EVALUATION OF SIMULATION DESIGN LEARNING IN SILLIMAN UNIVERSITY COLLEGE OF NURSING

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This descriptive-correlational study evaluates the degree of implementation and benefits of a learning strategy using a high fidelity human patient simulator. Over one year, the majority of 688 fourth year Filipino nursing students, rated the accomplishment of four simulation design elements (objectives/information, student support, problem solving/complexity, fidelity/realism) as satisfactory and guided reflection/debriefing as excellent. Likewise, the majority rated the elements as very important. Furthermore, the majority expressed satisfaction and high confidence levels after the simulation experience. Spearman's Rho analysis showed significant correlations among all variables. The results give a strong basis for the continued use of simulation as a strategy, which is advantageous to student learning for global health. The researchers recommend that qualitative studies related to the learning strategy be done in order to further understand its impact on and possibilities for enhancing learning in Asian settings.

KEYWORDS: high fidelity human patient simulator, simulation design learning, health education, nursing students, Silliman University

INTRODUCTION

SIMULATION IN HEALTH education involves presenting students with activities, resembling real clinical practice experiences to help them prepare for managing the situation when it occurs in the real practice setting (Morton, 1995). Strategies range from simple psychomotor activities to more complex, sophisticated, computer based scenarios which afford a high degree of realism for problem solving and response. Certain acute care situations, such as cardio-pulmonary arrest and trauma, require critical thinking, skill, competency and speed that are too risky to practice using actual patients. High fidelity human patient simulators (HPS), which are presently used to address this concern, provide a wide range of programmable settings to realistically demonstrate a patient's probable physiologic response to illness and management. Simulation experiences provide learners the opportunity for repeated practice, analysis of decision-making, and independent or collaborative nursing skill development, which is safe for both students and patients. This, in turn, contributes to learner satisfaction, increased confidence for future practice, and better patient management.

Students who engage in active learning simulations retain knowledge longer and can be exposed to rare clinical experiences (Johnson, Zerwic, & Theis, 1999). Moreover, they have reported an increase in self-confidence and higher levels of satisfaction, effectiveness and consistency with student learning styles (Sinclair & Ferguson, 2009). Simulation was found useful as an evaluation and learning strategy for anesthesiologists' training, and as a tool to evaluate resuscitation performance in physicians, nurses, and medics (Bearnson & Wiker, 2005).

The need for and use of simulated learning has increased along with evidence-based practice and care competency development. Other factors include increased awareness of patient safety needs, limited number of clinical sites for practice, reduced faculty-student ratios, shorter length of patient stay, and higher patient acuity (Seropian, Brown, Gavilanes, & Driggers, 2004; Medley & Horne, 2005). Medley and Horne (2005) noted that, other than evaluative reports, there was a lack of valid research on whether or not nursing students have improved learning through simulated technology. Comparative methods were not utilized for pretest-posttest data, nor were rigorous designs used to demonstrate differences between traditional methods and high-fidelity simulation learning. It was suggested that more rigorous outcome and comparative studies need to be conducted, and that research address the critical role of facilitators in simulation technology (Medley & Horne, 2005). Few studies have compared the effects of simulation and lecture strategies on student learning (Sinclair & Ferguson, 2009), and the popularity and supply of simulation materials pose continuing challenges for validation and training across learning institutions and cultures.

Nursing schools in the Philippines are among the top producers of nurses for the international workforce and as such should readily adapt to global changes in health care. Most of the clinical practice by students is done in actual clinical settings, where patient care is generally limited to less complex health situations. Simple simulations such as case studies, role playing, and the use of low-moderate fidelity simulators are the mainstay of related learning experiences. The use of high fidelity patient simulation technology in institutions is scarce primarily due to the cost of the technology and appropriately trained instructors. This ongoing reliance on traditional approaches to learning is challenged by the need for global relevance, dwindling faculty and practice areas, as well as the increasing clamor for patient comfort and safety. The impetus for change will largely be provided by early adopters of simulation who have the implied responsibility to show evidence of the possibilities and advantages of the strategy for the improvement of global health care.

METHODOLOGY

This descriptive–correlational study utilized the Nursing Education Simulation Framework (Jeffries, 2005) to evaluate simulated learning in a nursing college in the Philippines. The variables examined were objectives/information, student support, problem solving/complexity, fidelity/realism, and guided reflection/debriefing as well as the learning outcomes: learner satisfaction and self confidence. After receipt of ethics clearance, all fourth year nursing students were exposed to two learning scenarios in the simulation laboratory. An orientation to the physical set up of the environment and review of basic concepts and principles necessary for each simulation experience were provided at the start of every session. The first 20-30 minute simulation exposure with the HPS comprised scenarios revolving around the care of a patient with minor to complex respiratory problems where manipulation of a mechanical ventilator and other respiratory care equipment were necessary. Scenarios for the second 20-30 minutes were related to acute and life-threatening cardiac conditions requiring the respondents to perform basic life support and advanced cardiac life support using the defibrillator and emergency drugs. Both simulations employed branching scenarios such that they had multiple potential endings (Kardong-Edgren, Starkweather & Ward, 2008); however, all were within the realm of the set learning objectives and concepts to be applied in practice. Critical points in the scenarios were modified by the facilitator as necessitated by students' need for cues, safety, and evaluation of nursing judgment. All respondents were debriefed and given the opportunity to qualitatively evaluate their experience after each actual simulation.

Data were gathered through questionnaires, one of which was a modified two part Simulation Design Scale (SDS) developed by the National League of Nurses (NLN) to measure the perceived implementation and importance of the elements of simulation. The scale consisted of 22 five-point Likert items (1-indicating least importance to 5-indicating highest importance) and evaluated the following sub-scales: objectives/information (8 items), fidelity/realism (3 items), problem solving/complexity (4 items), cues (3 items), and feedback/debriefing (4 items). The questionnaire package also included a 6-item Satisfaction with Simulation Scale, and a 6-item Self Confidence from Learning Scale, in a Likert format. These were modifications from the Student Satisfaction and Self Confidence in Learning Scale (SSSCI) designed by NLN. Cronbach's Alpha internal consistency values for the combined questionnaires was 0.94 (Table 1). The data were collected from the first simulation (n=412) and a second simulation (n=396); however, only a total of 688 sets of data were analyzed (first simulation=349; second simulation n=339) because questionnaires with missing data were excluded from analyses.

Table 1. **Data Showing Reliability Test Results**

Questionnaire Type	Chronbach's Alpha Value		
	Pretest n=36	Post-test n=36	Combined Tests n=72
Simulation design elements	0.87	0.89	0.92
Perceived importance of simulation design	0.94	0.92	0.94
Perceived level of satisfaction from simulation	0.75	0.62	0.72
Perceived level of confidence from simulation	0.80	0.83	0.82
All questionnaires combined	0.95	0.93	0.94

Percentages derived from the questionnaire were compared and ranked, unlike the proposed interpretation of summing of scores in the original scales. This was done for the purpose of exploring the perceived degree of occurrence of each sub-item or data group in the scale. Spearman's Rho analysis of factor correlations (α-0.05) was used to determine significant correlations between simulation design elements' implementation and importance, learner satisfaction, and confidence from learning. Perceived learner satisfaction with simulation and confidence from learning were likewise analyzed for significant correlations.

RESULTS AND DISCUSSION

The majority of the respondents agreed with the statements in the sub-scales: objectives/information (67.59%), fidelity/realism (58.43%), problem solving/complexity (57.84%), and student support/cues (59.98%) (Table 2). The majority (55.81%) also strongly agreed with statements in the subscale reflection/debriefing. This showed that the simulation design approach satisfactorily accomplished its intent to provide students with opportunities for learning from scenarios resembling real life situations. It offered an evaluation of student skills, decision making, and values proportionate to prior learning experiences as concepts were longitudinally and progressively threaded through the program.

The results may likewise imply the adequacy of student support provided by the facilitator through cues to guide and direct learners to respond appropriately and develop their competencies in the simulation scenario. Furthermore, the simulation learning strategy provides appropriate student support through constructive, timely and reflective feedback sessions. The results support a recent study utilizing the SDS where analysis reflected high ratings on objectives and information, support, problem solving, feedback, and fidelity (realism). This was also matched by ratings of each element as very important. In that study, they were all rated 88-90/100 in the design and 89-90/100 in importance (Kardong-Edgren et al., 2008).

The simulation design elements applied in the learning strategy are appropriate for adult learning and learner preparation for the nursing profession. Caring as a competence in nursing necessitates critical thinking, which can be enhanced by the simulation strategy. Critical thinking is important to ensure patient safety and the best care approach to fit individual and changing health needs of patients. As a process, critical thinking can be developed by mentally analyzing or evaluating nursing knowledge that has been offered as true, reflecting, examining new evidence and reasoning and forming judgments about facts (Marquis & Huston, 2009) that can be encountered in a simulation experience. Furthermore, other components of critical thinking, such as insight, intuition, empathy and willingness to take action, communication, flexibility and creativity, can be accomplished through vicarious learning in simulations.

Importance of the Elements of Simulation Design

The majority (53.34-75.72%) of learners consider the elements of simulation design as very important (Table 3). This may imply that the students greatly value learning strategies that offer information and support for practice skills and decision-making. They put a premium on constructive criticism and non-threatening approaches in the evaluative process of debriefing. Preparedness through prior learning and cues are also valued as important before they are exposed to more complex application situations. Furthermore, the level of situation complexity and problem-solving required were highly appreciated presumably for their congruence with level of learning needs and goals. Although all elements were perceived as very important, the sub-scale fidelity and realism was lowest, being noted in only 48.55% of the responses. This may indicate that realistic scenario manipulations

Table 2. **Student's Over All Perception on the Extent of Accomplishment of Simulation Design Elements**

Simulation Design Elements	No Accomplishment		Poor Accomplishment		Undecided		Satisfactory Accomplishment		Excellent Accomplishment		Total Responses
	f	%	*f*	%	*f*	%	*f*	%	*f*	%	
Objectives and Information	2	0.29	11	1.59	121	17.59	465	67.59	89	12.93	688
Fidelity and Realism	2	0.29	12	1.74	154	22.38	398	57.84	122	17.73	688
Problem Solving Complexity	2	0.29	7	1.02	92	13.37	392	59.98	195	28.34	688
Student Support Cues	2	0.29	21	3.05	90	13.08	402	58.43	173	25.14	688
Guided Reflection/ Debriefing	4	0.59	2	0.29	34	4.94	264	38.37	384	55.81	688
Total Responses	**12**		**53**		**491**		**1921**		**963**		**3440**

Table 3. **Students' Overall Perception on the Importance of Simulation Design Elements**

Simulation Design Elements	Not Important		Somewhat Important		Neutral		Important		Very Important		Total Responses
	f	%	*f*	%	*f*	%	*f*	%	*f*	%	
Objectives/ Information	0	0	1	0.14	35	5.08	285	41.42	367	53.34	688
Fidelity/ Realism	0	0	1	0.14	60	8.72	293	42.58	334	48.55	688
Problem Solving/ Complexity	0	0	1	0.14	36	5.23	190	27.62	461	67.00	688
Student Support/ Cues	0	0	4	0.58	32	4.65	183	26.59	469	68.17	688
Guided Reflection/ Debriefing	0	0	1	0.14	18	2.61	148	21.51	521	75.72	688
Total Responses	**0**		**8**		**181**		**1099**		**2152**		**3440**

are not as valuable as intrapersonal processes in the learner.

In a related study on simulator use among 106 medical residents, the majority (94%, 84%, and 87%) felt that simulators should be used to learn technical skills, refine technical skills and acquire procedural teaching skills, respectively. Moreover, the majority (92%, 92%, 84% and 89%) felt that simulation instruction should include demonstration, learner observation, teaching evidence behind procedural steps and providing feedback, respectively. That study, likewise, identified some barriers to the procedural teaching which include limitations in time, number of instructors and simulators, and the lack of realism of some simulators (Shanks et al., 2010). This information to enhance learning is essential to the nursing profession, which includes a large portion of procedural performance in its practice. The novelty and scarcity of simulators in the Philippines, thereby, challenges educators to enhance training, budget allocation, and investment towards an increased acquisition and utilization of high fidelity simulators to address the limitations which are also observed among educational institutions in the country.

The data (Table 4) show that the majority of respondents were satisfied with the learning strategy (63.66%) while the rest were very satisfied (28.50%), undecided (7.41%), and dissatisfied (0.43%). This perceived moderate expression of satisfaction may be related to non-maximal accomplishment of the elements of simulation design as shown in Table 2. This may imply the need for improvements in the conduct of simulations to complement students' individual needs or reflect reservation to give perfect responses. On average, respondents reflected higher levels of satisfaction to simulation learning during the second simulation. Similarly, in the other previously cited study, satisfaction was noted at 21-24/25 (Kardong-Edgren et al., 2008).

In a related study comparing 174 student ratings, 91% reported ratings of effectiveness and high effectiveness of the lecture-simulation approach versus 68% in the pure lecture approach to teaching. The difference was also seen in satisfaction ratings where 91% reported "satisfied and very satisfied" with lecture-simulations compared to 70% for lectures only. The levels of effectiveness and satisfaction with lecture–simulations were clarified through qualitative data, which highlighted gaining knowledge, experience, peer collaboration, and information recall as part of the students' experiences. The data also included application of theory to practice, critical analysis of care without pressure and hands-on learning (Sinclair & Ferguson, 2009). A recent study on the predictors of knowledge gains using simulation shows that the human patient simulator is an effective teaching methodology for nursing students regardless of age, learning style or critical thinking ability (Shinnick, Woo, & Evangelista, 2012).

Table 4. **Students' Overall Perception reflecting Satisfaction with Simulation Learning**

Responses Reflecting Satisfaction of Students	**First Simulation**		**Second Simulation**		**Combined**	
	f	%	*f*	%	*f*	%
Very Dissatisfied	0	0	0	0	0	0
Dissatisfied	3	0.85	0	0	3	0.43
Undecided	46	13.20	5	1.47	51	7.41
Satisfied	237	67.90	201	59.30	438	63.66
Very Satisfied	63	18.05	133	39.23	196	28.50
Total	**349**	**100**	**339**	**100**	**688**	**100**

Ranking of perceptions of satisfaction in the two simulation exposures showed positive learning from mistakes as the highest contributor (Table 5). This, however, indicates that errors in decision-making or nursing care are indeed committed by students and therefore practicing on a human patient simulator and the mimicry of reality may have spared clients from actual harm. These results may likewise lend to learners' positive realizations and cautions for future similar care scenarios in actual settings. It is also noteworthy that the simulations were considered as helpful, enjoyable and effective. Although enhancement, motivation, and suitability of the learning design were ranked fourth, they were rated 4, 'satisfied'.

Furthermore, these results support the vast possibilities for improvement to motivate and enhance learning. It was revealed in the concurrent qualitative comments from respondents that they were anxious about being exposed to the simulation laboratory, handling equipment (mechanical ventilator, defibrillator) for the first time and being observed by the instructor through cameras and the one way mirror. The lower rank of perceived suitability

Table 5. **Ranked Statements Reflecting Student Satisfaction with Simulation Learning**

Statements Reflecting Satisfaction	First Simulation		Second Simulation		Combined Responses	
	Average Rating	Rank	Average Rating	Rank	Average Rating	Rank
I have learned from my mistakes in a positive manner.	4.60	1	4.80	1	4.70	1
The simulation provided me with good strategies to assist my learning.	4.40	2	4.70	2	4.55	2
The teaching methods used in simulation were helpful and effective.	4.30	3	4.70	2	4.50	3
I enjoyed how my teachers taught using simulations.	4.30	3	4.70	2	4.50	3
The teaching materials used in the simulation enhanced and motivated my learning.	4.00	4	4.70	2	4.35	4
The way my teachers taught the simulation were suitable to my learning needs.	4.00	4	4.70	2	4.35	4

*Rating equivalents: 5 = very satisfied, 4 = satisfied, 3= undecided, 2 = dissatisfied, 1 = very dissatisfied

of facilitation for individual learning needs may likewise be attributed to the differences in the conduct of simulation, the lack of teacher sensitivity to students' cues, or a mismatch of student-teacher expectations. Even if the set of trained teachers who facilitated the learning process were the same for the entire period, they varied in relation to specific student groups per session. Achievement of optimal learning requires collaboration and engagement by facilitators and students in a simulation design to meet different learner types as some may tend be more tactile, kinesthethic, auditory, or visual in their learning (Kardong-Edgren, Starkweather, & Ward, 2008). Feelings of satisfaction, likewise, may be influenced by students' individual predispositions, attached meanings experiences and other confounding variables referred to in the preceding discussion

A very important consideration for satisfaction in learning is choosing a strategy which meets individualized learning needs. Traditional pedagogical approaches are usually ineffective for mature learners such as fourth year college nursing students. Knowles (1970), described androgogical learning environments as being characterized by openness and respect, involvement in evaluation, experiential techniques, tolerance for mistakes, opportunities for application of learning, and assessment of needs (see also Marquis & Huston, 2009). These are all provided for in a simulation strategy for learning.

College learners are social beings and therefore learn through and value social interactions. Social learning theory suggests that behavior is learned by observation and direct experience. These behaviors are retained based on positive or negative rewards. An important component of social learning is vicarious experience through observing others' actions or learning from their feedback. Evaluation of new information by inductive or deductive reasoning as well as anticipation of reinforcement also characterizes the learning process (Bandura, 1986). Simulations done in groups provide opportunities for social learning as was seen in the study.

Students' Confidence After Simulation Design Learning

The majority (66.13%) of respondents had high confidence levels after the simulation experiences (Table 6). The rest reflected indecision about confidence levels, very high confidence, low confidence and very low confidence (26.45%, 6.25%, 1.02%, 0.15%) respectively. These responses may relate to their experience. The average ratings of confidence range from high confidence (4) to undecided (3) as seen in responses for first simulation and overall. Slightly higher ratings of confidence were observed after exposures to the second simulation experience than the first.

The second simulation scenarios revolved around critical illness states requiring cardiopulmonary resuscitation (CPR). This may be due to the fact that care for a patient in scenarios requiring

CPR is largely regulated by universal protocols, which can become very familiar with repetition and practice. Successfully reviving a supposedly lifeless person in the care process leads to a feeling of high confidence. The results are likewise supported by a related study with an acute myocardial infarction scenario, where confidence levels increased in the post test as compared to the pre-test in the two groups (Brannan, White, & Bezanson, 2008). A lecture group was compared to a simulation group, using a 9-item confidence in learning tool, and gains in confidence in the latter group were noted to be higher at post-test, although the increases were not significant. High confidence levels among learners were also noted in the study of Kardong-Edgren et al. (2008) with scores of 35-38/40.

Table 6. **Students' Evaluative Reflection of General Self Confidence From Simulation Learning**

Responses Reflecting Self Confidence of Students with Simulation	First Semester		Second Semester		Combined Semesters	
	f	%	*f*	%	*f*	%
Very Low Confidence	1	0.29	0	0	1	0.15
Low Confidence	6	1.72	1	0.29	7	1.02
Undecided	119	34.09	63	18.58	182	26.45
High Confidence	209	59.89	246	72.57	455	66.13
Very High Confidence	14	4.01	29	8.55	43	6.25
Total	349	100	339	100	688	100

High confidence (rank 1) was attributed to the development of positive attitudes for the practice of nursing (Table 7). Furthermore, obtaining knowledge for a similar clinical situation, acquiring skills to perform roles, and gaining general confidence as a future professional nurse likewise contributed to high confidence, albeit in rank 2. Perception of preparedness and mastery of content ratings were both noted to be at the average or "undecided" levels of confidence, ranking 3 and 4 respectively. These results are understood to be quite natural since persons acquire confidence as they develop expertise through experience and additional learning.

Confidence levels in students, whether high or low, are not only influenced by the mastery of skill or procedure but also by the corresponding cognitive evaluations of learning. Respondents of the study all took a written post test for evaluation (not a study variable) prior to answering the study questionnaire. Excellent performance in written exams to evaluate learning may correspondingly lead to high confidence while poorer performance to lower confidence levels. It was suggested by Brannan et al. (2008) that students would naturally declare high confidence levels if they perceived that they met their learning objectives after a class.

The perceptions of confidence may be influenced by students' individual personality predispositions and attached meanings to the experience. In addition, future goals and preparation compatibility, previous experiences, teacher-facilitation, or other general environmental situations are among a few of the diverse influencing factors for confidence development. This is a consideration that facilitators of learning must reckon with in order to promote optimum learning.

The development of self confidence is closely related to Bandura's Theory of Self Efficacy, where an individual's belief of competence is influenced by performance mastery and his /her psychological state (Bandura, 1986). Simulation design learning exposes the learner to self efficacy promoting factors in the form of opportunities for repetition, active decision-making in realistic scenarios, peer to peer interactions and debriefing seminars. Simulations also allow prior knowledge/concepts to be integrated with newly acquired knowledge for more efficient learning.

The results of the study suggest positive implications for professional nursing since confidence and self efficacy are valued attributes for professionalism. A confident and competent person generally reflects the development of initiative and adequate preparation in skills, knowledge, and attitudes. Furthermore, it reflects courage and belief in the capacity to deliver safe and effective patient care. Students who realize their lack of confidence or competence but admit their need for improvement may have brighter possibilities for enhanced and effective learning for future professional practice.

Table 7. **Ranked Statements Reflecting Student Confidence From Simulation Learning**

Statements Reflecting Confidence	First Simulation		Second Simulation		Combined Responses	
	Average Rating	Rank	Average Rating	Rank	Average Rating	Rank
I have developed positive attitudes for the practice of nursing.	4.30	1	4.60	1	4.45	1
I have obtained the knowledge needed for future similar clinical situations.	4.00	3	4.40	2	4.20	2
I have acquired the skills needed to perform my role as a nurse.	4.10	2	4.30	3	4.20	2
I have gained confidence to be a future nurse professional.	4.00	3	4.40	2	4.20	2
I am better prepared for actual clinical practice.	3.80	4	4.10	4	3.95	3
I have mastered the content my teachers present to me in the simulations.	3.80	4	4.00	5	3.90	4

*Rating equivalents: 5 = veryhigh confidence, 4 = high confidence, 3 = undecided, 2 = low confidence, 1 = very low confidence

Inter-variable Correlations

Perceived accomplishment of elements in the simulation design were significantly correlated with perceived importance of each element (r=0.484, p=0.00), perceived satisfaction with simulation (r=0.705, p=0.00) and perceived confidence from simulation learning (r= 0.551, p=0.00) (Table 8). Likewise, perceived satisfaction with simulation and perceived confidence from simulation learning were also significantly correlated (r=0.679, p=0.00).

These results support previous research where simulations in an intervention group led to greater self efficacy, higher levels of satisfaction and greater consistency with students' learning style (Sinclair & Ferguson, 2009). In another related study, results show an observation of positive influence where cognitive skills were significantly higher among students compared to those exposed to traditional lecture teaching (Brannan, White, & Bezanson, 2008). Such improvements are attributed to better student-teacher learning related interactions. It can be noted that quality engagement opportunities are highly possible with simulations since they are done in smaller groups compared to large group lecture sessions.

Table 8. **Results of Spearman's Rho Analysis of Factor Correlations at 0.05 Level of Significance (n=688)**

Factors Measured	Values	Remarks
Elements of Simulation Design VS Perceived Importance of the Elements	r= 0.484 p-value= 0.000	Significant
Elements of Simulation Design VS Perceived Levels of Student Satisfaction	r= 0.705 p-value= 0.000	Significant
Elements of Simulation Design VS Perceived Levels of Student Confidence	r= 0.551 p-value= 0.000	Significant
Perceived Levels of Student Satisfaction VS Perceived Importance of the Elements	r= 0.363 p-value= 0.000	Significant
Perceived Levels of Student Confidence VS Perceived Importance of the Elements	r= 0.289 p-value= 0.000	Significant
Perceived Levels of Student Satisfaction VS Perceived Levels of Student Confidence	r= 0.679 p-value= 0.000	Significant

CONCLUSION

The results of this study provide a strong basis for the continued use of simulation, as it was found advantageous to student learning and professional preparation. Its use is reinforced as a strategy for Filipino nursing students' learning of skills, knowledge, and attitudes for globally relevant quality patient care. It can be harnessed as a learning strategy, where exposure to actual environments poses more risks than benefits to both clients and learners. The present quality of implementation of simulation design elements generally ranges from satisfactory to excellent and is congruent to the learners' perceived importance of each.

However, it must be noted that there is room for improvement in the conduct of simulations to maximize its benefits for learners' individualized needs. It is recommended that continuous evaluation be done on the conduct of simulation learning to meet this concern. The researchers further recommend that qualitative studies and experimental designs related to the learning strategy be done in order to further understand its impact on, and possibilities for enhancement of learner and patient outcomes.

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