STUDENT FACTORS AFFECTING SIMULATION LEARNING ON FETAL HEART RATE ASSESSMENT SKILLS AMONG NURSING STUDENTS IN PUBLIC MEDICAL TRAINING COLLEGES IN WESTERN KENYA

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Abstract

Globally, nursing education literature advocates the use of simulation learning in healthcare education as a means of enhancing students understanding of the various concepts. Simulation learning is affected by various factors that could either enhance or limit knowledge acquisition. This study was to examine the student factors affecting simulation learning in assessing fetal heart rate skills among Kenya Registered Community Health Nursing (KRCHN) diploma students in five Kenya Medical Training Colleges in the former western province of Kenya. The study employed analytical cross-sectional descriptive design approach and a study sample of 194 participants consisting of 1st year nursing students within the five colleges. The results indicate student perception regarding simulation learning, confidence levels and anxiety are important factors determining the effectiveness of simulation learning. The increase in students' confidence levels ($t=-24.9$, $p<0.0001$) in understanding the theory of fetal heart rate assessment after exposure to simulation reaffirms Benner's theory of skill acquisition.

Keywords: *Clinical Mentor /Preceptor, Clinical Placement, High Fidelity Mannequin, Partograph, Simulation, Simulator.*

1. Introduction

In nursing education, simulation has gained significant ground as a method of learning and equipping students with necessary practical skills (Flo, Flaathen, & Fagerstrom, 2013). Jeffries (2005) defines simulation practice as activities that mimic the reality of a clinical environment and are designed to demonstrate procedures, decision making, and critical thinking through techniques such as role-playing and the use of devices such as interactive videos or manikins. The use of simulation method has been in existence in high-risk industries and organizations like the military and aviation as a necessary tool to meet the training and risk management needs of these industries (Weller, Nestel, Marshall, Brooks & Conn, 2012). It has existed in nursing education in many forms,and the first healthcare simulation manikins were introduced in the early 1960s (Jeffries, 2005).

As science technology and education have progressed, simulation has become sophisticated and innovative learning and teaching approach encompassing a vast spectrum of educational modalities. Simulation method has been shown to enhance learners' skills as well as safety in various industries (Ziv, Wolpe, Small, & Glick, 2003). In healthcare profession, simulation learning is associated with enhancing clinical performance and this view is consistent with the belief that this method of learning is necessary for skill acquisition (Meyer, Connor, Hou, &Gajewski, 2011). Therefore, adequate training is thus essential since there have been cases where maternal heart rate has been mistaken for that of the fetus before the diagnosis of fetal death.

2. Methodology

Cross-sectional analytical design was used where data was examined at one point in time with the same subjects. Exploration of the relationship, correlation, and comparison between the variables was also carried out. This study was conducted at five Medical Training colleges located in the former Western Province of Kenya. A simple random sampling procedure was used to enlist 194 participants drawn from first-year nursing students. Ethical clearance to conduct the study was

approved by Masinde Muliro University of Science and Technology, Ethical Review Committee. Further, permit was also granted by National Council for Science &Technology (NACOSTI). Questionnaires for this study were adapted from the West Yorkshire Nursing Simulated Practice Pilot (WYNSPP)and modified to suit our context (Nursing and Midwifery Council, 2008).The Likert method was used to collect subjective data whereby confidence levels of the nursing students were assessed using a 5-point Likert scale. Pre-theory was done followed by pretest then briefing and subsequently simulation. After simulation, students were taken through a briefing process. The assessment was carried on the computerized model by the students after briefing and debriefing carried out after the assessment had been conducted. The student's perception was collected by pre and post questionnaires. At the end of the of each data collection session, the questionnaires were checked for completeness and consistency. The data was cleaned, sorted out and coded for easy entry into SPSS (Carver & Nash, 2012). A p-value of 0.05 was considered statistically significant. Descriptive statistics were used for easy presentation and interpretation of data. Dependent sample t-test was used to determine the relationship between the study variables and pre-post test scores.

3. Results and Discussions

3.1 Social-demographic of the students

To evaluate the simulation method of teaching the FHR assessment in the five training institutions and their corresponding hospitals, a total of 194 students were randomly selected to take part in the study. Results on their socio-demographic characteristics showed that 93.3% were aged between 20 – 24 years with a mean age of 23.2±0.9 years ranging from 20 to 26 years. MTC 1and MTC 3 had the highest proportion of students in this age category (97.5%). There were more females (55.1%) students in the sample compared to their male counterparts (44.9%). MTC 2, MTC 3and MTC 5contributed the highest proportion of female students with each having over 57%. All the randomly selected students met the inclusion criteria of being in the regular program as shown in table 1.

Table 1: Social Demographic of Students

Variable	Categories	MTC 1	MTC 2	MTC 3	MTC 4	MTC 5	Total
		N (%)	N (%)	N(%)	N (%)	N(%)	N (%)
Age group in years	20 – 24	39 (97.5)	38 (95.0)	39 (97.5)	35 (89.7)	30 (85.7)	181 (93.3)
	>25	1 (2.5)	2 (5.0)	1 (2.5)	4 (10.3)	5 (14.3)	13 (6.7)
	Total	**40**	**40**	**40**	**39**	**35**	**194**
Mean age±SD (Range)		23.2±0.8 (22 - 25)	23.0±0.9 (22 - 25)	23.0±0.8 (22 - 25)	23.6±0.9 (22 - 26)	23.2±1.2 (20 - 26)	23.2±0.9 (20 - 26)
Gender	Male	19 (47.5)	17 (42.5)	17 (42.5)	19 (48.7)	15 (42.9)	87 (44.9)
	Female	21 (52.5)	23 (57.5)	23 (57.5)	20 (51.3)	20 (57.1)	107 (55.1)
	Total	**40**	**40**	**40**	**39**	**35**	**194**
Student program	Regular (N)	40 (20.6)	40 (20.6)	40 (20.6)	39 (20.1)	35 (18.0)	194

3.2 Students' Knowledge of Assessment of FHR before simulation sessions

A self-assessment of students' knowledge of the FHR assessment before simulation sessions showed that more than three-quarters (75%) had a poor knowledge. Figure 1 below shows the proportion of students in the five colleges on the basis of their knowledge of taking fetal heart rate assessment prior to simulation session.

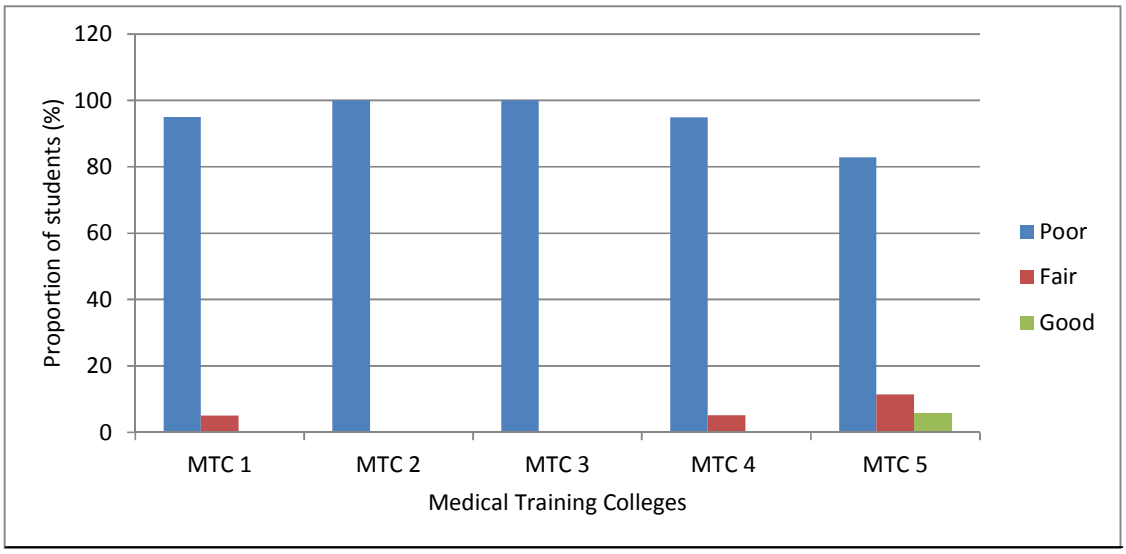

Figure 1: Students' knowledge of FHR assessment before simulation sessions

3.3 Student self-assessment following exposure to a simulation session

According to lecturers, new clinical practice such as FHR monitoring is introduced to students through competency-based training. With specific reference to the number of hours devoted for teaching FHR assessment in skills in classroom range between 1 hour in Vihiga, MTC 3 and MTC 4 MTC to 2 hours in MTC 2 and MTC 5. More time is however spent skills lab practical with a range of 3 hours in Vihiga, MTC 3and MTC 4 MTCs to 4 hours in MTC 2 and MTC 5. Apparently, the latter two MTCs spent more time (2 hours) teaching the same in the classroom compared with former training institutions (1 hour) as illustrated in Table 4.2. According to the lecturers, it is not possible to estimate the number of additional practice hours set aside by lecturers for each student as they are few and students are many. The point was confirmed by the ratio of staff to students which stood at 1:80. Usually, OSCEs or practical assessments are used as a way of evaluating students' competence in taking FHR measurement.

Table 2: Student self-assessment following exposure to a simulation session

Variable	MTC 1	MTC 2	MTC 3	MTC 4	MTC 5
How new clinical practice is introduced in the skills lab	Through competence training	Through competence training	Through competence training	Through competence training	Through competence training
Number of hours allocated for teaching FHR assessment skill in classroom	1	2	1	1	2
Number of hours allocated for teaching FHR assessment skill in skills lab	3	4	3	3	4
Number of additional practice hours scheduled for each student and supervised by lecturer	Not possible to tell lecturers are few and students are many	Not possible to tell lecturers are few and students are many	Not possible to tell lecturers are few and students are many	Not possible to tell lecturers are few and students are many	Not possible to tell lecturers are few and students are many
Staff/student ratio in skills lab sessions	1:80	1:80	1:80	1:80	1:80
How assessment on competence in measuring FHR is conducted	OSCE	OSCE	Practical assessment	OSCE	Practical assessment

3.4 Student self-assessment following clinical session

In the clinical area, students are introduced to clinical skills related to FHR assessment after the Introductory Block in the 1st Semester as shown in Table 4.3. New clinical practice is introduced in the clinical areas during workshops in all the MTCs. In addition, MTC 1, MTC 2 and MTC 5 organize Continuing Education sessions for the same purpose. Students spent at least 2 hours on FHR measurement as part of their clinical experience before being allowed to undertake the procedure on clients. They also benefit from several additional practice hours where each student is supervised by a supervisor. Mostly, such supervision is provided when the ward is not busy. Notably, staff-student ration was highest in MTC 1 and MTC 4 which reported a ratio of 1:80 as compared to MTC 2 and MTC 5 which had a ratio of 1:40. Students' competency is basically assessed through OSCE where they perform the procedure under the watch of a supervisor.

Table 3: Student self-assessment following clinical session

Variable	MTC 1 Hospital	MTC 2 Hospital	MTC 3 Hospital	MTC 4 Hospital	MTC 5 Hospital
When students are introduced to clinical skills related to FHR assessment skills	After Introductory Block 1st semester	After Introductory Block 1st semester	After Introductory Block 1st semester	After Introductory Block 1st semester	After Introductory Block 1st semester
How new clinical practice is introduced in the clinical area	Workshops Continuing education sessions	Workshops Continuing education sessions	Workshops	Workshops	Workshops Continuing education sessions
Duration spent on FHR measurement in the clinical area	2.0	Uncountable	Uncountable	2.0	Uncountable
Number of additional practice hours when each student is supervised by registered nurse	Not possible to count as patients are a priority	So long as the wards are not busy we can afford time for students	So long as they are on duty	Not possible to count as patients are a priority	Depends when the ward is not busy
Staff/student ratio in the clinical placement	1:80	1:40	1:60	1:80	1:40
How student's competence is assessed in the clinical area	OSCE	By performing the procedure	Through assessments in the clinical area	Through assessments in the clinical area	Through assessments in the clinical area

3.5 Comparison of student self-assessment in the level of confidence and competence following exposure to a simulation method and clinical experience

A comparison of the mean of student self-assessment after exposure to the simulation method and clinical competency in assessing FHR was done by students responding to the Likert Scale items on the questionnaire. The two samples taken in the training institutions and the clinical area were treated as dependent samples as the same students interviewed and assessed in the training institution were the same group followed up in the clinical area and interviewed and assessed using the same instrument. Thus, the samples could be paired in the two study settings and were thus treated as matched pairs.

To determine the effectiveness of student exposure to simulation teaching in preparing 1st year nursing student in the assessment of FHR using fetal monitoring machine in the clinical setting, it was important to establish changes in students' confidence and competency levels before and after reporting in the clinical area. Differences between pretest and posttest means were tested by applying a paired-sample t-test to each of the items assessed. The results are presented in table 2. The table displays mean scores on each item for the pretests and posttests.

Table 4: Comparison of student self-assessment in the level of confidence and competence following exposure to a simulation method and clinical experience

Item	Exposure to simulation method (n=194)	Clinical experience (n=194	Difference	t	df	p value
	M±SD	M±SD				
Confidence in understanding of theory of assessing FHR	1.2±0.5	2.0±0.2	-0.82	-24.9	193	<0.0001
Level of competence in assessing FHR	1.1±0.2	2.0±0.2	-.0.96	-48.6	193	<0.0001
Number of times practiced taking a manual FHR	3.1±2.9	22.1±9.6	-18.93	-25.3	193	<0.0001

Except for the number of times student practiced taking an electronic FHR, the difference between means is statistically significant for each item. There was statistically significant improvement in confidence level in understanding of theory of assessing FHR ($t=-24.9$, $p<0.0001$), level of competence in assessing FHR ($t=-48.6$, $p<0.0001$) and the number of times practiced taking a manual FHR ($t=-25.3$, $p<0.0001$) revealing substantial improvement in the items examined. Given the significant paired-sample t-tests, it can be concluded that students' confidence and competency levels were greater in the clinical area than at the time they were being assessed in the skills lab after exposure to simulation method of teaching. It is also evident that the number of times students practiced taking FHR using manual method had significantly increased while in the clinical area.

3.6 Comparison of student's self-assessment regarding readiness for FHR assessment following exposure to a simulation method and clinical experience

Student self-assessment following exposure to simulation teaching method in the skills lab and during the clinical experience was conducted. Students individually completed the self-assessment immediately after simulation teaching on how to take FHR measurement. They were not given copies of the self-assessment before conducting the simulation. After completion of the self-assessment in the skills lab (pre-test) they were then subjected to taking FHR in the clinical area and instructed to complete the same self-assessment of their performance a second time (post-test).

During the post-test self-assessment, students were asked for their perceptions regarding the achievement of the simulation method of teaching (Table 3).

Table 5: Comparison of student's self-assessment regarding readiness to taking FHR measurement following exposure to a simulation method and clinical experience

Item	Exposure to simulation method (n=194)	Clinical experience (n=194	Difference	t	df	p-value
	M±SD	M±SD				
I am more anxious about undertaking new skills for the first time in skills lab/clinical practice	1.9±1.1	3.1±0.9	-1.18	-10.5	193	<.0001
I feel more confident in the application of theory in the skills lab about the taking and recording of FHR	1.5±0.7	3.0±0.8	-1.582	-20.1	193	<.0001
I feel well prepared to perform the skill of fetal heart measurement and recording in practice	1.6±0.8	2.9±0.8	-1.29	-15.8	193	<.0001

Student self-assessment scores in skills lab and in the clinical area were significantly different on items asking about level of anxiety about undertaking new skills for the first time in skills lab and clinical area ($t=-10.5$, $p<0.0001$); confidence in the application of theory in skills lab in relation to taking and recording FHR ($t=-20.1$, $p<0.0001$) and level of preparedness to perform the skill of FHR measurement and recording ($t=-15.8$, $p<0.0001$).

3.7 Comparison of lecturer/supervisor assessment of student's performance for FHR assessment following exposure to simulation method and clinical experience

Students were assessed by lecturers in the skills lab and in the clinical area by clinical supervisors following exposure to simulation teaching method in the skills laboratory and during the clinical experience. Lecturers and supervisors individually completed the Likert Scale assessment instrument immediately after simulation teaching and during the clinical experience on student's preparedness, knowledge of the procedure relating it to practice on FHR and student level of confidence.

The scores in skills laboratory and in the clinical area were significantly different on items assessing student's knowledge on the relationship between knowledge and practice ($t=-7.4$, $p<0.0001$); confidence in the application of theory ($t=-7.8$, $p<0.0001$) and ability to ask questions relating to the recording and interpretation of fetal heart monitoring ($t=-7.1$, $p<0.0001$).

Table 6: Comparison of lecturer/supervisor assessment of student's performance on FHR following exposure to simulation method and clinical experience

Item	Exposure to simulation method (n=194)	Clinical experience (n=194	Difference	t	df	p value
	M±SD	M±SD				
The student had a sound understanding of the relationship between knowledge and practice	2.6±0.8	3.2±0.8	-0.60	-7.4	193	<0.0001
The student was confident in the application of knowledge in the clinical areas or expressed confidence	2.6±0.9	3.4±0.7	-0.70	-7.8	193	<0.0001
The student was able to ask questions relating to the recording and interpretation of fetal heart monitoring	2.6±0.8	3.4±0.7	-0.61	-7.1	193	<0.0001

The differences in student perception, knowledge and confidence levels pre and post-exposure to simulation, therefore, affirm that there was advancement from one competency level to another. The positive response following exposure to simulation and subsequent application of the gained knowledge in the clinical area by the participants confirmed the efficacy of Benner's theory as far as the increase in competency level is concerned.

Student factors play an important role in determining how nursing students integrate the concepts they are taught through simulation learning. A research study by Nel and Stellenburg (2015) showed that nursing students felt more competent and confident after practicing on human subjects than on simulator models. The findings by Nel and Stellenburg (2015) are consistent with the findings of this research as far as student perception of simulation learning is concerned. Our findings indicated that the level of student competency, as well as confidence, was higher in the clinical area than in the skills laboratory after exposure to simulation method of learning. This was also demonstrated by an increase in the frequency of FHR measurement while in the clinical area compared to the skills laboratory.

The findings of this study support that of Baptista *et al.,* (2014) that increased student's satisfaction often resulted in the use of simulation learning. The research by Nel and Stellenburg (2015) further argues that simulation is an important learning approach in ensuring a good foundation base, but students' perception of increased competency often occurs after practicing what they have learned on human subjects. There have been various research studies that have attempted to explain the observed differences in student nurses competency as observed in the skills lab and the clinical area. According to McCaughey and Traynor (2010), the majority of students (95%) often tend to apply the skills and knowledge gained from simulation learning in the clinical setting. Even when high fidelity simulation is used, the perception that exists among student nurses is that the mannequin is not a real human being and this then hinders the students from fully immersing themselves into the scene while in the skills laboratory (Au, Lo, Cheng, Wang, & Van, 2016). The

observed differences in the competency levels in this study affirm that student perception is an important factor that influences simulation learning.

The differences between clinical and skill laboratory competency observed could be explained based on the argument that simulation only provides experiential learning and thus cannot replace the exposure value that is gained when students are exposed to the real patient (Bilings & Halstead, 2015). Secondly, based on the aforementioned argument, high competency observed in the clinical area could be as a result of increased student immersion into the scenario which might be lacking in the skills laboratory area because of student's prior perception regarding simulation practice. Simulation learning is limited in terms of not being able to provide student nurses with real experience.

Other student factors that were explored in this study related to student's perception of their readiness to engage in FHR assessment through simulation learning and clinical placement. Higher mean scores realized during post-test compared to pre-test self-assessment and statistically significant differences in the mean before and after, it can be concluded that the simulation method of teaching has a positive effect on students' self-perception on their level of anxiety, confidence in applying theory to practice and preparedness to perform required skills.These findings are consistence with those of the study by Waldner and Olson (2007) who'sopinion was that student nurses are likely to benefit from simulation learning as this enables them to lower their anxiety and expose them to rare experiences that would enhance their knowledge acquisition. The implication of this finding is that participants in the present research studies, being at the novice and advanced beginner stages based on Benner's model, were able to refine their knowledge upon exposure to simulation learning.

In nursing education, simulation has gained significant ground as a method of learning and equipping students with necessary practical skills (Flo, Flaathen, & Fagerstrom, 2013). Among the student factors that influence learning by simulation method include student attitudes, prior knowledge, and student demographic factors such as gender, age, and student diversity. With regards to demographic factors, gender differences also influence the response of students to new technology which in itself is an element of simulation. According to research, male students tend to acclimatize easily to the introduction of simulation training that incorporates a high level of technology compared to their female counterparts (Van Gelderden., 2012).

Student's prior knowledge is also an important factor affecting learning by simulation. It is more likely that prior knowledge in an area would serve as a base where information can be sought by the student to deal with the presented simulation learning activity. While research has established that prior knowledge is important in explaining clinical problem-solving performance (Stuart, 2013), the same implications could also apply to senior nursing students than in junior nurses (novice).

Student attitudes also play an important role in determining the effectiveness of simulation-based learning. The attitude may either be positive or negative towards a simulation method. Research by Brynildsen, Bjørk, Berntsen, and Hestetun (2014) asserts that students might have differing opinions on certain methods of simulations that may either hinder or enhance their learning. For instance, the view that a certain simulation method is difficult or does not represent reality may tend to hinder or negatively influence the learning activities of these students. If a simulation

method is however viewed on a positive light such as it may seem interesting to students, it is possible that students will readily accept it.

4 Conclusions and Recommendations

4.1 Conclusion

This research study affirms that student factors impact simulation learning in nursing education. Student factors including their perception and satisfaction are important factors to consider when assessing the effectiveness of simulation learning. The findings of this study are consistent with previous studies that have focused on students' perception regarding the use of the simulation method. Knowledge of the impact of these factors in simulation learning is important because it provides mentors and nurse educators with an avenue of assessing student's knowledge gain.

4.2 Recommendations

There is need for nursing students to be provided with additional hours of simulated classes prior to conventional clinical training.

Nursing educators should seek to enhance learner engagement and this can be achieved through debriefing section that take into consideration the student factors that affect simulation learning.

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