Design, Implementation and Evaluation of a Nursing Simulation: A Design and Development Research Study

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Abstract: The purpose of this study was to investigate the use of the Jeffries/National League for Nursing Framework for Designing, Implementing and Evaluating Simulations. The model was used to develop a simulation-based course to teach interprofessional communication to new graduate nurses in an acute care setting. Design and development research was employed to examine the phases of design, implementation, and evaluation. Findings revealed that the model generally functioned well in this context. Particular strengths were its emphasis on problem solving and recommendations for attending to fidelity. Identified weaknesses were inadequate guidance for designing and implementing student support and debriefing. Recommendations for strengthening the model include providing scaffolds to students during problem solving and a focus on the interrelationships of the design components in the model. Overall, designers would benefit from using the framework, supplementing it in areas where the model does not currently provide adequate guidance.

Keywords: instructional simulation, clinical simulation, instructional design, simulation, instructional development

Clinical simulations have been used in recent years to provide instruction on interprofessional communication skills to nursing students. Simulations have been effective in assisting undergraduate nursing students construct more organized communication and develop increased confidence (Guhde, 2010; Thomas, Bertram, & Johnson, 2009). They have also been effective to instruct new graduate nurses recognize when help from other medical professionals is required and to improve their communication with physicians (Mulligan, 2010). These findings provide evidence that clinical simulation is a viable option for teaching interprofessional communication skills to nurses.

The most common structure for a simulation-based course in nursing consists of an initial briefing followed by participation in the experience and then a debriefing (Cant & Cooper, 2009). This structure is similar to the recommendations provided by Lindsey and Berger (2009) who suggest three universal principles for experiential instruction – framing, activating, and reflecting on the experience. These principles are evident in the Jeffries/National League for Nursing Framework for Designing, Implementing and Evaluating Simulations (Jeffries, 2005, 2006; Jeffries & Rizzolo, 2006; Jeffries & Rogers, 2007).

Simulation Design Framework

This framework consists of three major components – outcomes, contextual elements, and design elements (Jeffries & Rogers, 2007). The outcomes of a nursing simulation include knowledge acquisition, skill performance, learner satisfaction, critical thinking, and self-confidence. Contextual elements are the students and teachers, their backgrounds and experiences, as well as educational practices embedded in a particular setting. Design elements include objectives, fidelity, problem solving, student support, and debriefing. These design elements are discussed below.

Objectives. Within the Jeffries framework, objectives must be clearly written to allow students to participate effectively in the simulation (Jeffries & Rogers, 2007). Other important features include matching objectives to a learner's knowledge and experience and including intended outcomes and expected behaviors (Jeffries, 2005; Jeffries & Rogers, 2007). The number of objectives should be reflective of the complexity of the simulation but ideally no more than three to four objectives should be included in a 20 -minute simulation (Jeffries, 2006).

Fidelity. Fidelity is defined as the level of realism found within a simulation both in the technology used and in the environment within which the simulation occurs (Jeffries, 2005). The level of fidelity in a simulation is a design decision based on learner characteristics and the learning objectives (Hertel & Mills, 2002). Simulations should be as realistic as possible to increase the likelihood of transferring learned skills to the real world (Lindsey & Berger, 2009). However, creating simulations that are too realistic and complex may overwhelm learners and overshadow the learning objectives (Hertel & Mills, 2002; Lampotang, 2008).

Problem solving. Another important simulation design feature is the opportunity for problem solving (Jeffries, 2006). Within the framework, problem solving is viewed as decision points that learners create for themselves (Jeffries, 2006). Jeffries (2005) discussed problem complexity in terms of the level of uncertainty found within the scenario; complexity increases with the number of problems presented, the number and stability of the relationships between the problems and the presence of irrelevant data. Complexity of a problem is also judged by the number of cognitive operations and degree of cognitive burden that is placed on the problem solver (Jonassen, 2004). In terms of complexity, the goal of the designer is to create simulations that are challenging while still allowing learners to be successful (Jeffries, 2007; Lindsey & Berger, 2009).

Student support. Student support includes the cues provided during the simulation (Jeffries & Rogers, 2007) as well as facilitation of guided reflection on decision-making during debriefing (Jeffries, 2006). The provision of cues during the simulation should "offer enough information for the learner to continue with the simulation, but do not interfere with his/her independent problem solving" (Jeffries & Rogers, 2007, p. 29). The decision to provide support during a scenario is based on balancing learner needs so that the learner uncovers their own strengths and weaknesses but does not become so overwhelmed as to have their self-concept threatened (Glavin, 2008). These decisions may be made by the designer prior to implementation and by faculty during implementation (Glavin, 2008).

Debriefing. Debriefing allows students and faculty to review what happened during the simulation and reflect on the meaning of events (Jeffries & Rogers, 2007). The goals of debriefing are to provide emotional support to learners (Flanagan, 2008) and help them achieve learning objectives (Glavin, 2008). Although debriefing is considered an essential element of simulation-based learning, it remains a poorly understood learning strategy (Dreifuerst, 2009).

The model described above was developed to guide nursing faculty design high fidelity clinical simulations. It was employed as part of an extensive, multi-site study (Jeffries & Rizzolo, 2006). The study was carried out in four phases, with model and instrument development included in the initial phase. Eight project directors (with the assistance of nursing faculty) utilized the framework to design, implement and evaluate a simulation experience at their site during the second phase. The results from this phase of the study are not included in the report, so little is known about how the model was actually used to design and implement the simulations. During the third phase, 395 students were randomly assigned to one of three conditions – paper/pencil case study, simulation with a moderate fidelity simulator, and simulation with high fidelity. There were no significant differences in knowledge based on posttest score comparisons. However, learners using the high fidelity simulation scored higher than those in the other groups on satisfaction and self-confidence measures. Additionally, student perceptions of the incorporation of active learning, feedback and diverse learning styles were significantly increased with high fidelity simulation.

Purpose of the Study

The purpose of the current study was to investigate the use of the Jeffries/National League for Nursing Framework for Designing, Implementing and Evaluating Simulations. The model was employed to develop a simulation-based course to teach interprofessional communication to new graduate nurses. The study focused on the processes used to design the simulation, its implementation by faculty, and its impact on students.

Method

Research Design

Design and development research (Richey & Klein, 2007) was used in this study to address the validity of the Jeffries framework. According to Richey and Klein (2007) "model validation is an empirical process that demonstrates the effectiveness of a model's use in the workplace or provides support for the various components of the model itself" (p. 12). The study of a design model can be accomplished through "validation of the impact of the products of model use" (Richey, 2005, p. 174). The current study focused on documenting the Jeffries model during simulation design, implementation, and evaluation.

Data Sources

Establishing model validity in a design and development study requires collecting data from a variety of sources. Triangulation of data from designers, instructors and learners improves a researcher's ability to make inferences about the data as it relates to the validation of the model (Richey, 2005).

Designer Data. Demographic data including gender, ethnicity, education, and design experience in both general and simulation-based courses were collected from the designer. A log was kept by the designer to provide data regarding model use during the design phase, as well as any problems encountered and impressions of the model. The designer log was analyzed for evidence of decisions made during the design phase and designer reflections on the model.

Faculty Data. Demographic data including gender, ethnicity, teaching experience in traditional and simulation-based courses, highest degree, and education in facilitating simulation-based education were collected from the faculty. A log was kept by the faculty to capture their impressions of the design components. Furthermore, course implementation was observed and videotaped to collect data on how student support was provided and how objectives and application to practice were addressed during debriefing. After each implementation of the course, faculty participated in a semi-structured interview regarding perceptions of course effectiveness, the level of fidelity and complexity in the scenarios, the experience of providing learner support, and perceptions regarding debriefing.

Student data. Demographic data including gender, ethnicity, educational background, prior experience with simulations, and overall perception of simulation-based education was collected via questionnaire. Student participants completed a pretest and posttest on the day of the course requiring construction of a report in the situation, background, assessment and recommendation (SBAR) format in response to a videotaped patient assessment. A different patient assessment videotape was used for the pretest and posttest. The critical patient assessment data was the same in both videotapes, but surface features, such as age and gender, were different. The organization and accuracy of the responses were scored using a researcher-designed rubric. The responses for the pretest and posttest were scored for inclusion of important elements of (1) patient identity and current problem (situation); (2) diagnosis, pertinent history and current treatment (background); (3) reporting of salient assessment data; and (4) recommendations reflective of the severity of the patient's condition that do not include harmful recommendations. Participants received a score of 0-3 for each component of the report with a total possible score of 12.

Student participants also completed two surveys. The first was a 12-item questionnaire designed to measure satisfaction with the simulation activity and self-confidence in learning. The second was a 20-item questionnaire to measure their perception of the presence and importance of design features in the simulation. Both of these instruments were developed by Jeffries (2005). To further explore student perceptions, participants were asked to list activities that supported or hindered their learning during the simulation.

Participants

Participants in the study were a course designer, three graduate nursing faculty members, and 27 registered nurses who had been in practice for less than six months and were enrolled in an in-service education course on interprofessional communication. The course designer was a female with 29 years of experience as a registered nurse. She holds a Master of Science in Nursing and a Doctor of Philosophy in Educational Technology. She has 10 years of experience in designing, developing, implementing, and evaluating classroom, online, and simulation-based courses for physicians, nurses, and other allied health professionals in a hospital setting. Additionally, there were three nursing faculty members who implemented the course. All were Caucasian females ranging in age from 32 to 47 years and each possesses a license to practice as a registered nurse. Their average number of years experience in nursing education was 6.8 (range 3.5 – 11) and all had experience implementing simulation-based courses. Student participants were mostly female (22 of 26, with one non-report) and all were white, non-Hispanic. All had recently graduated from an entry-level program in nursing. The mean age of the group was 30 years (SD 9.5, range 22 -57) with 23 participants having some clinical experience beyond nursing school. The majority of participants (N = 23) had experienced simulations in their undergraduate nursing programs. The average was 3.5 simulation experiences per semester. Of those who had experience with simulation, their overall attitude towards the use of simulation in clinical learning was favorable [M=4.08, SD=0.78] on a 1-5 scale, with five being very useful.

Setting

The setting for the study was a medium sized tertiary care hospital located in the southwestern United States. The course was implemented within the care facility's Simulation Center, a 3300 square foot facility with a 20-seat classroom and four simulation environments – an operating room, an intensive care/ emergency department room, a medical-surgical hospital room, and an outpatient room. The simulation rooms are built around a core control room used by the staff to run and record simulation activities. All clinical scenarios for this study were scheduled in the medical-surgical environment which is designed to be similar to a standard hospital room. The Simulation Center provided a SimMan 3G® human patient simulator for the clinical scenarios as well as the necessary clinical equipment. All simulations are recorded using a web-based system for capturing, annotating and archiving videos obtained during scenarios and debriefing. This system also allows students who are not direct participants the scenario an opportunity to observe the scenario in real time. This capability permits observers to consider their own approaches to the situation and participate in the debriefing.

Results

Data were collected throughout the design, implementation and evaluation phases of the simulation-based course. Results are reported below for each of these phases.

Design

Following the tenets of design and development research (Richey & Klein, 2007), the simulation-based course was designed by the principal investigator in collaboration with nursing faculty who served as subject-matter experts, provided input on objectives, reviewed and suggested revisions to the case scenarios prior to course implementation. The designer kept a log as a method of reflecting upon the use of the model. Coding of these data uncovered three primary themes – decisions about design characteristics, interrelationships between these characteristics, and challenges encountered in designing the course.

Fidelity. Reflection on this design characteristic related to ensuring fidelity and barriers to it. For example, the designer noted that she referred to a variety of sources to create realistic patient cases including nursing textbooks, online opioid calculators, and contacting a physician who specializes in pain management. Environmental fidelity was promoted by using moulage to create body fluids such as urine and liquid stool. Barriers to fidelity noted in the designer log related to the known capabilities of the human patient simulator. For example, one log entry read, "To adequately portray delirium, the limitations of the mannequin have to be taken into account. Agitation is not an option with the mannequin – it just isn't real."

Student support. The designer made several references to student support focusing on the adequacy of cues and how to make those cues available. Student support was written into the patient case scenario by providing sufficient and appropriate cues for the student to use in problem solving. An example of the use of cues as student support are found in this log entry regarding the gastrointestinal bleeding case scenario: "Cues available are patient script regarding symptoms, a stool that has the appearance of an upper GI bleed, vital signs . . . and recent physiologic stress." The designer wrote that decisions on how to make cues available to students are not always obvious:

> You don't want to just give it away – you want learners to work for it, but how concealed is too concealed? I decided to tightly script the patient and provider roles so that information is only given on request to decrease the potential of faculty leading too much and lessening the problem solving aspects of the scenario. The lack of predictability of learner actions in the scenario makes tight scripting difficult.

Problem solving. Problem solving includes the events that trigger decision-making and considerations of the level of complexity of the scenario in terms of the learner's level of knowledge and skill. The designer documented decisions and concerns related to how to trigger problem solving, physician communication within the case scenarios, and how to alter complexity to fit the learner. The designer documented an approach to problem solving that required listing the questions that would need to be answered within the case scenario: "What is needed to do a thorough patient assessment? What do we think is going on here? What merit does the antibiotic argument have? What information should I share with the physician? What orders should I request or anticipate?" In this same case scenario, the designer recorded reflections on aspects of complexity, giving "careful consideration of complexity; how available are the cues in the scenario, how many conflicting cues to distract learners away from the real problem?"

Objectives and Debriefing. The designer reflected on the challenge of writing objectives to meet the model criteria of providing enough information to allow students to participate in the simulation effectively. This was an area in which the designer noted that faculty input would be important. In planning debriefing, the designer noted that an observation sheet based on expected student actions was developed to assist faculty in note taking during the scenario so that they would not need to "trust their memory." The designer also recorded the development of reflective questions based on objectives and application to practice for use by faculty during debriefing to meet model recommendations that debriefing be focused on the objectives.

Interrelationships. Interrelationships between the above mentioned design characteristics were also noted in the designer log. Decisions made about one characteristic often impacted others. For example, the designer wrote, "Building problem solving into the scenario flows naturally from the objectives." The interplay between problem solving, student support, and fidelity were documented as "Fidelity and student support are intimately tied to complexity" and "Fidelity is tightly tied – because if the cues aren't plausible, they won't support the learner."

Challenges. Several log entries discussed challenges in the design of the simulation-based course. While several of these challenges fell under the various design characteristics, a variety of other challenges also arose such as selecting the best types of patient cases, designing for an interactive learning session where there is lack of predictability of what students will do within a scenario, limitations of equipment, and the level of detail required. An example of a challenge faced is documented as part of the tryout session discussion, "timing of family interaction is a subject of debate among faculty – it is difficult to know what the best timing would be, as the family is there to distract the nurse from the real problem."

Model Utility. Analyses of the designer log also uncovered themes directly related to the utility of the model. These were adequate guidance, lack of guidance, and use of outside resources. In terms of providing adequate guidance, the designer noted that the "model makes you think about what the problem solving aspects are going to be relative to the objectives. It is flexible enough to encompass almost any problem designed into the scenario." However, areas in which the model did not provide adequate guidance were also noted in the log, particularly in designing learner preparation and debriefing. In learner preparation, the designer wrote that "it is difficult to determine how much detail learners need in the objectives to be able to participate in the simulation." This theme of preparation arose again during the tryout – "The model doesn't give good information about designing the prebrief; the scenario tryout experience suggests that objectives alone are not enough to allow learners to fully participate". Lack of guidance in preparing for debriefing was also evident in this statement written in the design log:

Other than making sure the objectives are re-stated and used for debriefing, little guidance is provided for how this is done. The model is not very robust for the part that most experts agree is the most important aspect of simulation-based learning.

Closely tied to lack of guidance is the theme of use of outside simulation resources. This was noted when designing pre-briefing and debriefing activities, where other models and literature were used for guidance.

Implementation

The simulation-based course was implemented twice during a single week, with content being repeated for two different groups of students. Typical of simulation use in nursing education, each group of students was randomly divided into three teams and then assigned to a patient case. Each case had five roles – two primary registered nurses, a team lead who could be called as an extra resource, a family member who served as a source of patient information via a written script, and an allied health staff member who could perform a range of activities such as obtaining laboratory specimens from the human patient simulator. During the case, the primary registered nurses were expected to identify the patient's primary medical problem by interacting with the human patient simulator and other persons or materials in the room. Each student directly participated in one case scenario; those who were not directly participating in the case observed the simulation via live video feed. At the conclusion of each patient case, two faculty members conducted a debriefing session. A video of the case was available for review during debriefing. Direct participants and observers took part in the debriefing session. This pattern was repeated for subsequent patient cases, allowing all students an opportunity to directly participate in a patient case.

Data collected during implementation included logs kept by faculty who carried out the simulation-based course, observations of each case scenario and debriefing sessions captured via videotape, and interviews of faculty conducted after each day of implementation. Findings from these data sources are provided below.

Faculty Logs. Analyses of these logs revealed themes related to faculty roles and fidelity. The faculty noted some initial confusion regarding their roles during implementation, as demonstrated by the entry, "… defining [our] roles in this simulated environment, such as; who would be keeping time, how would the groups be divided, who would be giving the participants the report on the patient prior to beginning the simulated scenario." Faculty noted that their discussions provided needed clarity, "Today it was clear as to what our roles were going to be in the simulation." The faculty also reflected on the importance of fidelity in the simulation. For example, one documented that it would be important for "orders [to be] given the way new grads would see them ordered on the computer." Concern for environmental fidelity was evident in the discussion of "what materials and equipment would be needed to allow the new grads to implement the first intervention to carry through with orders received."

Observation. Analyses of the videotapes captured during implementation of the simulation-based course revealed themes related to student support and debriefing activities. During each case, one faculty member provided the voice of the patient while the other provided the voice of the physician. These roles allowed faculty to provide students with support as they progressed through the case. Differences in student support were observed during implementation. For example, patient prompts related to pain were given earlier and more frequently on the second day of implementation. These were geared to focus students on symptoms missed on the first day. There were also more physician prompts supplied by faculty on the second day. For example, students were asked if the patient was on pain medication at home, which was the primary issue for the case. This question was not asked by faculty on the first day, and students did not discover this issue during the case. Furthermore, there were more instances of environmental support related to changes in vital signs during the second day of implementation. Additionally, the faculty were required to provide verbal answers to neurologic physical assessment questions that could not be produced by the human patient simulator.

The videotapes from debriefing sessions were analyzed for time spent on discussion related to course objectives and the application of learning to practice. The greatest percentage of time was spent discussing application to nursing practice (24%), appropriate nursing interventions (23.1%), and diagnostic assessment (21.2%). Much less debriefing time was spent discussing the objectives of selecting and organizing information and selecting recommendations (8.4% and 3.8%, respectively).

Faculty interviews. Analysis of these data revealed themes related to fidelity, student support and debriefing. Faculty found both positive and negative aspects to fidelity during implementation. For example, one commented, "It was good to have a faculty person as the voice of the patient . . . students needed responses in the moment to have dialogue . . . mannequin-canned phrases would not have worked as well." Environmental fidelity was seen as the biggest challenge; faculty noted that not having real-life resources such as an automated drug dispensing machine presented a challenge to students.

Faculty indicated that they chose to give additional support when students were "struggling" and "not getting to the heart of the matter." One stated that they provided support when the "information given was not adequate" for problem solving. Faculty mentioned that determining how much support to provide was not a simple decision. For example, one commented "I didn't want to give too much information [so] I was slow to respond . . . it was difficult to balance because I couldn't do [patient] movements to show I was still awake." Similarly, enacting the role of provider came with difficult decisions regarding student support. One faculty stated, "How far do you go and let them not be successful? You don't want to hold their hand and lead them down a path, but it would be natural for a provider to ask these questions."

Faculty interviews also revealed that debriefing was different after each day of implementation. One shared that the "first group was tough; the primary nurse beat herself up that she didn't recognize the issue." Faculty managed this situation by first discussing what went well then she was able to "come around to what the scenario was about." Despite these challenges, faculty shared that "nobody felt unsafe." Debriefing during the second day was less challenging; one faculty observed that "students declared topics that we had determined we wanted to talk about; only a few times did we need to ask questions to redirect." In terms of addressing objectives during debriefing, faculty stated that they "did achieve communication" but one acknowledged that "[we] talked about communication less than intended."

Evaluation

Following approved institutional review board procedures, student participants were recruited by the researcher prior to the beginning of instruction. Subsequent to obtaining permission, students took the pretest, participated in the simulation-based course, and then completed the posttest, the satisfaction and self-confidence questionnaire, and the simulation design scale.

Results are reported below for student achievement, attitudes, and perceptions of design characteristics.

*Student achievement***.** The mean score on the pretest was 3.11 (SD = 1.40) out of a possible 12 points and was 4.89 (SD = 1.93) on the posttest. A paired-samples t-test indicated a significant difference between pre- and posttest scores, $t(26) = 4.44$, $p < .01$. An examination of each of the four components of the SBAR report revealed that scores improved significantly for the first component, $t(26) = 2.60$, $p < .05$. Small, but non-significant increases were shown for the second and third component. There were no differences on the fourth component.

Student satisfaction & confidence. Means and standard deviations for items on the Student Satisfaction and Self Confidence questionnaire (Jeffries, 2007) are shown in Table 1. In general, participants expressed positive attitudes toward the simulation-based course. They agreed that the simulation was motivating (M = 4.50, SD = 0.58) and effective (M = 4.41, SD = 0.64). Participants also expressed satisfaction toward the resources used during the simulation (M = 4.00, SD = 0.69). They were confident in their mastery of skills and knowledge covered in the simulation (M = 4.31, SD = 0.79) and in their ability to apply this content to clinical settings (M = 4.15, SD = 0.54). They also felt it was their own responsibility to determine what was to be learned from the simulation (M = 4.46, SD = 0.58).

Table 1: Student Satisfaction and Self-Confidence in Learning

Item	Mean	SD
The teaching methods used in this simulation were helpful and effective.	4.42	0.64
The simulation provided me with a variety of learning materials and activities to promote my learning the medical surgical curriculum.	4.15	0.88
The teaching materials used in this simulation were motivating and helped me to learn.	4.50	0.58
The way my instructor(s) taught the simulation was suitable to the way I learn.	4.15	0.67
I am confident that I am mastering the content of the simulation activity that my instructors presented to me.	4.31	0.79
I am confident that this simulation covered critical content necessary for the mastery of medical surgical curriculum.	3.85	0.67
I am confident that I am developing the skills and obtaining the required knowledge from this simulation to perform necessary tasks in a clinical setting.	4.15	0.54
My instructors used helpful resources to teach the simulation.	4.00	0.69
It is my responsibility as the student to learn what I need to know from this simulation activity.	4.46	0.58
I know how to get help when I do not understand the concepts covered in the simulation.	4.54	0.51
I know how to use simulation activities to learn critical aspects of these skills.	4.38	0.64
It is the instructor's responsibility to tell me what I need to learn of the simulation activity content during class time	3.19	1.13

Note: 5 = Strongly Agree; 1 = Strongly Disagree

To further explore student attitudes, participants were asked to list activities that supported or hindered their learning during the simulation. They identified debriefing (N = 10), practicing physician communication (N = 8), and receiving feedback (N = 8) as the most helpful activities. Some participants specifically mentioned that feedback received during peer discussions was helpful (N = 4). The activity that was identified as least helpful related to being watched or videotaped during the simulation (n = 4).

Student perceptions of design characteristics. Means and standard deviations for items on the Simulation Design Scale (Jeffries, 2005) are shown in Table 2. These data reveal that most participants either agreed or strongly agreed that objectives, student support, problem solving, feedback, and fidelity are important in simulation-based courses. They rated being supported in the learning process (M = 4.81, SD = 0.49) and the opportunity to obtain guidance/feedback (M = 4.81, SD = 0.57) as the most important design characteristics. Furthermore, most participants agreed or strongly agreed that each of these design characteristics were present in the simulation used in this study. The highest scores were on items related to feedback and guided reflection. Specifically, students thought feedback was provided in a timely fashion (M = 4.56, SD = 0.87) and that there was an opportunity after the simulation to obtain guidance/feedback to build knowledge to another level (M = 4.60, SD = 0.91).

Discussion

The purpose of this study was to investigate the Jeffries/National League for Nursing Framework for Designing, Implementing and Evaluating Simulations. The model was used to develop a simulation-based course to teach structured communication to new graduate nurses in an acute care setting. Overall, results confirm the usefulness of the model. The simulation contributed to student learning and satisfaction with the course. Faculty were also satisfied with the course overall in terms of enacting their roles and with student learning. The strengths and weaknesses of the model are highlighted below followed by suggestions for how to improve it.

Model strengths

Particular strengths of the design characteristics are the guidance provided in designing and implementing problem solving and fidelity. The model focuses designers on creating problem solving situations as the basis for clinical simulation; this direction was important in developing the clinical scenario narrative that would trigger the decision points called for in the objectives. The model is also explicit in describing the factors that alter the level of complexity, such as adjusting the amount of information available, how information is made available, and how much conflicting information is included. The designer may use this to guide decisions regarding the types of information to provide to adjust the complexity of the clinical scenario.

Achieving the highest level of fidelity possible within a clinical scenario is also advocated by the model; a recommendation that contributed to student success in the current study. The perception that there was a possibility of encountering similar patient situations in actual nursing practice was motivating to students. Conversely, areas where fidelity was lacking presented a barrier to students when participating in the clinical scenarios.

Model weaknesses

Finding from the current study suggest that the model provided minimal guidance in designing instruction to prepare students for using simulation-based instruction and for structuring guided reflection. Although the model recommends writing objectives that provide sufficient detail for students to be able to participate in a simulation, this was shown to be insufficient preparation in this context. Similarly, other than recommending reflecting on the scenario in terms of the objectives and application to practice, little guidance for structuring debriefing is provided by the model. This is a particularly important concern given that students in this study indicated that guided reflection was the activity that most supported their learning. For both preparation and guided reflection, the designer referred to resources beyond the current model.

Within the design characteristic of student support, the model suggests pre-determining the content and timing of cues to be provided to students during a clinical scenario. Based on the findings of this study, this guideline may not be the best approach in every situation. Overall, the balance of providing student support in the form of cues during the clinical scenario was an area of uncertainty for both the designer and faculty. Additionally, the model indicates that student support also occurs within guided reflection but does not provide any further information regarding how to design or implement student support in that phase of the simulation.

Table 2: Presence and Importance of Design Characteristics

Objectives and Information	Presence		Importance	
	M	SD	M	SD
There was enough information provided at the beginning of the simulation to provide direction and encouragement	4.23	0.95	4.65	0.56
I clearly understood the purpose and objectives of the simulation.	4.42	0.99	4.54	0.71
The simulation provided enough information in a clear manner for me to problem-solve the situation.	3.81	0.94	4.54	0.58
There was enough information provided to me during the simulation.	4.08	0.98	4.54	0.58
The cues were appropriate and geared to promote my understanding.	4.15	0.83	4.38	0.64
Student Support	**Presence**		**Importance**	
Support was offered in a timely manner.	4.40	1.00	4.69	0.55
My need for help was recognized.	4.30	1.02	4.60	0.58
I felt supported by the teacher's assistance during the simulation.	4.20	1.04	4.65	0.63
I was supported in the learning process.	4.38	0.98	4.81	0.49
Problem Solving	**Presence**		**Importance**	
Independent problem solving was facilitated.	4.28	0.94	4.62	0.57
I was encouraged to explore all possibilities of the simulation.	4.19	0.94	4.69	0.47
The simulation was designed for my specific level of knowledge and skills.	4.31	1.12	4.73	0.45
The simulation allowed me the opportunity to prioritize nursing assessments and care.	4.00	1.20	4.77	0.43
The simulation provided me an opportunity to goal set for my patient.	3.46	1.17	4.35	0.75
Feedback/Guided Reflection	**Presence**		**Importance**	
Feedback provided was constructive.	4.42	1.10	4.77	0.59
Feedback was provided in a timely manner.	4.56	0.87	4.65	0.63
The simulation allowed me to analyze my own behavior and actions.	4.38	0.97	4.73	0.60
There was an opportunity after the simulation to obtain guidance/feedback from the teacher in order	4.60	0.91	4.81	0.57

Table 2: Presence and Importance of Design Characteristics (continued)

Fidelity (Realism)	Presence		Importance	
	M	SD	M	SD
The scenario resembled a real-life situation.	4.36	0.86	4.65	0.56
Real-life factors, situations, and variables were built into the simulation scenario.	4.36	0.86	4.69	0.47

Presence scale 5=strongly agree; 1=strongly disagree. Importance scale 5=very important; 1=not at all important

The model depicts the five design characteristics as separate and equal entities within the realm of design. Findings indicate that the characteristics interact in ways that impact the students' ability to problem-solve the scenario. The current iteration of the model does not clarify these interactions (Jeffries and Rogers, 2007).

Another weakness of the model is that it focuses only on designing activities for the participant who will assume the role of primary nurse in the clinical scenario. Due the number of students enrolled in nursing courses, it is typical that observers will be present when simulations are implemented. The model does not address engagement of observers or participants assuming non-nurse roles in clinical scenarios.

Strengthening the model

Based on findings of the current study, there are four areas where the model could be strengthened: (1) provide greater clarity and flexibility when designing and implementing student support, (2) increase guidance in student preparation and guided reflection, (3) expand the model to consider all students who may be present, and (4) define the interrelationships of the design characteristics.

Guidance in providing student support in designing and implementing the clinical scenario and guided reflection could be informed by the research on scaffolding in education. Scaffolding is defined by Merrill (2002) as "performing parts of the task that the student cannot perform and gradually reducing the amount of guidance and shifting control to the student" (p. 50). Evidence related to both cognitive scaffolds to assist students during the process of problem solving and metacognitive scaffolds which promote reflection on action (Lajoie, 2005) could provide an expanded conceptualization of student support. For example, Merrill (2002) states that learning from errors made in the problem solving process requires instruction on error recognition, error recovery and error avoidance. Using this principle of instruction during guided reflection may enhance learning from the clinical scenario.

Providing enhanced guidance to designers and faculty regarding learner preparation and guided reflection and feedback may be accomplished by referring to other currently available models. The approach to debriefing proposed by Rudolph, Simon, Dufresne, and Raemer (2006) includes both student preparation and debriefing. Dreifuerst (2009) has also proposed a comprehensive framework for debriefing that includes reflection, emotion, reception, integration, and assimilation/accommodation. The designer and faculty could overlay one of these models of debriefing while maintaining a focus on the course objectives.

Expanding the model to consider others present would assist designers develop roles in addition to the primary nurse and would help faculty implement learning activities for students who may be required to observe the simulation. There is little literature on the topic of observer engagement. However a case report by Kalmakis, Cunningham, Lamoureux and Elshaymaa (2010) demonstrated that student observers who were provided with a case-specific observation sheet demonstrated engagement in a clinical scenario enacted by peers in a simulation laboratory. Further exploration of techniques to assure engagement of observers would be beneficial to faculty who manage larger groups in simulation environment.

The Jeffries model would also be strengthened by clarifying the interrelationships between the design characteristics. Based on the results of this study, a direct relationship between objectives, problem solving, and debriefing was found; objectives directly influenced the design of the problem solving situation and both objectives and student problem solving behaviors informed the structure of debriefing. The design characteristics of fidelity and student support directly impacted complexity in problem solving. Thinking of the design characteristics as an interrelated systems approach could provide added guidance when using the model.

Conclusions

The findings from the current study support the validity of the Jeffries/National League for Nursing Framework for Designing, Implementing and Evaluating Simulations. The combined results of student achievement and satisfaction, coupled with faculty satisfaction with the course and designer data provide evidence that using this model is feasible and beneficial for designing simulations. Although there are areas that could be strengthened, supplementing the model with evidence-based recommendations is a practical approach. Further examination of the interrelationships among the design characteristics will benefit designers using the model in their setting.

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