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Research Article

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Analysis of the Impact of Hours of Simulation on HESI Scores

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Abstract

Statement of problem: *Undergraduate nursing programs are challenged to develop high cognitive skills in students and prepare them for practice readiness. Limited clinical placements that offer a narrow exposure to clinical experiences to prepare nursing students adequately to apply their knowledge are a growing concern. Simulation experiences allow students the opportunity to acquire competencies necessary to apply knowledge to practice. Is there a direct relationship between increased hours of simulation to students' readiness for practice?*

Purpose: *To determine if there is a relationship between hours of simulation received and student performance on HESI exam to better explain the relationship of simulation to student knowledge acquisition and application.*

Goals: *Provide evidence of impact of simulation on nursing student knowledge. This study will provide information that may guide undergraduate nursing curriculum development specifically surrounding clinical hours.*

Objectives: *To determine if there is a relationship between the number of hours of simulation received and student performance on a standardized exam.*

Plan: *Challenges for clinical placements required innovative strategies to meet the clinical requirements within this organization. The use of simulation in place of clinical hours was being done, but cohorts were receiving different numbers of hours. A retrospective look at each of the cohorts was done to determine simulation hours received. Data was collected from each cohort's HESI exam results and compared.*

Outcomes and Results: *The analysis of data revealed that 6 hours of simulation is a minimum number of hours that will have a positive impact on student learning, and 12 hours showed the greatest impact on students within this study. The data does not appear to reach saturation one cannot prove that only 6 or 12 hours of simulation should be considered as all levels are statistically significant. One cannot prove that additional hours is a waste of time or that student learning has reached a plateau.*

Introduction

Problem Recognition/Definition

Nursing education is rapidly changing to meet the demands of the paradigm shift within health care. The once acute-focused curriculum must now adapt to incorporate multiple aspects of nursing care to ensure the future nurses are prepared to practice in a community, holistic care profession with a focus on patient centered and multidisciplinary collaborative care [1]. This shift has created challenges to undergraduate schools of nursing to change their curriculum to meet these standards. In addition to curriculum changes the decreasing availability of quality clinical sites has challenged schools of nursing to creatively fill these gaps. The use of simulation experiences is one way schools are attempting to meet the needs of the students [2]. Simulation experiences allow students the opportunity to acquire competencies necessary to apply knowledge to practice and can produce specific experiences that may not be available within traditional clinical placement [3]. The purpose of this study is to determine if there is a relationship between hours of simulation received and student performance on Health Education Systems Incorporated (HESI) exam. The HESI exam was developed as a predictor test to determine student readiness to take the NCLEX [4]. The HESI standardized test provides information to determine individual remediation needs for students [5]. This information can be used by nursing faculty to better prepare students to be successful with the licensure exam.

Simulation is a method of evaluating performance that has been around for many years. The military has used simulation in flight simulators and computer programs to evaluate one's skills or adaptation to specific variables. Many years of use in a variety of

organizations has shown that simulation is a proven way to teach, learn and evaluate learning [6]. The increase of interest in simulation within the healthcare field has created benefits, but also its share of challenges. The shift within health care focus and education is creating a push toward increasing the knowledge of the students to be able to transition into a practice setting and be prepared to practice independently, but the challenges faced by schools of nursing for quality clinical placements are increasing. The use of simulation is popular among both rural and urban schools to attempt to fill the gaps created by poor or non-existent clinical site placement [2]. Simulation, both high and low fidelity, is widely used throughout nursing programs, however the number of hours used in place of clinical varies among states and programs [7]. Undergraduate nursing programs are challenged to develop high cognitive skills in students and prepare them for practice readiness. Limited clinical placements that offer a narrow exposure to clinical experiences to prepare nursing students adequately to apply their knowledge are a growing concern. Simulation experiences allow students the opportunity to acquire competencies necessary to apply knowledge to practice [8].

Theoretical Models

Dorthea Orem's self-care deficit theory is described as the relationship between one's initiative for self-care and the identification of deficits. This theory describes three basic levels of self-care requisite which if not met create a deficit [9]. This deficit can be identified and fulfilled by another until the person can meet the needs independently. It is a continuous process of evaluation, implementation and re-evaluation. Major assumptions of this theory are all people are individuals and needs or deficits can change per circumstances [9]. Orem described nursing as a form of action-interaction between two or more people [10]. This can be applied to nursing education as well if one thinks of the student learner as the patient and the educator as the nurse. This is especially true within simulation where the type of simulations given to students can be a direct response to student deficits in learning experiences. Orem's theory has the end goal to render the patient, or student in this case, capable of meeting their needs [10]. This is shown by bringing the person to as near normal function as possible. Within the education realm this would translate to bringing the students to the desired competency necessary [11]. This theory could help guide this PICO as the identification of the needs of the students by the faculty to create simulations that can help fill these deficits in a controlled environment. The evaluation of students within a simulation environment can also reveal deficits that are recognized by both the student and the faculty which can lead to curriculum changes to focus on those specific needs. The relationship between educator and student can encourage autonomy over learning, but allow for additional support when needs are identified. It is a give and take relationship to be successful and requires active participation of all parties involved.

Kolb's Experiential learning theory (ELT) focuses on learning through process and experience as a source of learning [12]. The ELT consists of four stages within a cycle of learning that describe the process of knowledge acquisition [12]. The first stage of concrete experience is a new experience or reinterpretation of an existing experience [13]. The second stage is observation and reflection [13. This allows the learner to determine inconsistencies between the experience and understanding. The third stage is Abstract Conceptualization in which the reflection from stage two creates new ideas and generalizations or conclusions about the experience [13]. This lead into the final stage of Active Experimentation where the learner applies the information to the world around them resulting in new experiences [12]. Kolb also described four learning styles encompassing a combination two of the stages. The ELT suggests that experience assigns meaning to knowledge thus increasing the retention [14]. The stages are a continuous process and at the completion of stage 4, the experimental stage, new experiences are created thus repeating the cycle once again [15]. This process of knowledge acquisition can be applied to this PICO as a road map to understanding the importance of experience and knowledge acquisition.

Objectives

The objective for this research is to determine if there is a correlation between the number of hours received in simulation and student performance on the standardized HESI exam. The HESI exam is a nationally recognized NCLEX readiness indicator examination that is used by nursing programs nationwide [4]. This exam is used by nursing programs to follow the progress of students throughout the program to identify areas of concern. This data will be organization sensitive as it will provide an understanding of the students' performance and knowledge level as well as provide guidelines for curriculum development to ensure the students are receiving quality education that will successfully prepare them to enter the profession of nursing. In addition, it will provide information to use the data to create best practice for this university. Long term goals are to see an improvement in NCLEX scores and possibly policies surrounding simulation in undergraduate nursing programs. This form of quality improvement could potentially be a foundation for other nursing schools to model.

Method

The shift in nursing education toward a community based focus instead of an acute care focus is creating a change in curriculum [1]. Traditional clinical sites are still acute care focused and the limited availability of alternative sites creates additional challenges. Nursing programs strive to understand the effectiveness of their curriculum as well as student readiness for state board testing. Many programs have adopted the use of nationally recognized standardized testing platforms to quantify both. The results of the med-surg HESI specialty test was used as the primary outcome measure within this study. This test is a computerized test that includes questions that are weighted differently from easy to hard (HESI, 2013). HESI tests the students' performance in a variety of nursing applications within the med-surg curriculum.

Each student has the same question bank of difficulty. The test provided a conversion score to account for the question difficulty [4]. This allowed a more consistent comparison of the four cohort scores. Every student in each cohort took two versions of the HESI within the same semester. The mean average of each version was compared. This was done to better reflect the overall knowledge. The cohorts were given two versions as a percentage of their overall course grade which was approximately 10% (100 points) on the first version and the second worth 15 % (150 points). The points were assigned on the following scale: >900 HESI = 100%, 899-750 = 75%, 749-500 = 50%, <499 = 25%. This allowed students to get a minimum of 25% of the points just for participating in the test. If students did well on the first test and were satisfied with their overall grade for the course they might have put less effort into the second test. This could have skewed the results. Due to this potential for decreased

effort the choice was made to take the average result of the two versions to gain a better overall result of the student performance.

The sample size for this study consisted of all the students from four separate cohorts, looking specifically at their junior year med-surg class. The cohort sizes varied from 16-31. Each cohort received a different number of hours of simulation experience. Due to the retrospective design the use of all the cohort students adds to the value of the data, however, it also limits the sample size as it is already pre-determined.

A logic model was created to determine resources, constraints as well as long and short term goals. The determined impact of this project could allow for significant curriculum changes with overall improved student outcomes. The timeline was approximately 18 months from start to finish. As this was a retroactive study, the data from the three previous cohorts was already completed and the fourth cohort was completed within a semester.

This was a retrospective, correlative study aimed at determining the relationship of hours of simulation and performance on a standardized examination. Utilization of the data to attempt to find a correlation of the variables involved. The independent variable was the number of hours of simulation experienced by undergraduate BSN nursing student and the dependent variable was mean scores achieved on the Health Education System Inc. (HESI) specialty medical-surgical exam. The focus was on four separate cohorts who received simulation hours in place of clinical experience from 5%-25% of total hours required within the medical-surgical clinical rotation. Cohort one received 5% (6 hrs), cohort two 10% (12 hr), cohort 3 received 20% (24 hrs), and cohort 4 received 25 % (30 hrs). To process this data an Analysis of variance (ANOVA) was used. This technique was used to analyze the differences among the 4 groups receiving different hours of simulation [16]. It was used to determine if the hours of simulation had an impact on student performance. This tool allows the comparison of multiple students within each cohort to create a visual representation of the data per cohort. The comparison of this data gave a better understanding of the relationship of the variables.

The results of the med-surg HESI specialty test was used as the primary outcome measure within this study. This test is a computerized test that includes questions that are weighted differently from easy to hard [4]. It is written similar to the National Council Licensure Examination (NCLEX)-style and tests the students' performance in a variety of nursing applications within the med-surg curriculum.

In addition to the overall score the test breaks down the student performance according to the nursing process sections (assessment, analysis, planning, implementation, evaluation). The scores for these areas was compared to further determine if the simulation impacted each section. The average score of version 1 & 2 per student for each section has been compared. The data collected is interval data as it will determine the degree of difference between the scores. It can be classified and ordered, and has specified differences between each interval. This data can be rank ordered, it is exhaustive and has equally spaced intervals.

Due to the type of data an ANOVA was used. The Levene's test of homogeneity of variances was measured to determine if the variances between groups was consistent. A robust test of equality of means was also run. Once the significance was determined the Post Hoc Bonferroni test was run. This allowed for a comprehensive comparison analysis for each group to one another to be conducted. This same process was followed for all the sections (Overall HESIscore, Assessment, Analysis, Planning, Implementation and Evaluation). The Overall score was looked at first, then each of the subsequent sub-sections.

Results

The independent variable was the hours of simulation received by each cohort. This was broken into the four groups of 6 hr, 12 hr, 24 hr and 30 hr. The dependent variable was the score of the HESI exam. The effect size was calculated as partial Eta Squared through SPSS. $F = 3.812$, $p = 0.013$. The Partial Eta Squared = 0.121(Table 2). This is considered a large effect size which would indicate that the effect of simulation hours on HESI scores is strong.

The data was gathered from the HESI test bank. The students were de-identified and the raw data for the version 1 and version 2 of each group was collected. This data included each students' individual overall score as well as the scores under each of the nursing process categories. The groups were labeled by the number of hours of simulation received and which version of the test. The two version scores were averaged to give an overall performance for each student in each of the six categories. The data was compiled in an Excel spreadsheet and then transferred into SPSS. The data was labeled in SPSS with simulation hours containing the four independent groups (6 hr, 12 hr, 24 hrs, 30 hrs) and each dependent variable labeled separately. An ANOVA was run for each of the dependent variables to compare the simulation hour groups, six in total. Each included descriptives, a Levene test of homogeneity and a comparison between groups. If this comparison was found to be significant then a post hoc test was run.

The ANOVA for overall HESI scores revealed descriptive statistics of mean scores for each dependent variable. The Hesiscore overall out of 87 students had a mean of 729.86, range 411.5-1085, and a standard deviation of 159.09 (Table 1). The overall assessment for the group had a mean of 742.79, range 327.5-1126, and a standard deviation of 185.76. The analysis mean was 703.36, range 236.5-1190 and standard deviation of 208.13. Planning mean for the 87 was 712.51, range 202.5-1150.5 and standard deviation of 226.01. Implementation mean was 742.26, range 265-1196 and standard deviation of 176.14. Finally, the evaluation mean was 705.28, range of 108.5-1428.5 and a standard deviation of 281.75 (Table 1).

Table 1: Overall mean for total population in primary and subsets

N=87	Mean	SD	Std. Error	95% CI for Means		Min	Max
				Lower Bound	Upper Bound		
Overall HESI	729.86	159.09	17.06	695.95	763.76	711.50	1085.0
Assessment	742.79	185.76	19.92	703.20	782.38	327.50	1126.0
Analysis	703.26	208.13	22.31	658.91	747.62	236.50	1190.0
Planning	712.51	226.01	24.23	664.34	760.68	202.50	1150.5
Implementation	724.26	176.14	18.88	704.72	779.80	265.00	1196.0
Evaluation	705.28	281.75	30.21	645.23	765.33	108.50	1428.5

Table 2

Tests of Between-Subjects Effects					
Dependent Variable: HESI score					
Source	Type III Sum of Squares	df	Mean Square	F	Sig
Corrected Model	263566.749[a]	3	87855.583	3.812	.013
Intercept	44438806.92	1	44438806.92	1928.110	.000
Simulation hours	263566.749	3	87855.583	3.812	.013
Error	1912972.205	83	23047.858		
Total	48520590.75	87			
Corrected Total	2176538.954	86			
a. R Squared = .121 (Adjusted R Squared = .089)					

The ANOVA for the HESIscore showed a between groups significance in mean scores (F=3.812, p=0.13). This lead to a Post hoc Bonferroni test to be run. The results of this test revealed a significant relationship between the 6hr group and the 12hr group (p=0.041, CI: - 30.48 - -3.76). It also revealed a significant relationship between the 6 hr and 24 hr groups (p=0.48, CI: 3285.81 - -0.796). The rest of the comparisons were not statistically significant. The scores were higher for the 12 hr and 24 hr groups when compared to the 6 hr group. This would indicate that simulation had an impact on the scores between 6 and 12 hr. There was not a saturation of scores so it can be concluded that simulation has its greatest impact on student knowledge at the 12 hr level for this sample.

This was repeated for the additional variables. Assessment is the only variable that had some significant findings. Scores improved between 6 hr and the 12 hr group (p= 0.001, CI: -364.4459- -70.2118), the 6 hr and 24 hr group (p<0.001, CI: -388.4969 - -107.7562) and the 6hr and 30 hr group (p=0.046 CI: -252.0872 - -1.4919). There was no significance between 12 and 24 hour groups however, which indicates once again that 12 hr of simulation within this study had the greatest impact on student scores (Figure 3).

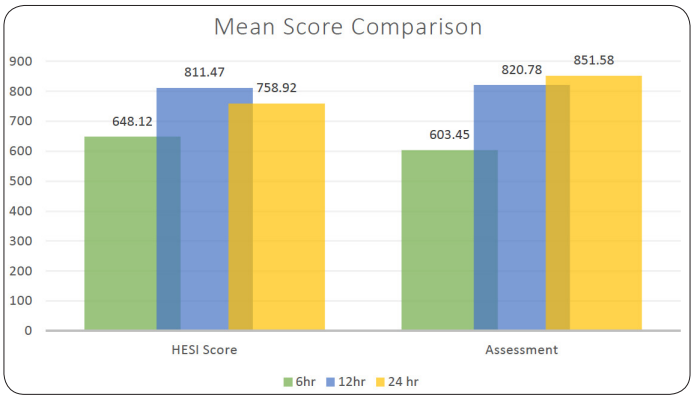

Figure 3

The results indicate the bare minimum of 6 hrs of simulation will have an impact on the overall HESI score and it will also impact the assessment variable scores within the test. There was a significant change in the overall HESI between the 6 hr and 12 hr group which would indicate that 12 hours of simulation in this sample had the greatest impact on overall HESI scores. The data does not appear to reach saturation one cannot prove that only 6 or 12 hours of simulation should be considered as all levels are statistically significant. One cannot prove that additional hours is a waste of time or that student learning has reached a plateau.

Discussion

The question about hours of simulation and impact on student learning is one that requires additional research. The results of this study make a good argument that simulation at minimum of 6 hours will have a positive impact on student learning. These results are exciting and can be used as a spring board for further research. Simulation should be utilized within the undergraduate nursing curriculum as it is shown to have a positive impact. A minimum of 6 clinical hours can be achieved without too large of an impact on a nursing program.

Limitations

Although the research reached its objectives there were several limitations identified within this study. First, the sample was a small convenient sample of 87 students. To generalize the findings the study should have included a larger, random sample size. Second, the simulations varied in content and execution between the cohorts. This lack of consistency between the cohorts could alter the HESI results. Finally, the simulations received by each of the cohorts were a mix of fidelity levels. This lack of consistency in the implementation of the simulation could affect student learning outcomes.

Recommendations

Recommendations going forward are to repeat this study accounting for some of the challenges that were faced. The first recommendation would be to give only one version of the standardized test to measure the results. A second is to ensure that the simulation hours received are given by consistent instructors with the same expectations from cohort to cohort. This study should be repeated with a more consistent cohort size who all have the same processes in simulation. All simulations should be high fidelity and not a mix of simulation fidelity between the groups. A final recommendation is to look at other core courses that have simulation hours to better capture overall student impact of simulation across the curriculum instead of only one course.

Implications for change

The implications for simulation in undergraduate nursing education will continue to evolve as more solid research is completed. Nursing programs are challenged to find quality clinical sites and they lack the ability to ensure that students are exposed to necessary skills and clinical experiences. Simulation can bridge the gap between theory and clinical and allow all students to experience specific skill sets to ensure they are ready to enter practice at the level that is required by facilities. The ability to expose students to every situation is not possible within an undergraduate curriculum. The use of simulation can help create an avenue for students to have guaranteed exposure to the foundational experiences and patients that will allow them successful entry into practice upon graduation [17-19].

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