Comparing Clinical Learning Effectiveness Among Lecture-Based Training, Simulation-Based Training and Training Using Animal Tissue Models

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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 onjob- training to health care professionals including doctors, nurses and allied health care workers.

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Abstract

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

Method: All the students who attended the courses organised by the CSTC from 1st Jan 2013 to 31st Dec 2015 were enrolled in the study. Data was collected through a questionnaire delivered at the end of the course. The questionnaire contained 15 questions and used a ten-point Likert scale to rate the students' satisfaction to the course and also the competence before and after the course. (Appendix A)

Result: 5024 questionnaires were collected with a response rate of 67%. Students demonstrate a higher post-course 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 eight for both.

Conclusion: Simulation-based courses, lecture-based courses and courses using animal tissue are effective teaching modalities. They are equally acceptable to students with similar satisfaction rates. When compared to lecture-based courses, students perceived that simulation-based courses or courses using animal tissue were more effective in learning.

Key Words

Learning Effectiveness; Lecture; Simulation

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1.1 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 workers.

Since its establishment, the centre has organised around 100 courses per year, including life support courses, pain management, suturing courses and ventilator care workshops, amongst others. Total participants reach more than two thousand per year. Most of them are medical and nursing staff, accounting for approximately 75% of all participants in 2016.

In general, the courses organised 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)

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

Table 1: Course organised by CSTC

The aim of this study is to compare lecture-based training, simulation-based teaching and training using animal tissue in terms of participants' satisfaction, knowledge gain and learning efficiency.

2. Methods
2.1 Study Design
This study was designed to measure participants' satisfaction and knowledge gains and compare the learning efficiency among Lecture-based training, Simulation-based training and Training using animal tissue. The subjects of this study were the participants who attended the courses organised by the CSTC during the period of 1st Jan 2013 to 31st Dec 2015.

2.2 Study Protocol
Each participant attending the courses organised by the CSTC received a questionnaire (Figure 1) at the end of the course. The questionnaire contained 15 questions using a ten-point Likert scale to rate participants' satisfaction about the course and their competence before and after the course.

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 categorised into three types:
1. Simulation-based training (SIM): It is an imitation of real-life situations without utilising animal tissues. The instructors begin with lectures and participants are then required to utilise the knowledge learnt in the designed scenarios.
2. Lecture-based training (LEC): The instructors present lectures and discuss related issues with participants in a conference room.
3. Training using animal tissue (ANT): The instructors use animal tissue to demonstrate a series of procedures. Participants then perform the procedures under observation.

2.3 Measurement
The primary outcome is the knowledge gained after the courses. It is based on comparing the self-rated competency before and after three 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 (ΔB) 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 simulation-based training or training using animal tissue, they are asked to compare the courses with lecture-based training 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 lecture-based teaching.

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

3. Result
3.1 General
There were 5024 questionnaires completed during the period of 1st Jan 2013 to 31st 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 lecture-based training (LEC), simulation-based training (SIM) and training using animal tissue (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-course score in SIM, LEC and ANT (p<0.001). The median difference between the pre-course and post-course score (ΔB) was 2 (IQR: 1-3) for SIM, 2 (IQR: 1-3) for LEC and 2 (IQR: 1-3) for ANT. Kruskel-Wallis test showed that there was no significant difference in the knowledge gain (ΔB) between each group (p = 0.9).

The self-rated learning competency before and after the course represented by question B1 and B2 were shown (Figure 1).
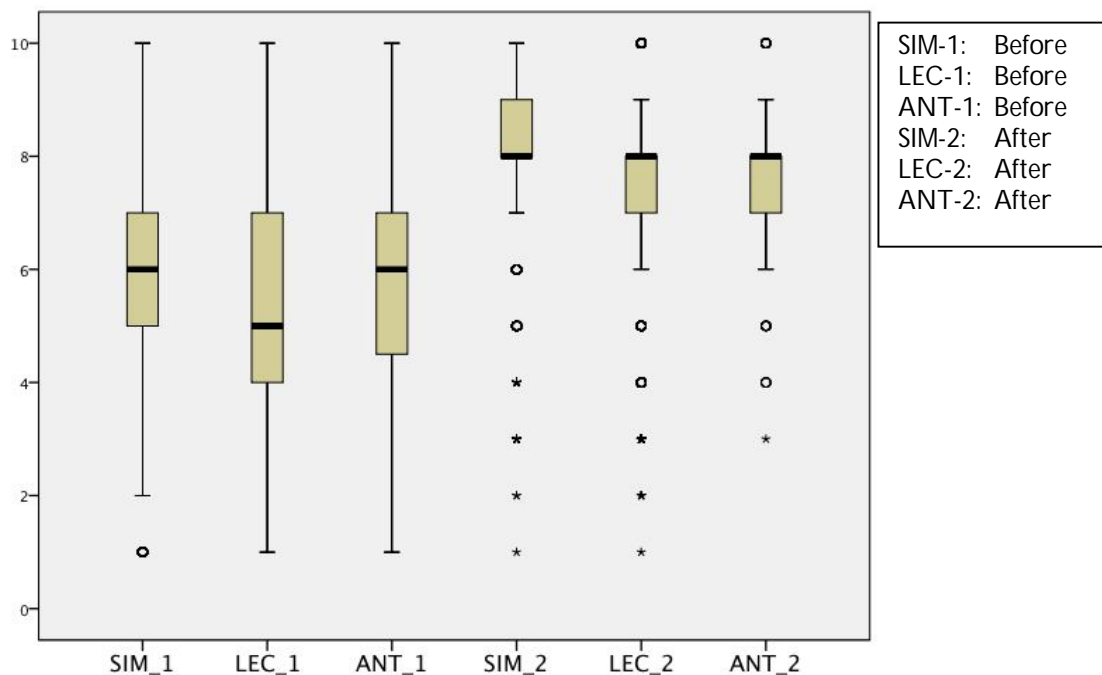
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Figure 1: Box and whisker plot showing the self-rated learning competency before and after the course represented by question B1 and B2

3.2 Participants' Satisfaction

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

Although the Kruskel-Wallis test showed there is significant difference in the score among the three groups (p<0.005), clinically their differences are small with similar median score and interquartile range.

3.3 Comparison with Lecture-Based Course

Question 6 in part C (C6) specifically asked the participants 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.

4. Discussion

Simulation-based medical education is gaining popularity and the use of simulators in medical education has increased in recent years[3,4]. Studies have shown that simulation-based training was associated with a higher performance in intensive care[5], medical emergencies[6], perioperative ultrasound[7], obstetrical emergencies[8] and anesthesia induction[9]. On the contrary, 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, simulation-based training 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 hand, simulation-based teaching is more resource intensive. First, it involves the cost of simulator as well as the on-going maintenance cost. Since our centre delivers a wide range of courses including adult, paediatric and neonatal resuscitation, different models of simulator are needed and hence the costs are tremendous.

Secondly, simulation-based teaching generally requires more preparation time for the participants and instructors. Instructors need extra time to become familiar with the simulators as well as the designed scenarios. Extra time is needed to assign different roles to participants and explain the designed scenarios.

Thirdly, simulation-based teaching requires higher instructor-to-participant ratio. At least one assistant is needed to operate the simulator and to provide interactive response to participants during simulation.

Training using animal tissue is in fact a type of simulation-based teaching. However, instead of using simulators, animal tissue is used. Animal tissue

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is used in training of surgical procedures including chest drain insertion, suturing or surgical airway. There was no live animal used in our training centre. Therefore, it does not involve issues of animal rights.

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 terms 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 simulation-based teaching[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 were 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.

Regarding the teaching effectiveness of SIM or ANT compared to LEC, our study showed participants moderately agree that SIM or ANT is more effective for learning then 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 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.

5. Limitations
We acknowledge the limitations 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 constraints, 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.

6. Conclusion
While acknowledging the limitations, this study demonstrated that simulation-based courses, lecture-based courses and courses using animal tissue are effective teaching modalities. They are equally acceptable to participants and attain similar satisfaction rates. When compared with lecture-based courses, participants perceived that simulation-based training or training using animal tissue were more effective.

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

Appendix A

(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 ——————— Strongly Satisfied									
Sample	1	2	3	4	5	6	7	⑧	9	10
1. Program Organization	1	2	3	4	5	6	7	8	9	10
2. Theme/topics clearly stated	1	2	3	4	5	6	7	8	9	10
3. Appropriate venue setup	1	2	3	4	5	6	7	8	9	10
4. Appropriate question time	1	2	3	4	5	6	7	8	9	10
5. Enhance your learning/interest	1	2	3	4	5	6	7	8	9	10
6. Overall satisfaction	1	2	3	4	5	6	7	8	9	10

Part B Competence	Very incompetent — Very competent									
1. Before the course	1	2	3	4	5	6	7	8	9	10
2. After the course	1	2	3	4	5	6	7	8	9	10

Part C Course content (for simulation course only)	Strongly Disagree — Strongly Agree									
1. Fostering teamwork.	1	2	3	4	5	6	7	8	9	10
2. Assessing existing services and system.	1	2	3	4	5	6	7	8	9	10
3. Identifying process gaps and initiating improvement	1	2	3	4	5	6	7	8	9	10
4. Evaluating clinical performance/knowledge	1	2	3	4	5	6	7	8	9	10
5. The debriefing session was informative and useful.	1	2	3	4	5	6	7	8	9	10
6. Compared with the conventional non-simulation training, this simulation workshop was more effective for my learning	1	2	3	4	5	6	7	8	9	10
7. Enhancing the Personal technical Skills	1	2	3	4	5	6	7	8	9	10

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!

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