self-assessments did not accurately reflect their ability to respond to Exam questions or safely perform clinical skills.

Research Question Two

What is the relationship between pre-licensure nursing students' perceptions of knowledge and clinical skills on post-KS scores, Exam, and SimEval scores? The analyses, purpose and summary of findings are found in Table 5.

Table 5. Results of data analysis research question 2.

| Analysis Number/Description | Purpose | Analysis Summary |
|------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1. Relationship of the IG post-KS survey responses to the IG Exam responses. | Examine the relationship between students' perceptions of their ability to select correct exam responses when completing the post-KS and Exam. | Participant perceptions of their knowledge demonstrated mixed results. Findings revealed non-relationship (36%); positive relationship (36%); and negative relationship (28%). |
| 2. Relationship of the IG post-KS survey responses to the IG SimEval scores. | Examine the relationship between students' perceptions of their ability to safely perform clinical skills when completing the post-KS and the SimEval scores. | Participant perceptions of their ability to perform clinical skills are more strongly and positively related to their expected clinical skills performance. Findings revealed no negative relationships. Positive relationships were small (17%); medium (17%); and, large (58%). |

Research Question #2 Findings. There was variability in the relationship strength between students' perceptions of their ability to select a correct exam response and safely perform clinical skills on the post-KS and Exam and the scores on the SimEval. Therefore, it is challenging to assert a strong relationship between students' perceptions of knowledge and clinical skills.

Discussion

Feasibility

The first aim focused on the feasibility of using a KS containing cognitive and behavioral outcomes. As this is the first use of behavioral KS items for self-assessment of clinical skills, an essential component of feasibility was determining whether behavioral items could be easily incorporated into a KS. Another component to consider was the ease of use and administration of the KSs. The pre-post KSs were administered via Qualtrics, which allowed for ease of use, and the administration timing of the surveys avoided the use of face-to-face class time. Other components regarding feasibility include the overall participation retention rate (high) and the use of Qualtrics, which enabled data transfer into IBM SPSS, minimizing data input error. A final component of feasibility included the option to repeatedly view student performance via the audio/video recordings of the HFS to enable consistent scoring on the SimEval. While there is room for improvement in the design and approach, this study demonstrates that using a KS with cognitive and behavioral components is feasible in nursing education.

Effectiveness of the Pre-Post KS

The second aim was to explore the effectiveness of a KS for increasing students' knowledge and clinical skills as part of a HFS. Students demonstrated difficulty with accurate perceptions of knowledge and clinical skills. Because the study occurred early in the semester, students may have felt overwhelmed, quickly skimming the KS items before selecting a response, contributing to inaccurate perceptions. A potential impact of these findings is that students may not focus upon their limitations

and will forge ahead with the false assumption that they have sufficient knowledge and ability to provide safe care to patients when they do not. Also, the study findings concur with others, including the perception of knowledge improvement (Bahati et al., 2017; Favazzo et al., 2014); and the tendency to *over* or *under* estimate actual ability (Karatjas, 2013; Lindsey & Nagel, 2015; Luce & Kirnan, 2016; Webb & Karatjas, 2018).

Student Perceptions

The third aim was to ascertain students' perceptions of knowledge and clinical skills. Although the relationship between student perceptions of clinical skills was not SS, the lack of association may occur because of a misalignment between students' *perception* of ability and their *actual* ability. The Dunning-Kruger effect, noted by others (Karatjas, 2013; Lindsey & Nagel, 2015; Luce & Kirnan, 2016), aligns with the study findings. A potential impact of this finding is that students' perceptions will persist, leading to hesitation to act swiftly or forging ahead with overconfidence. Both circumstances could lead to safety risks in the clinical environment.

Study Limitations

Several study limitations may have influenced the results. First, the small sample size and lack of diversity limit the study's generalizability and potential for replication. Second, because the KSs were completed early in the semester, a potential for recall bias on the post-KS exists as students may have remembered the pre-KS content. Third, a pre-test should be administered, establishing a baseline for comparison, because when students are not expected to provide an answer to the questions posed in the KS, they may not seriously consider their ability to answer the question, leading to overconfidence (Bahati et al., 2017; Favazzo et al., 2014). Thus, measuring impact through requiring students to complete a pre-test followed by the pre-KS may decrease levels of overconfidence and result in a closer alignment between perceptions and actual knowledge and skill performance.

Recommendations for Future Research

This study has led to several "lessons learned" regarding the use of KSs in higher education. First, this study introduces a KS focused upon assessing cognitive and behavioral outcomes, which is essential for health- or practice-based professions utilizing simulation learning activities, notably those programs of study, which have a "real world" impact on the safety of others. Second, introducing KSs early in the curriculum, providing students with opportunities to use KSs as low-stakes self-assessments, may improve the alignment between perceptions and performance. Third, requiring students to view the audio and video recordings of the HFS and rating their performance may improve self-assessment skills and heighten awareness of deficits. Fourth, administering a pre-test before the pre-KS and HFS would provide a baseline comparison of knowledge and skills. Fifth, if faculty incorporated KSs into a formal study guide for students to access while preparing for the Exam and HFS, the possibility exists for improved self-direction, targeted review of course content and skills practice. Sixth, students could be exposed to KSs in earlier courses and provided with the rationale behind metacognitive development. Introducing students to KSs in a low-stakes manner may motivate them to participate in a research study once they experience this type of survey. Finally, the study instructions suggested that survey completion could take up to one hour. However, students completed the KSs in much less time. Therefore, altering time commitment expectations may yield a larger sample size.

Before engaging in subsequent research, expert faculty should validate the KSs, Exam and SimEval tools for reliability and validity. Analysis using reliable instruments may not achieve an acceptable level of reliability if the sample size is too small due to the difficulty of separating random noise from the signal generated from actual data (Nuhfer et al., 2016). A potential challenge is keeping survey items consistent as changes in professional practice may occur. Addressing the potential for random noise could be managed through aggregating data over several semesters.

While this study was small and exploratory, the population could be expanded for future research. An increase in the diversity within the study population could be achieved through using data from several cohorts of students, or collaboration with other prelicensure nursing programs could be explored, including accelerated, second-degree nursing programs. Students with an undergraduate degree may possess a higher level of metacognition, leading to more accurate self-assessments. Other opportunities include studying how KSs transfer into the clinical environment and conducting qualitative research related to students' lived experiences.

Implications for Practice

A positive component of using KSs is that when faculty ask students to self-assess, the potential for further development of metacognition exists. Students can use KS results and constructive faculty feedback while considering the strategies needed to learn course content and accurately respond to exam questions or perform skills during simulation (Mills, 2016).

There are implications for health- and practice-based professions, notably, students' ability to self-assess, conduct peer evaluations, participate in simulations, and ensure the safety of others. Although faculty offers constructive feedback, students may not understand the feedback or identify areas for improvement. Familiarity with the Dunning-Kruger effect can heighten faculty awareness of the potential for students to believe they can perform beyond their ability, improving fieldwork supervision and error mitigation. The persistence in the belief that performance is satisfactory is critical for faculty to keep in mind, particularly for self or peer evaluation activities. Therefore, faculty play a crucial role in providing students with opportunities for improving metacognitive skills (Mills, 2016; Zell & Krizan, 2014).

Conclusion

This study evaluated the feasibility of using a KS in a pre-licensure professional nursing program, introducing the KS as a potentially valuable educational tool for a blended learning approach in higher education programs using simulation. Adapting Jarzemsky et al.'s (2010) work through incorporating the QSEN competencies into the behavioral outcomes illustrates how profession-specific behavioral competencies can be integrated into a KS so that students and faculty can assess clinical performance in a safe environment.

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