The Effectiveness of Computer-Assisted Instruction for Caring Nasogastric Tube: a Randomized Controlled Study

Chuthamat Yuchareon, B.Tech.*, Pranom Phromdaeng, M.NS., Aree Booranakul, M.NS.**, Pratuang Naksit, BS.***

**Department of Education, **The School of Nurse Assistant Siriraj Hospital, Faculty of Medicine Siriraj Hospital, Mahidol University, Bangkok 10700, Thailand.*

ABSTRACT

Objective: To compare the effectiveness of Computer-Assisted Instruction (CAI) with traditional instruction for the training of nurse assistant students in the care of patients with nasogastric tube (NG tube).

Methods: Nurse assistant students were randomized to either the CAI group or the control group. Student academic performances, including both the theoretical and practical parts were observed.

Results: 170 participants were enrolled in this study and were equally randomized to CAI group (n=85) and the control group (n=85). 24.7% of CAI group (24/85) and 14.1% of control group (12/85) passed both examinations (Difference 10.6% (95% CI: -1.37% to 22.57%), $p = 0.081$). Interestingly, 54.1% of the CAI group whereas only 35.3% of the control group passed the theoretical part examination (Difference 18.8% (95% CI: 3.8% to 33.0%, $p = 0.041$). For practical part, 64.7% of the CAI group and 58.8% of the control group passed the examination (Difference 5.9% (95% CI: -8.73% to 20.26%, $p = 0.430$).

Conclusion: For nurse assistant students, CAI for caring the patients with NG tube did not demonstrate benefit for the whole examination. However, CAI seemed to offer some benefit for teaching especially the theoretical part.

Keywords: A randomized controlled trial; computer-assisted instruction; nurse assistant students; patients with nasogastric tube (Siriraj Med J 2019; 71: 324-330)

INTRODUCTION

Students enrolled at the School of Nurse Assistant Siriraj Hospital endeavor to develop their ability to become productive, contributing, and essential members of the total healthcare experience team at Siriraj Hospital. Creativity, critical thinking, communication, and collaboration are essential components of an effective educational program.[1] Theoretical and practical medical education at all levels is necessary for providing effective care and treatment and to assist in preventing healthcare-related errors and omissions. Care of patients with nasogastric tube (NG tube) is a key responsibility of nurse assistants. Instruction given to nurse assistants in NG tube-related patient care protocols is generally delivered via textbooks and lectures in a traditional classroom setting. Though NG tube-related care involves gastric intubation, enteral tube feeding, NG tube cleaning, and NG tube removal, nurse assistant students receive only one combined theoretical and practical course in NG tube-related care. This abbreviated training in NG tube-related care may lead to complications in NG tube management, unprofessional techniques, and negative physical and psychological outcomes for patients. Accordingly, the inclusion of computer-assisted instruction (CAI) as

Corresponding author: Chuthamat Yuchareon
E-mail: chuthamat.yuj@mahidol.edu
Received 11 September 2017 Revised 7 March 2018 Accepted 14 March 2018
ORCID ID: http://orcid.org/0000-0002-9494-6715
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a method for training nurse assistants in the care of patients with NG tube may yield significant benefits for both our patients and our center.

The ongoing development of technology continues to provide additional and often improved methods for supporting instructors. Dedicated computer-assisted instruction (CAI) modules have been created to help teach nurse assistants the theories and methods used in the care of patients with NG tube. Specifically, CAI involves learning via computer using specifically designed software. Several educational computer programs are available online, from computer stores, and from textbook publishing companies. These instructional software packages offer several instructional enhancements, including well-produced animation, sound, and visualized and detailed demonstration. Using these programs, students are able to progress at their own pace and work individually. After receiving instruction, students can form groups and engage in the solving of hypothetical clinical NG tube-related problems. Another benefit of CAI is that these programs often provide immediate feedback, letting students know whether their answer is correct or not.[2] CAI also improves instruction for students with disabilities, making access to instruction easier and more convenient. CAI has the ability to capture student attention for the following reasons: instructional software programs are interactive and interesting, programs are designed to engage the student's spirit of competitiveness to increase scores, and computers are fundamental to a student's digital world experience. Another advantage of CAI is that it moves at the student's pace and normally does not move ahead until the student has mastered the skill being taught. Programs also provide differentiated lessons to challenge students who are at-risk, average, or advanced.[2-3] Demonstrated advantages of active learning, reflective learning, independent learning, and task-based teaching were all observed in students who learned using CAI.[4]

Computer-assisted instruction (CAI) was investigated in this study to determine if it is a better instruction method than traditional class-based instruction for nurse assistant training in the care of patients with NG tube at the School of Nurse Assistant Siriraj Hospital.

MATERIALS AND METHODS

This experimental study was conducted among students enrolled at the School of Nurse Assistant Siriraj Hospital, a subsidiary unit of the Faculty of Medicine Siriraj Hospital, Mahidol University, Bangkok, Thailand. Inclusion criteria were nurse assistant students who were enrolled in SIPN 043-NG Tube Healthcare course and who were older than 18 years of age. Students were excluded if they were for some reason unable to participate in or follow the protocol of the study. The study design was a randomized controlled trial. One hundred and seventy nurse assistant students were enrolled in this study, of which 85 were randomly assigned to the computer-assisted instruction group (CAI group) and 85 were allocated to the PowerPoint instruction group (control group). Study group randomization was determined by computerized randomization. Student age, GPA, and O-net (Ordinary National Educational Test) scores were not different between groups (Table 1).

TABLE 1. Demographic and academic performance data of 170 nurse assistant students.

Data	Sample	
	CAI Group (n=85)	Control Group (n=85)
Gender		
Male	7 (8.2%)	3 (3.5%)
Female	78 (91.8%)	82 (96.5%)
Age (yrs)	19.2±1.3	19.3±1.3
GPA	3.1±0.4	3.1±0.4
O-Net score	179.8±16.8	179.6±15.5
Anatomy and physiology score	41.5±7.5	41.8±7.2

Data are presented as n (%) or mean ± standard deviation

The hypothesis of our study comprised a primary and a secondary outcome. Instructor's teaching and outcome experience found that 60% of students passed both the theory and practical skills course components with a score >70%. As such, the primary outcome hypothesis was that >80% of the students in the CAI group would pass both components of the exam with a score of 20 for theory and 11 for practical skills or higher. According to a calculation by nQuery Advisor software (Statistical Solutions Ltd., Cork, Ireland), a p-value = 0.05 was calculated using a 2-sided test ($Z_{\alpha}=Z_{(0.05/2)}=1.96$) and a power = 80% ($Z_{1-\beta}=Z_{0.8}=0.84$). The secondary outcome hypothesis was that >70% of students in the CAI group would report satisfaction with computer-based learning in order to compare students behavior during studying of media learning between CAI and control groups such as motivation, interest in lesson and cooperative learning. Data were collected from 6 October 2014 to 9 October 2014. The student instruction and data collection process for each day of the training was conducted, as follows:

Day 1: All students in both study groups attended traditional lecture-based instruction in NG tube-related patient care protocols in a traditional classroom setting.

Day 2: Students were randomly separated into the 2 study groups for lecture review. The control group was provided with a textbook and PowerPoint instruction and the CAI group was provided with computer-assisted instruction (CAI). The duration of the review and study period was 3 hours, with student study behavior observed and recorded by School of Nurse Assistant Siriraj Hospital's staff.

Day 3: A 25 question multiple-choice examination was given to students in both groups to test their knowledge. The same exam was given to both groups.

Day 4: A practical examination consisting of 16 operations on a medical model was given to students in both study groups. Enteral feeding exam was also given to both groups on day 4.

Data were analyzed using SPSS Statistics version 18 (SPSS, Inc., Chicago, IL, USA). Descriptive statistics are presented as mean ($\overline{X}$) ± standard deviation (SD). Student examination scores were analyzed by chi-square test, with results presented as odds ratio (OR) and 95% confidence interval (CI). A p-value<0.05 was considered statistically significant (Tables 2-3).

The protocol for this study was approved by the Siriraj Institutional Review Board (SIRB) of the Faculty of Medicine Siriraj Hospital (Si 429/2015). CAI instructional content was reviewed and approved by 3 experts by report evaluation and instructional content validity was verified by the course instructor.

TABLE 2. Knowledge and practice skill scores for lesson on patient with NG tube health care (n=170).

Score	Sample		Mean difference (95% CI)	*P*-value
	CAI Group (n=85) (mean±SD)	Control Group (n=85) (mean±SD)		
Knowledge score	18.1±2.4	16±3.0	2.1 (1.3 - 2.9)	<0.001
Practice skill score	20.9±4.6	20.6±5.0	0.3 (-1.2 - 1.7)	0.735

A p-value<0.05 indicates statistical significance

TABLE 3. Pass rates by type of assessment for CAI and control groups.

Type of assessment	CAI Group (n=85) n (%)	Control Group (n=85) n (%)	Difference (95% CI)	*P*-value
Pass theory	46 (54.1)	30 (35.3)	18.8% (3.8% - 33.0%)	.041
Pass practice skill	55 (64.7)	50 (58.8)	5.9% (-8.73% - 20.26%)	.430
Pass theory and practice skill	21 (24.7)	12 (14.1)	10.6% (-1.37% - 22.57%)	.081

A p-value<0.05 indicates statistical significance

RESULTS

A total of 170 students were enrolled, with students randomly allocated into one of two study groups [CAI group (n=85) or control group (n=85)]. There were no exclusions and all enrolled participants were analyzed (Fig 1). Objective testing results for subject theory were statistically significantly higher in the CAI group than in the control group (18.1 vs. 16) (p<0.001, T-test) with mean difference equal to 2.1 (95% CI; 1.3-2.9). Scores for the practical examination were only slightly higher in the CAI group than in the control group, with the difference failing to achieve statistical significance (20.9 vs. 20.6) (p=0.735, T-test) (Table 2).

The procedure for enteral feeding of patients with NG tube was important for students to carefully follow - particularly 2 key points. The students were required to position the patient with the head at a 30-45 degree angle and drain gastric content for purposes of testing the position of the feeding tube. A failure to perform these two key steps resulted in a failing grade for the practical component of the test. Regarding the 25 question multiple-choice examination, the CAI group performed significantly better than the control group (46 *vs.* 30) (p=0.041, Chi-square). The level of passing scores for the practical examination were not significantly different between groups (55 *vs.* 50) (p=0.430, Chi-square). Pass rates by type of assessment for CAI and control groups are presented in Table 3. Regarding the number of students that passed both the theoretical and practical portions of the exam, the CAI group exceeded the control group by 10% (21 *vs.* 12) (p=0.081, Chi-square).

Student levels of satisfaction regarding different aspects of computer-assisted instruction (CAI) are shown in Table 4. Mean level of student satisfaction with CAI was 4.58 out of 5. Nine students (10.6%) commented that CAI was "modern", "easy to understand", "colorful", and "exciting to learn". Regarding other feedback results, 7.65% of students requested that CAI be used for instruction in other lessons, 2.55% said they would like to have more available exercises, and 1.7% indicated a desire to have the ability to study at home with CAI. Eight students (9.4%) expressed displeasure that the playback button was necessary in the exercise section. Regarding student behavior during the study period, students in the control group demonstrated a low level of attention and minimal active learning behavior. In contrast, the CAI group demonstrated much higher levels of attentiveness during the study period (Table 5).

DISCUSSION

Our null hypothesis in this study (primary outcome: Theoretical instruction pass rate of >80% and practical instruction pass rate of >70%) was not able to be rejected based on the combined pass rate (theory and practical) in

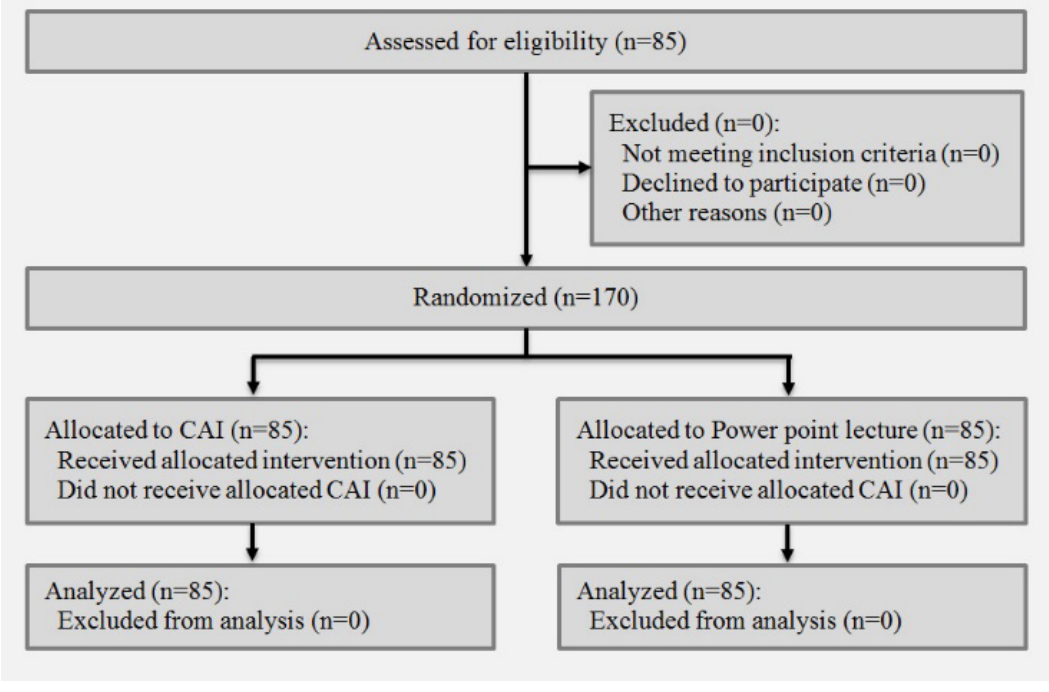

Fig 1. Flow diagram of participant eligibility and randomization process.

TABLE 4. Student level of satisfaction with computer-assisted instruction (CAI) (n=58).

Topic	Level of satisfaction Mean±SD
Total for content presentation	4.57±0.12
Presentation easy to understand	4.67±0.52
Language easy to understand	4.64±0.61
Appropriateness of lesson sequence	4.64±0.55
Appropriateness of lesson content difficulty	4.48±0.65
Appropriateness of number of exercises in the lesson	4.40±0.76
Total for design of learning media	4.39±0.20
Convenient use of button	4.05±0.98
Composition of media learning appropriate and interesting	4.48±0.68
Appropriateness and clarity of characters	4.58±0.62
Appropriateness of sound effects	4.40±0.90
Ability of media learning to motivate students	4.45±0.76
Total for lesson satisfaction	4.65±0.06
Students are attentive and enjoy the lesson	4.58±0.59
Students find the answer by themselves and can repeat the lesson	4.62±0.62
Students are satisfied with the outcome of the lesson	4.62±0.53
Students can easily study by themselves	4.66±0.52
Students can study independently	4.75±0.46
Overall total	4.53±0.17

TABLE 5. Student learning behavior in the CAI and control groups.

Behavior	CAI Group (n=85)	Control Group (n=85)
Display interest in and attention to media learning	Students display interest in and pay attention to media learning and ask staff when they have a question	Students do not pay attention to or display interest in media learning; students look tired and unmotivated Half of students watch another video that is not related to the lesson
Behavior during media learning	Some students talk to each other, but most pay attention to media learning Some students reset their lesson to repeat again	Students play on their mobile telephones, talk to each other, sleep, and/or wait for the time they can leave the room
Behavior after media learning	Students cooperate with each other to answer questionnaire Some students ask their friends about the lesson and how to use media learning	Students continue to display a lack of interest in learning Some students remain attentive to their lesson as their friends leave the room

the study group of only 24.7%. Students became nervous during the examination, causing them to demonstrate incorrect process of nursing care. Although most students knew the related processes, a loss of concentration and test anxiety adversely affected their scores. Previous study of the effects of instructional videos on knowledge and practical skills of labor and delivery nursing students demonstrated that these learning materials were useful in improving student knowledge in clinical practice during the intra partum period.[5] Similar to the results of a comparative study on the effectiveness of two teaching medias: use of video and use of flip chart instructions on the knowledge of postpartum woman, the video group in this study had higher practicum and satisfaction scores than those of the control group.[6] However, one-time use of CAI for students to practice their NG tube healthcare skills could not improve student skills in this study. As suggested by several opinions, students require several learning and practice opportunities, including repeated demonstrations, before they should be asked to perform a skill.[3,7] A study that used CAI to enhance student critical thinking ability found a difference in knowledge scores between pre-test and post-test scores, but there was no difference in critical thinking skills.[8,9] Exposing students to new types of CAI has been proposed.

Park EJ found computer-assisted instruction (CAI) was likely to be useful and practical in the training of abstract skills to nursing students, though certain challenges remain, such as the precise understanding of cognitive or affective responses to ethical issues.[10] Their finding suggests effective use of the constructivist learning theory, which actively emphasizes students as the key factor in improving learning outcomes. The variability in teaching levels and instructional resources that are available via CAI enables students to develop knowledge and skills and construct meaning according to his/her preferred style of learning. Attractive and eye-catching colors, endearing animated characters, music and sound effects, and compelling visual effects and animation effectively attract student attention and create a fun and relaxed learning atmosphere. CAI methods can achieve excellent results, with students' reading and speaking abilities being continuously enhanced during the learning process.[11]

There is limited empirical evidence regarding the effectiveness of CAI in clinical skills education.[12] A previous study in Information and Communication Technologies (ICTs) found many obstacles to CAI nursing education.[11] They reported age, previous knowledge, and preferred learning style as factors that affected learning of nursing clinical skills. They also recommended the following research guidelines for studies investigating CAI instruction: randomized controlled trial study design, avoid voluntary recruitment, and test for differences in the demographic characteristics of participants in the study groups.

The results of this study revealed computer-assisted instruction (CAI) to be useful in improving student knowledge, but not in improving student practical skills. In addition to instruction by CAI, demonstration of practical skills by the instructor is required to improve student practical skills. Based on the promising findings of this study, the authors recommend the integration of CAI as an instruction method for students at the School of Nurse Assistant Siriraj Hospital. Integration should include other nursing care training subjects and the use of pre-test and post-test to evaluate training effectiveness. Moreover, the results of this study should inform teachers of nurses and nurse assistants not only to confidently incorporate CAI for teaching theoretical parts but also to build more "real skill" training with patients in practical part.

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