

# Comparing Clinical Learning Effectiveness among Lecture-Based Training, Simulation-based Training and Training using Animal Tissue Models

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## Abstract

**Background:** To compare simulation-based teaching (SIM), lecture-based teaching (LEC), and teaching using animal tissue (ANT) in terms of student's satisfaction, knowledge gain and learning efficiency.

**Method:** All the students who attended the courses organized by the CSTC from 1<sup>st</sup> Jan 2013 to 31<sup>st</sup> Dec 2015 were enrolled in the study. Data were collected using a questionnaire delivered at the end of the course. The questionnaire contained 15 questions using a ten-point Likert scale to rate the students' satisfaction of the course and also the competence before and after the course.

**Result:** 5024 questionnaires were collected with a response rate of 67%. Students demonstrate a higher post-courses score in SIM, LEC, and ANT ( $P < 0.001$ ). However, neither one course performed better than the others. Student satisfaction was similar among the three courses. When specifically asked to compare the teaching effectiveness of SIM or ANT with LEC, our study showed that the answer is positive with median score of 8 for both.

**Conclusion:** SIM, LEC, and ANT courses are effective teaching modalities. They are equally acceptable for student with similar satisfaction. When compared with LEC courses, students perceived that SIM or ANT courses were more effective in learning.

**Keywords:** LEARNING EFFECTIVENESS, LECTURE, SIMULATION

*Journal of Medical Education Winter 2018; 17(1):19-24*

## Introduction

Traditionally, lectures are considered the most effective mode of information transfer amongst instructors and participants in medical education. In recent decades, simulation-based learning and teaching using animal tissue have become an attractive

educational modality.

Simulation provides a safe setting for repeated practice. Learning is facilitated through immersion, reflection and debriefing. Many researches demonstrated that simulation improves knowledge, skill performance, critical thinking and satisfaction (1). Yet, simulation-based teaching is more resource-intensive, considering the cost of simulators, long preparation time and higher instructor-to-participant ratio. Therefore, to make the best use of limited resources, evaluation of the effectiveness of different approaches used in medical education is necessary (2).

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## Background

With advances in science, technology and knowledge, skill of health-related disciplines is expanding. Commenced in 2009, the NTWC Clinical skills training centre (CSTC) provides on-job-training to health care professionals including doctors, nurses and allied health care worker.

Since the establishment, the center had organized around 100 courses per year, including life support course, pain management, suture course, and ventilator care workshops, etc. Total participants reach more than two thousands per year. Most of them are medical and nursing staff, accounting for about 75% of all participants in 2016.

In general, the courses organized by CSTC are divided into three categories. They are Lecture-based training (LEC), Simulation-based training (SIM) and Training using animal tissue (ANT) (Table 1).

The aim of this study is to compare LEC, SIM and ANT in terms of participants' satisfaction, knowledge gain, and learning efficiency.

## Methods

### Study Design

This study was designed to measure participants' satisfaction and knowledge gains

and compare the learning efficiency among LEC, SIM and ANT. The subjects of this study were the participants who attended the courses organized by the CSTC during the period of 1<sup>st</sup> Jan 2013 to 31<sup>st</sup> Dec 2015.

### Study Protocol

Each participant attending the courses organized by the CSTC will receive a questionnaire (Figure 1) at the end of the course. The questionnaire contains 15 questions using a ten-point Likert scale to rate participants' satisfaction about course and their competence before and after the course (Appendix A).

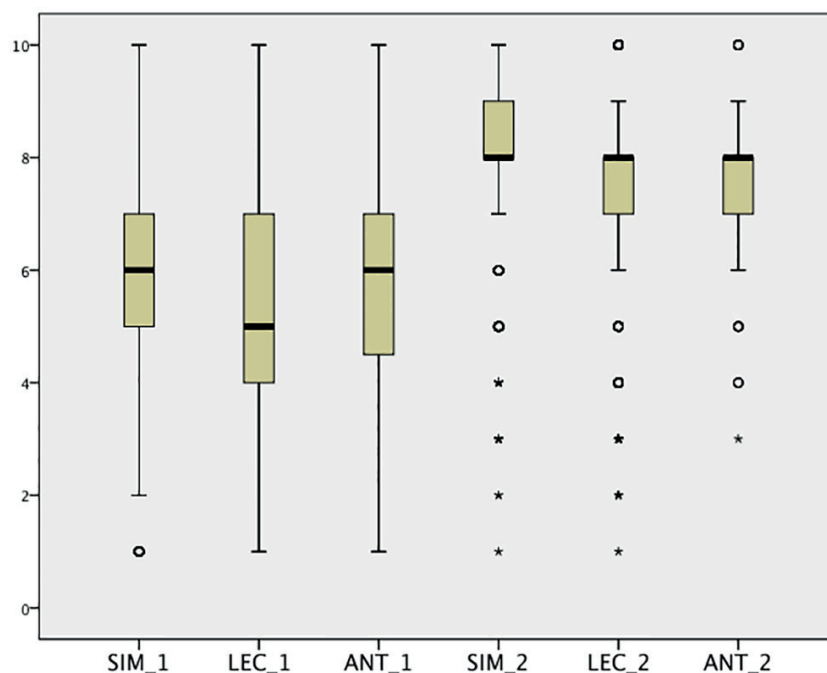
To ensure confidentiality, entry of all personal data was optional. The study protocol was approved by the New Territories West Cluster Clinical and Research Ethics Committee (NTWC CREC) in January 2016.

The courses were categorized into 3 types:

1. SIM: It is an imitation of real-life situations without utilizing animal tissues. The instructors begin with lectures and participants are then required to utilize the knowledge learnt in the designed scenarios.
2. LEC: The instructors present lectures and discuss related issues with participants in a conference room.
3. ANT: The instructors use animal tissue to demonstrate a series of procedure. Participants

**Table 1:** Course organized by CSTC

Type of course	Example
Simulation-based	Basic Life Support resuscitation provider update Emergency Delivery workshop Procedural Sedation course Resuscitation course Nurse initiate Defibrillation course Emergency Medicine workshop on developing country Lumbar puncture workshop
Lecture-based	Interactive Neurosurgical Management Workshop Emergency PCI in AMI Clinical simulation education seminar Acute Grief Support Workshop PEG Workshop Trauma Course
Course using animal tissue	Surgical Interns practical workshop Wound management and suture workshop Chest drain workshop



**Figure 1:** Box and whisker plot showing the self-rated learning competency before and after the course represented by question B1 and B2

then performed under observations.

### Measurement

The primary outcome is the knowledge gained after the courses. It is based on comparing the self-rated competency before and after 3 types of courses. Other outcomes including participants' satisfaction and participant-rated teaching effectiveness among SIM and LEC, and ANT and LEC are measured as well.

Question 1 in part B (B1) and question 2 in part B (B2) reflect the self-rated competency before and after the course respectively. A higher numerical value indicates a higher self-rated competency. The difference between B1 and B2 ( $\Delta B$ ) is defined to be knowledge gained after the course. Question 6 in part A (A6) measures the overall satisfaction of the courses.

For participants attending SIM or ANT, they were asked to compare the courses with LEC and rate the effectiveness in question 6 in part C (C6). It measures the participant-rated learning efficiency. A higher numerical value indicates a higher self-rated learning efficiency compared with traditional LEC.

### Data Analysis

Data was analyzed using the Statistical Package for Social Science (SPSS) 20 for Windows using descriptive statistics, Kruskal-Wallis test and Mann-Whitney U test. Ordinal variables were summarized by median, interquartile range and compared among different groups by chi-square test.

### Result

#### General

There were 5024 questionnaires completed during the period of 1<sup>st</sup> Jan 2013 to 31<sup>st</sup> Dec 2015. The response rate was 67% (5024 / 7547). Among those completed questionnaires, 2532 (50.4%), 2297 (45.7%) and 195 (3.9%) came from LEC, SIM, and ANT, respectively.

Wilcoxon signed rank test was used to compare the self-rated competency among the same group of participants before and after the course. It shows that participants demonstrated a higher post-courses score in SIM, LEC, and ANT. ( $P < 0.001$ ). The median difference between the pre-course and post-course score ( $\Delta B$ ) was 2 (IQR: 1-3) for SIM, 2 (IQR: 1-3)

for LEC and 2 (IQR: 1-3) for ANT. Kruskal-Wallis test showed that there was no significant difference in the knowledge gain ( $\Delta B$ ) between each group ( $P=0.9$ ).

The self-rated learning competency before and after the course represented by question B1 and B2 are shown (Figure 1).

### *Participants' Satisfaction*

The answer of question 6 in part A (A6) reflects the satisfaction of participants. The median score for A6 are 8 (IQR: 8-9), 8 (IQR: 8-9) and 8 (IQR: 8-9) for SIM, LEC and ANT, respectively.

Although the Kruskal-Wallis test showed a significant difference in the score among the three groups ( $P<0.005$ ), clinically their differences were small with similar median score and interquartile range.

### *Comparison with Lecture-Based Course*

Question 6 in part C (C6) specifically asked the participant to compare the teaching effectiveness of SIM or ANT with that of LEC. The median score of C6 was 8 (IQR: 8-9) for SIM, and 8 (IQR: 8-9) for ANT.

## **Discussion**

Simulation-based medical education is gaining popularity and the uses of simulators in medical education has increased in recent years (3, 4). Studies had shown that SIM is associated with a higher performance in intensive care (5), medical emergencies (6), perioperative ultrasound (7), obstetrical emergencies (8), and anesthesia induction (9). In contrast, studies demonstrated no improvement in written test score among groups of radiology trainees receiving lecture versus simulation-based training in management of contrast reaction. On one hand, SIM in medicine has several merits including provision of a safe environment for risky procedures, exposure to rare but important clinical events, ability to provide immediate feedback and opportunity

for team training.

On the other hands, SIM is more resource intensive. First, it involves the cost of simulator as well as the on-going maintenance cost. Since our center delivers a wide range of courses including adult, pediatric and neonatal resuscitation, different models of simulator is needed and hence the costs are tremendous. Second, SIM generally requires more preparation time for the participants and instructors. Instructors need extra time to get familiar with the simulators as well as the designed scenarios. Extra time is needed to assign different role to participants and explain the designed scenarios.

Third, SIM required higher instructor-to-participant ratio. At least one assistant is needed to operate the simulator to provide interactive response to participants during simulation.

Training using animal tissue are in fact a type of simulation-based teaching. However, instead of using simulators, animal tissues are used. Animal tissues are used in training of surgical procedures including chest drain insertion, suturing or surgical airway. There was no live animal used in our training center. Therefore, it does not involve issues of animal right.

This study demonstrates that SIM, LEC and ANT courses enhance the knowledge of participants. However, this study failed to show the superiority of SIM among the LEC and ANT courses in term of immediate knowledge gain.

For participants' satisfaction, this study indicates that the difference among all three courses is small though significant. The lack of difference between the three types of courses was unexpected in contrast to many previous studies showing more enjoyable and valuable learning in SIMS (10). We speculate that participants remained somewhat comfortable in all three groups because participants chose the nature of courses based on their interest and they are not randomly assigned to different types of courses. The median score for participants' satisfaction in all three types

of courses was 8 (out of 10). It indicates that participants were satisfied with the courses. About the teaching effectiveness of SIM or ANT compared with LEC, our study showed participants moderately agree that SIM or ANT is more effective for learning than LEC. However, it was not reflected in the difference of knowledge gain for SIM or ANT compared with LEC. This can be explained by the lack of parameter measuring knowledge gain. Besides, knowledge gain is the only one aspect of teaching effectiveness and other aspects include participant enjoyment, learning atmosphere, and participants' effort in learning. The other explanation is the leading-nature of the question.

## Limitation

We acknowledge the limitation of a post-course questionnaire as the assessment tools on a voluntary basis can lead to a relatively low response rate. There were pre-test and post-test sessions for some of the courses. However, due to the time constraint, such arrangement was not feasible for all courses.

Other limitations of this study include the diversity of participants and courses. The participants share different knowledge as well as epidemiological background contributing possible confounders. Following the privacy policy, epidemiological data was collected on a voluntary basis. The courses are grouped simply based on the teaching modality only, irrespective of contents and themes. The inconsistency among each group is not properly measured in our study. Further study is required to draw a precise conclusion.

## Conclusion

While acknowledging the limitations, this study demonstrated that LEC, SIM and ANT are effective teaching modalities. They are equally acceptable to participants with similar satisfaction levels. When compared with LEC, participants perceived that SIM or ANT were

more effective. Further studies with better design and method are warranted to measure the long-term effectiveness of simulation-based education.

## Acknowledgment

The authors are thankful to Dr. Chan Suet Wah, Hewlett (Tuen Mun Hospital) for providing language help and proof reading the article.

## Conflict of Interest

The author declares no conflict of interest.

## Reference

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(V5)(Sept 2014)CSTC-Evaluation Form

**Clinical Skills Training Centre  
Evaluation Questionnaire  
CSTC – NTWC**

Course Title: \_\_\_\_\_ Date: \_\_\_\_\_

Please provide feedback about the course by circling the number that best represents your response:-

Part A	General	Strongly Dissatisfied	1	2	3	4	5	6	7	8	9	10	Strongly Satisfied
	<i>Sample</i>											8	
1.	Program Organization											8	
2.	Theme/topics clearly stated												
3.	Appropriate venue setup												
4.	Appropriate question time												
5.	Enhance your learning/interest												
6.	Overall satisfaction												
Part B	Competence	Very incompetent	1	2	3	4	5	6	7	8	9	10	Very competent
	1. Before the course												
	2. After the course												
Part C	Course content (for simulation course only)	Strongly Disagree	1	2	3	4	5	6	7	8	9	10	Strongly Agree
1.	Fostering teamwork.												
2.	Assessing existing services and system.												
3.	Identifying process gaps and initiating improvement												
4.	Evaluating clinical performance/knowledge												
5.	The debriefing session was informative and useful.												
6.	Compared with the conventional non-simulation training, this simulation workshop was more effective for my learning												
7.	Enhancing the Personal technical Skills												
Part D	Comments & Personal Details												
Comments:													
Specialty													
Profession (Please ✓ one)													
Doctor			Nurse			Allied Health			Others (Please specify)				
Contact Details (Optional) Name: _____ Phone no: _____													

Please return the completed questionnaire to the Reception Counter or to the Staff of CSTC.

Thanks for your participation in the Course!