PILOT STUDY: A NOVEL APPROACH TO CASE-BASED INSTRUCTION OF MEDICAL STUDENTS USING SIMULATION EDUCATION

A Thesis submitted to the University of Arizona College of Medicine -- Phoenix
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Dedication

To my wife who has not only supported me throughout medical school and this project, but has been a fantastic wife and mother throughout and gone the extra mile to impart her expertise when it was needed.

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Abstract

This pilot project explores medical student preference regarding simulation education in case based instruction (CBI) compared with the traditional Power Point lecture CBI. The study population consisted of volunteer first, second, third, and fourth year medical students. The subjects were randomized into control (traditional CBI) and intervention (simulation CBI) groups and preference data was collected via pre- and post-survey administered before and after the activity. Preference was limited to enjoyment of learning activity and opinion of benefit on exams of the learning activity. T-tests were applied to the data in order to determine statistical significance. Enjoyment of the simulation activity was determined to be higher post-simulation activity in the intervention group compared to the control group. While opinion that simulation CBI may be beneficial in regard to exam scores and knowledge retention was above neutral for the two groups, this study did not determine a significance in opinion between the control and intervention groups. The study results suggest that students who have experienced a simulation CBI enjoy them more compared to the traditional CBI and are more in favor of changing the current model of case-based instruction.

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Introduction

Despite well-validated studies elucidating the value of simulation education in the clinical 3rd and 4th years of medical school as well as in Resident education (Huang et al., 2012), the first and second year basic science curriculum remains an underdeveloped opportunity for pre-clerkship education and preparation (Harris, D. M., Ryan, K., & Rabuck, C., 2012). Simulation education has shown to have a positive impact on resident education and assessments of simulation education for medical residents via core competencies have been developed to further improve the experience (Rosen, M.A. et al., 2008). Implementing medical simulation into pre-clinical basic science medical education is important in order to establish an active learning environment which has been documented to have positive results on learning (Richardson, D., & Birge, B., 1995). Studies and implementation of simulation into pre-clinical years of medical school offers the opportunity to improve learning and assessment of students.

Simulation also affords the student or trainee the prospect of practicing skills and asking questions in a safe environment (Satava, R.M., 2009). Facilitators and instructors can correct mistakes and answer questions without the possibility of harming a live patient (Spooner, N., Hurst, S., Khadra, M., 2012).

Kyrkjebo, et al. (2006) stated that even when health sciences students receive specific and factual details in the various health specialties, they get little or no hands-on training or training in a team environment. Lujan, et al. (2005) demonstrated that pre-clinical medical students rarely prefer one learning style and most of the time prefer learning through multiple modalities. These modalities include visual, tactile, auditory, visual, and kinesthetic learning styles. Simulation education offers multiple learning modalities for students nearly simultaneously throughout the activity.

Offering first and second year medical students the opportunity to participate in simulation activities allows them the chance to learn through many different modalities in a safe environment leading to a more effective learning activity. The hypothesis of this study is that students will prefer to participate in a simulation activity compared to a traditional small group

lecture activity with preference determined by enjoyment and possibility of performing better on exams.

Research Materials and Methods

Subjects in this study were first, second, third, and fourth year medical students recruited as volunteers through IRB approved recruiting materials. The subjects were asked to attend one three hour simulation activity in the evening at the Simulation Center at the Health Science Education Building (HSEB) on the University of Arizona – College of Medicine-Phoenix campus. Once the subjects arrived they were given a pre-survey on paper and randomized into intervention and control groups via random.org. There were nine subjects in both the control and intervention groups totaling 18 subjects.

The control group was subjected to a traditional PowerPoint case-based instruction. They were divided into two groups with two separate facilitators with the same instructions and the same PowerPoint presentation. The case used was a novel case written by the author and the principal investigator on the study. The case involved a female patient with bilateral joint pain arriving in the emergency room where she would find her new diagnosis of rheumatoid arthritis. The subjects in the control group were to develop and present brief learning objectives pertinent to the case being presented. Upon finishing the case and learning objectives, the subjects were given a post-survey.

The intervention group was presented with a simulation version of the rheumatoid arthritis case. The subjects were divided into two groups with two physician facilitators per group. Each group was subjected to the same case with the same instructions. The subjects in the intervention group were tasked with obtaining a history and physical exam of a simulated patient. The simulated patients were interactive manikins (SimMan3G™) provided by the Simulation Center and voiced by simulation center staff, who followed a script. While in the simulation center the two facilitators in each room were able to provide the necessary information to the participants in order for them to develop learning objectives. Upon developing learning objectives, group discussion of learning points followed. After group discussion of the case, a treatment plan was developed for the simulated patient. The subjects were then required to explain the treatment plan to the simulated patient.

Part of the treatment plan and workup of the simulated patient involved obtaining a joint aspiration of the effusion of the affected joint(s). After finishing the patient encounter the subjects were then required to perform an arthrocentesis on Syndaver simulation knees. During the procedure participants explained the significance, complications, and contraindications of the procedure. The students were then given the post-survey after they had completed the procedural portion of the activity.

The pre- and post-surveys administered during this activity were developed for the activity and consisted of a paper questionnaire based on learning styles, enjoyment of traditional case based instruction, participation in previous simulation events, and enjoyment of simulation events. The questions were asked on a 5 point Likert scale, 1 being “not at all agree” and 5 being “completely agree.”

Results

The scaled scores were compiled for each question on the survey and post test results from the control and intervention groups were compared. Statistical analysis was performed using t-tests to determine statistical significance. Statistically significant results are included in Table 1 and Table 2. Subjects in the intervention group differed significantly from the control group on 3 questions from the survey.

The first divergence was for the question, “I enjoy the traditional small group, power point version of CBIs.” Subjects in the control group (mean = 4.11) indicated statistically significant higher enjoyment scores, with a p-value of .015, than the intervention group (mean = 3.11) in the post-survey.

The next significant question from the survey was,”I would prefer to do more CBIs as simulations because I would enjoy the learning method more than the traditional CBIs.” The intervention group (mean = 5.00) differed significantly with a p-value of .008 from the control group (mean = 3.67). This indicated a preference toward more CBIs as simulations because of enjoyment of the learning method over traditional CBIs.

The last significant question from the post-survey was ‘I would prefer that CBIs stay exactly as they are currently’. The intervention (mean = 1.67) and control groups (mean = 2.78) differed significantly with a p-value of .001. The control group indicated a stronger preference to keep CBIs exactly as they are when compared with the intervention group.

The data from the other questions in the survey can be found in Table 3 and Table 4.

Table 1

Significant Group Statistics

I enjoy the traditional small group, power point version of CBIs	N	Mean	Std. Deviation	Std. Error Mean
Control Group	9	4.11	.928	.309
Intervention Group	9	3.11	.601	.200
I would prefer to do more CBIs as simulations because I would enjoy the learning method more than traditional CBIs				
Control Group	9	3.67	1.323	.441
Intervention Group	9	5.00	0.000	0.000
I would prefer that CBIs stay exactly as they are currently				
Control Group	9	2.78	.667	.222
Intervention Group	9	1.67	.500	.167

Table 2

T-test for Significant Group Statistics

	Levene's Test for Equality of Variances		t-test for Equality of Means						
								95% Confidence Interval of the Difference	
	F Variable (F)	Sig.	t	Degrees of Freedom (Df)	Significance (Sig.) (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
I enjoy the traditional small group, power point version of CBIs	.539	.473	2.714	16	.015	1.000	.369	.219	1.781
			2.714	13.706	.017	1.000	.369	.208	1.792
I would prefer to do more CBIs as simulations because I would enjoy the learning method more than traditional CBIs	17.920	.001	-3.024	16	.008	-1.333	.441	-2.268	-.399
			-3.024	8.000	.016	-1.333	.441	-2.350	-.316
I would prefer that CBIs stay exactly as they are currently	.291	.597	4.000	16	.001	1.111	.278	.522	1.700
			4.000	14.837	.001	1.111	.278	.518	1.704

Table 3

Statistically Insignificant Group Statistics

I learn more from the traditional small group, power point version of CBIs than from classroom lectures	N	Mean	Std. Deviation	Std. Error Mean
Control Group	9	3.67	1.118	.373
Intervention Group	9	3.44	.882	.294
I would prefer to do more CBIs as simulations because I believe I would do better on tests compared to traditional CBIs				
Control Group	9	3.22	1.302	.434
Intervention Group	9	3.89	.928	.309
I would prefer to include Standardized patients into CBIs because I would enjoy the learning method more than traditional CBIs				
Control Group	9	2.89	1.691	.564
Intervention Group	9	3.56	1.130	.377
I would prefer to include Standardized patients into CBIs because I believe I would do better on tests compared to traditional CBIs				
Control Group	9	2.89	1.691	.564
Intervention Group	9	3.11	1.167	.389

Table 4

T-test for Statistically Insignificant Group

	Levene's Test for Equality of Variances		t-test for Equality of Means						
								95% Confidence Interval of the Difference	
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
I learn more from the traditional small group, power point version of CBIs than from classroom lectures	1.346	.263	.468	16	.646	.222	.475	-.784	1.228
			.468	15.177	.646	.222	.475	-.788	1.233
I would prefer to do more CBIs as simulations because I believe I would do better on tests compared to traditional CBIs	.332	.573	-1.251	16	.229	-.667	.533	-1.796	.463
			-1.251	14.462	.231	-.667	.533	-1.806	.473
I would prefer to do more CBIs with interprofessional student teams because I would enjoy the learning method more than traditional CBIs	.294	.596	-1.516	15	.150	-.708	.467	-1.704	.288
			-1.497	13.581	.157	-.708	.473	-1.726	.310
I would prefer to do more CBIs with interprofessional student teams because I believe I would do better on tests compared to traditional CBIs	.566	.463	-1.429	16	.172	-.556	.389	-1.380	.269
			-1.429	15.835	.173	-.556	.389	-1.381	.270
I would prefer to include Standardized patients into CBIs because I would enjoy the learning method more than traditional CBIs	3.693	.073	-.983	16	.340	-.667	.678	-2.104	.771
			-.983	13.957	.342	-.667	.678	-2.122	.788
I would prefer to include Standardized patients into CBIs because I believe I would do better on tests compared to traditional CBIs	3.410	.083	-.324	16	.750	-.222	.685	-1.674	1.230
			-.324	14.207	.750	-.222	.685	-1.689	1.245

Discussion

The purpose of this study was to determine if medical students have learning style preferences for simulated CBI activity over a traditional PowerPoint, facilitator-lead CBI. Preference was to be determined by the enjoyment the students experienced during the simulation portion and whether they believed the simulation activity would be beneficial for future test taking.

The data from the study show that the students in the intervention group, after having the experience of the simulation activity, found the simulation CBI more enjoyable compared to a traditional CBI and felt more strongly that the current traditional CBI format should be changed. This suggests that because the students who personally were able to experience a more enjoyable model of case based instruction were more open to the idea of changing the current CBI model to a model with more integration of simulation.

Interestingly, the data show that the two groups did not differ on their opinion whether a simulation CBI would help them perform better on an exam compared to the traditional CBI. The means of both groups were above the neutral score of 3 at 3.22 for the control group and 3.89 for the intervention group suggesting that the students still may believe that the simulation would be beneficial on exam, but the experience of the simulation may not be a factor in their opinion of the relationship of a simulation CBI and exam scores.

The data suggest that while experiencing a simulation CBI affects the opinion of how much the students enjoy a simulation CBI compared with a traditional CBI, it does not affect their opinion of whether or not it will affect their ability to perform better on exam after a simulation CBI compared to a traditional CBI.

Limitations to this study include a low number of participants, resulting in low power. Inclusion of first through fourth year medical students may have skewed the results, as learners were at different levels in their education. Finally, selection bias may have been a factors, as the students that volunteered for the activity may be more interested in simulation learning opportunities compared to other students, given that they volunteered for this type of opportunity. The number of participants was powerful enough to obtain statistically significant data, but it was not powerful enough to perform more complex data analysis. This study was a

pilot study to determine student preference of simulation versus traditional CBI and the number of participants succeeded in that regard. The inclusion of all years of medical students includes students of different knowledge levels and students which have passed basic science curriculum which may be a problem for future studies in determining knowledge gained, but it was sufficient for determining preferences in this study. Opinions of the students that sought out this opportunity may be different than a typical medical student, but all of the students in the study sought out the opportunity so it may be reasonable to put the participants in a modestly comparable group.

Future Directions

This study showed that students who have experienced a simulation CBI find simulation CBIs more enjoyable compared to the traditional model. It also showed that the same students were more of making the innovative change of traditional CBIs into simulation CBIs. It would be interesting for future studies to be able to integrate simulation CBIs into basic science curriculum in order to determine the ability of simulation as a teaching tool. It would be important to determine if simulation enhances learning and memory of learning objectives in a manner that quantifiably increases, decreases, or has no impact on test scores. It is imperative that simulation is used in order to fortify and utilize medical advancements (Ziv, A., et al. 2003), but it must be with demonstrable benefits to outweigh the costs in terms of faculty, staff and simulation center time and supplies.

Another interesting study would be to determine the cost effectiveness of simulation in basic science curricula. Simulation undoubtedly carries a higher cost than more traditional learning modalities, but it would be important to determine if the simulation has a high enough benefit to justify the cost. The most important benefit would be increased learning, but being able to enjoy a learning activity, the benefit of possibly interacting with a team in basic science years of medical school (Zwarenstein, M., et al., 2001), etc. Simulation has been shown to have a higher retention rate than other learning modalities (Okuda, Y., 2009), but it is yet to be seen if this carries over to the basic science portion of medical school.

Conclusions

The level of enjoyment that the students experienced with a simulation CBI was shown in this study. While the results of the data did not necessarily state that experiencing a simulation activity changes the opinions of its ability to improve exam scores, it is still important to actually determine its ability to do just that. And this study is an important step in integrating simulation into curricula or to finding new strategies to improve learning in the basic science years of medical school. Simulation is a new and emerging teaching modality in medical education, and it is important that medical professionals effectively utilize the available technology, and utilize it in such a way to ultimately improve patient outcomes (Ladden et al., 2006). This pilot study is a essential early phase for determining how to utilize medical simulation throughout all levels of training in the medical field in an evidence-based manner.

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