The Effect of Computer Based Learning (CBL) Regarding Endotracheal Airway Suctioning on Knowledge and Skill Retention of Third Year Pediatric Nursing Students

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Abstract

Endotracheal airway suctioning (ETS) is one of the important pediatric nursing skills that should be used only after careful assessment. High qualified pediatric nursing care requires interesting in clinical skill education and seeking innovative learning methods. Reviewed studies comparing the effectiveness of CBL with traditional methods reported lack of studies that tested knowledge or skill retention. This quasi-experimental study evaluated the effect of CBL regarding ETS on knowledge and skill retention of third year pediatric nursing students. A total 120 students were divided into experimental and control groups. The experimental group was taught used an interactive, multimedia, self-directed computer-based learning module. The control group was taught used face to face lecture and demonstration in a pediatric clinical skills laboratory. Data were collected using knowledge test at four time points and at three time points using ETS performance checklist. The study revealed that CBL method produce significant cognitive gains and higher skill performance scores for the experimental students at immediate follow up but the retained knowledge was almost similar in both groups at 2 weeks follow up. The experimental group achieved significant higher differences emerging in retained knowledge at the 6 week follow up and in retained skill performance at 2 & 6weeks

follow ups. The findings indicated that CBL was an effective strategy for teaching both knowledge and practice. It also produced better knowledge and skill retention than in case of traditional learning method.

Keywords: Computer-based learning, Traditional teaching methods, Retention, Endotracheal airway suction.

Introduction:

Clinical skills competency can affect pediatric patient care and safety because clinical education is very important for high quality nursing care[(1).] Face-to-face lectures and skill demonstrations have traditionally been used to teach clinical skills to undergraduate students. Instructors usually use demonstration of a skill followed by an opportunity for rehearsal in a clinical laboratory or skills classroom as a traditional teaching method [(2).]

Airway suctioning is considered one of the most crucial skills for pediatric nurses and healthcare staff because it can prevent retention of secretion that may damage the cilia and interfere with mucous production leading to atelectasis (collapse of the alveoli), decreased oxygen saturation leading to hypoxemia, raised intracranial pressure, cardiac arrhythmias, respiratory arrest, and infection. It nonetheless is a traumatic and distressing process, and therefore should be used only after careful assessment[(3).]

Although traditional teaching methods have been espoused for providing an opportunity for students to learn directly from subject experts [(4).] such methods can lack flexibility, do not ensure teaching consistency nor accommodate the diverse learning needs of students [(5).] Therefore, the demands of caring for acutely ill patients in recent years, big students' numbers and staffing shortages have made teaching opportunities so difficult in many clinical areas, potentially limiting the support available for each nursing students to learn in practice. All these issues have compelled nurse educators to seek alternative methods for clinical teaching [(2).]

Computer based learning (CBL) is more popularly known as Computer Assisted Instruction (CAI) or Tutorials and other abbreviations, including: computer-assisted learning CAL, computer-based training CBT. It is a process of learning that is not executed in the traditional manner one would find in the educational environment. Rather than the conventional

classroom and instructor or professor setting, computer based training, for example change management tools involves learning using software applications installed in computers. The student is, in effect, trained by the computer [6].

Computer is nonjudgmental and endlessly patient. It can maximize time on task to mastery learning and provide instant feedback that is so effective in learning. Computer based learning can increase student motivation, instructional consistency, and cost effectiveness. This type of active approach makes learning more interesting and memorable and may lead to students spending more time on task. In addition, the learner maintains control of the learning process, its speed, order, and type to a great extent [2].

After reviewing studies comparing the effectiveness of traditional methods with computer based learning for clinical skills nursing education, they found lack of reviewed studies that tested knowledge or skill retention, and this remains a fundamental gap in the literature [7].

In the light of what have been mentioned before, the current study was conducted to evaluate the effect of computer based learning (CBL) regarding endotracheal airway suctioning on knowledge and skill retention of third year pediatric nursing students.

Aim of the study:

The aim of the present study is to evaluate the effect of computer based learning (CBL) regarding endotracheal airway suctioning on knowledge and skill retention of third year pediatric nursing students.

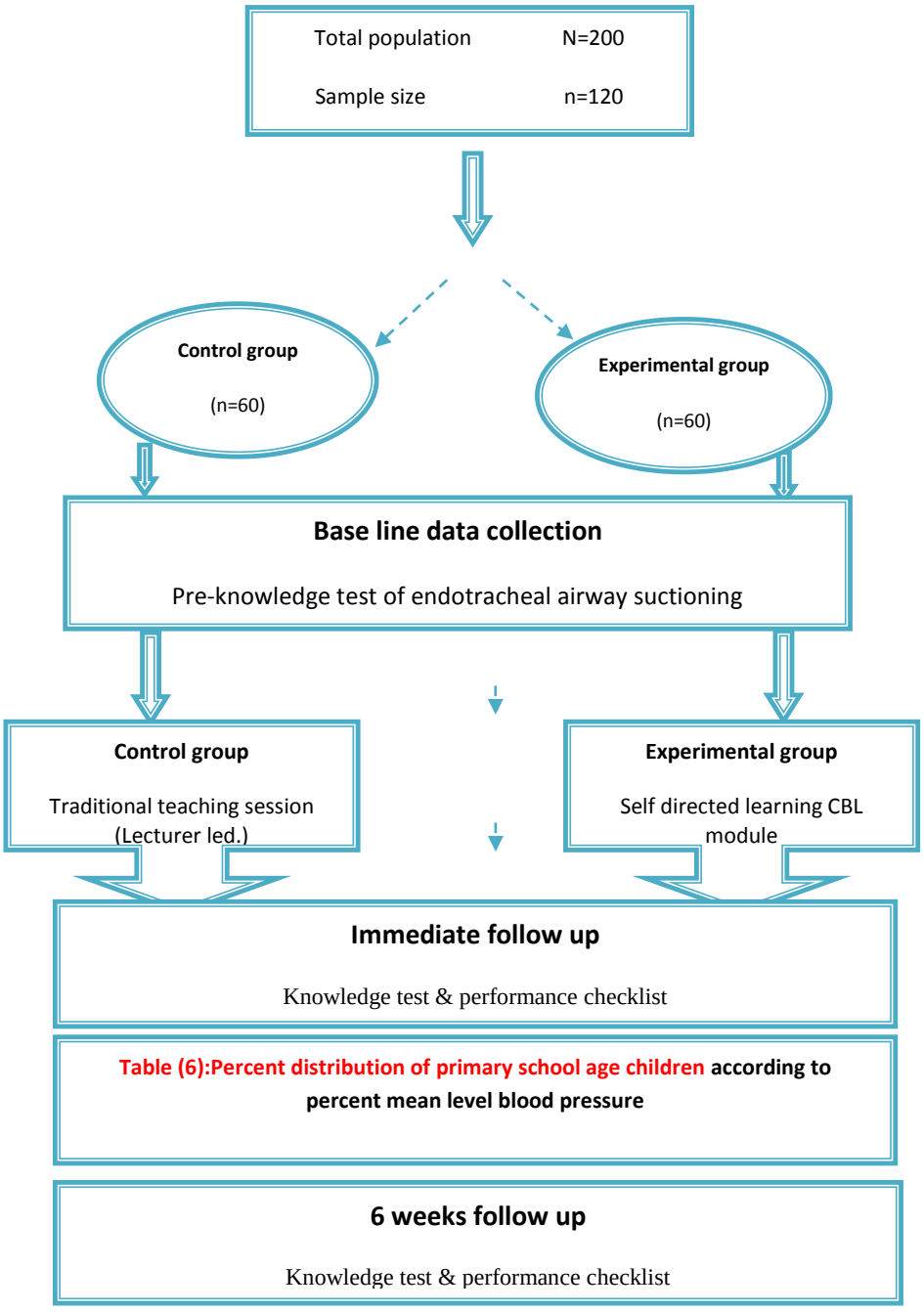
Materials and Method:

The study was conducted in clinical skills and computer laboratories at Faculty of Nursing, Mansoura University. In this study a convenient sampling was conducted to 120 students of female gender who were studying pediatric nursing in the second semester during the academic year (2010 -2011). These students were assigned into two groups: experimental group which included 60 students studying with computer based training module (CBL) and Control group which included 60 students studying with traditional training using face to face lecture and demonstration.

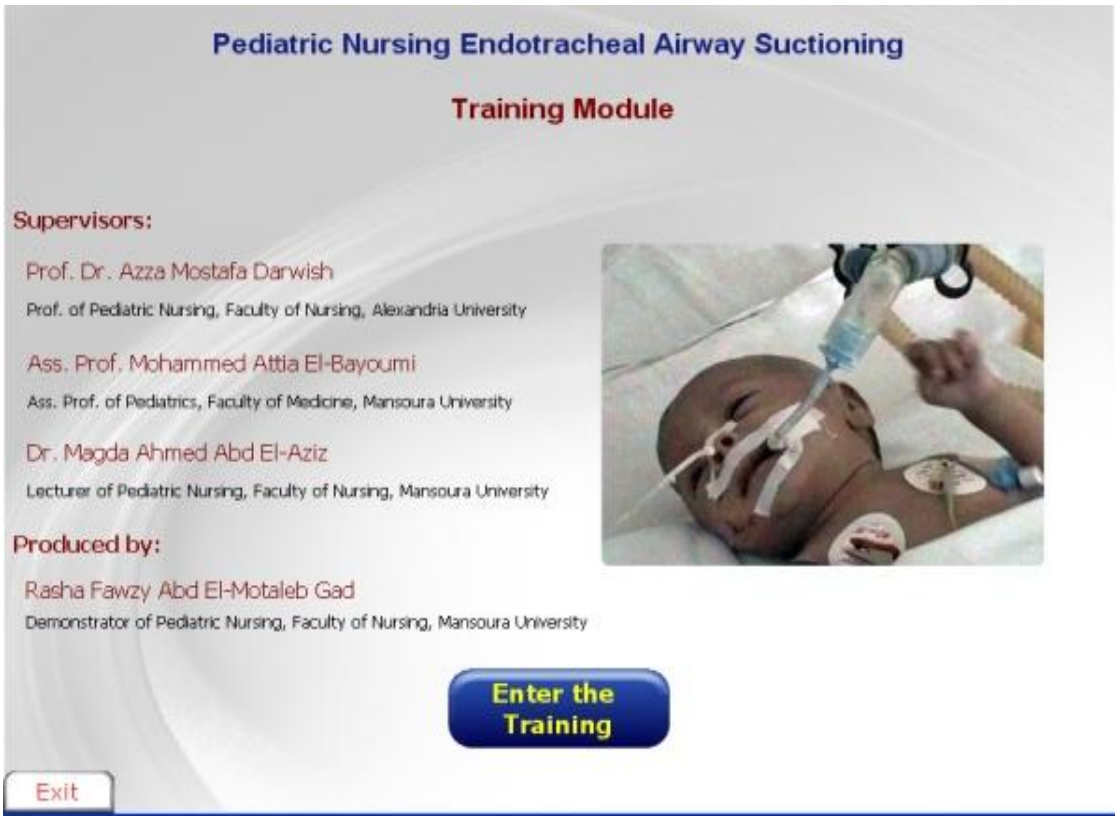
To verify the aim of the present study two tools were developed and used to collect the data. Tool one, endotracheal airway suctioning knowledge test which was conducted at four time points: prior to the teaching intervention, immediate follow-up, 2 weeks follow up and 6 weeks follow up to assess the students' knowledge of endotracheal airway suctioning. Tool two, endotracheal airway suctioning performance checklist which was

conducted at three time points: immediate follow-up, 2 weeks follow up and 6 weeks follow up to assess the students' performance of endotracheal airway suctioning.

Study design



Computer based learning (CBL) module developed by the assistance of a technologist using a combination of tutorials (text only), interactive multimedia and computerized testing with a manual user's guide. Interactive activities; animated multimedia, high quality photographs were also included to stimulate interest and promote learner engagement. The theoretical content was identical to that of the traditional teaching session. The endotracheal airway suctioning demonstration video was embedded within the module and could be viewed by participants as required. Participants were instructed to work through the module independently for the duration of the session after a brief orientation to navigational features beside the manual guide.



The module was containing 4 sections: objectives, knowledge, performance, and test yourself.

Data were sorted, coded, organized, categorized and then transferred into especially designed formats. Statistical analysis of data was done by using SPSS program (Statistical package for Social Science) version 16. Student's t test, student's paired t test, and Mann Whitney test were used for Statistical analysis. Data were presented by using descriptive statistics in the form of mean and standard deviation. Graphs were done for data visualization by using Microsoft Excel.

Result:

The results of the present study demonstrated no significant differences were found when knowledge scores were compared between the study groups prior teaching intervention, and knowledge mean in the two groups was (10.78 ± 1.37) for experimental group and (10.78 ± 1.52) for control group. Likewise the experimental group (n=60) achieved a significantly higher (p = 0.000) knowledge mean score of (19.6 ± 0.6689) compared with a mean of (19.167 ± 0.9828) for the control group (n=60) at immediate

follow up. Also, the experimental group (n=60) achieved a significantly higher (p = 0.001) knowledge mean score of (19.05 ± 1.2133) compared with a mean of (18.30 ± 1.2115) for the control group (n=60) at 2 weeks follow up. At 6 weeks follow up the experimental group (n=60) continued achieving a significantly higher (p = 0.000) knowledge mean score of (18.4500 ± 0.6746) compared with a mean of (16.7667 ± 1.0793) for the control group (n=60).

As regards skill performance scores, it was found that the experimental group (n=60) achieved a significantly higher (p = 0.000) skill performance mean of (36.3500 ± 1.0222) compared with a mean of (35.0167 ± 2.2661) for the control group (n=60) at immediate follow up. Also, it achieved a significantly higher (p = 0.000) skill performance mean of (35.9000 ± 1.0034) compared with a mean of (33.5000 ± 3.1650) for the control group (n=60) at 2 weeks follow up. And finally it achieved a significantly higher (p = 0.000) skill performance mean of (34.7000 ± 2.0936) compared with a mean of (30.5500 ± 2.06389) for the control group (n=60) at 6 weeks follow up.

Concerning the changes happened in knowledge from the baseline (prior teaching intervention) to the immediate follow up, there was an increase with a highly significance (p= 0.000) was evident for each group, but, when comparing this change in both groups with each other, the experimental group only differed significantly (p = 0.05). Likewise, there was a decrease in the knowledge test mean scores was identified for each group when mean scores of the immediate and 2-week follow-ups were compared with a highly significance (p=0.004) for experimental group and (p=0.000) for control group although, there were no significant differences emerged when comparing this change between both of them (p > 0.05).

Furthermore, a decrease in the knowledge test mean scores was identified for each group when mean scores of the immediate and 6-week follow-ups were compared with a highly significance (p= 0.000) for each group. Meanwhile, the experimental group achieved a highly significance (p = 0.000) when this change was compared between both of them. Also, There was a decrease in the knowledge test mean scores was identified for each group when mean scores of 2-week and 6-week follow-ups were compared with a highly significance (p = 0.002) for experimental group and (p = 0.000) for control group. Although there were no significant differences emerged when comparing this change between both of them (p > 0.05).

Regarding the changes happened in skill performance, there was a decrease was evident for each group when

changes in skill performance assessment mean scores were compared between immediate and 2-week follow-ups with a highly significance (p= 0.000) for each group. Meanwhile, the experimental group achieved a highly significance (p = 0.000) when this change was compared between both of them. Furthermore, a decrease in skill performance assessment mean scores was identified for each group when mean scores for the immediate and 6-week follow-ups were compared with a highly significance (p= 0.000) for each group but , the experimental group also achieved a highly significance (p = 0.000) when this change was compared between both of them. Also, There was a decrease in the skill performance assessment mean scores was identified for both groups when mean scores for the 2-week and 6-week follow-ups were compared with a highly significance (p= 0.000) for each group and the experimental group continued achieving a highly significance (p = 0.000) when this change was compared between both of them.

Table (I): Mean knowledge of experimental and control groups in each follow up

Total Knowledge	Experimental (n=60)		Control (n=60)		t	p
	Mean	Std. deviation	Mean	Std. deviation		
Total knowledge prior teaching intervention	10.78	1.37	10.78	1.52	0.000	1.000
Total knowledge at immediate follow up	19.6000	0.6689	19.167	0.9828	3.801	0.000**
Total knowledge at 2 weeks follow up	19.0500	1.2133	18.3000	1.2115	3.388	0.001**
Total knowledge at 6 weeks follow up	18.4500	0.6746	16.7667	1.0793	10.244	0.000**

Test : student's paired t test

* Significant (p< 0.05)

** Highly significant (p< 0.01)

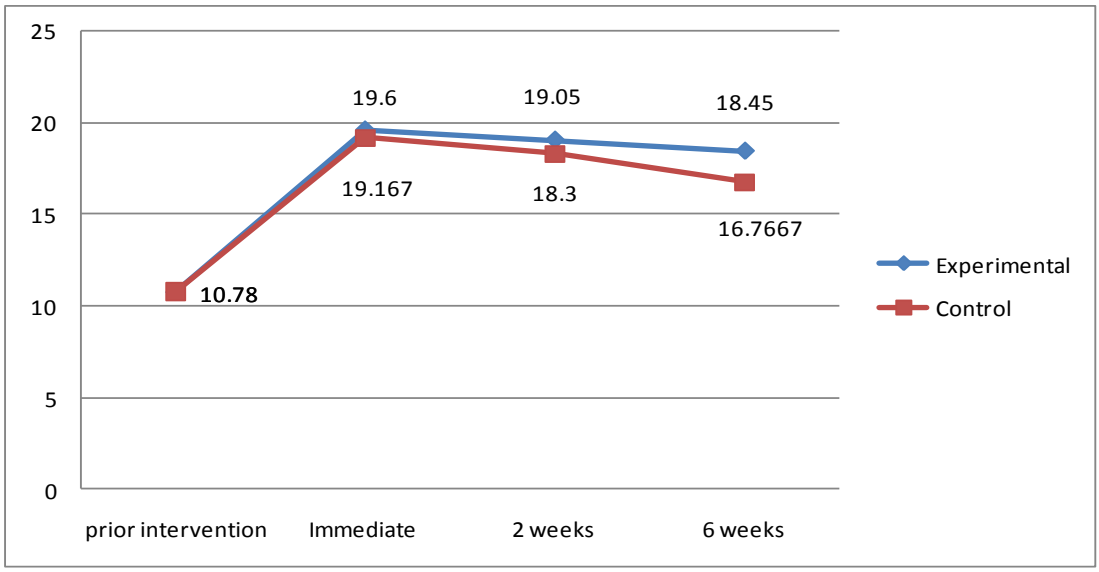


Figure (1): Mean total knowledge of experimental and control groups over time

Table (II): Mean performance of experimental and control groups in each follow up

Performance Total	Experimental (n=60)		Control (n=60)		t	P
	Mean	Std. deviation	Mean	Std. deviation		
Total Performance (immediate follow up)	36.3500	1.0222	35.0167	2.2661	4.154	0.000**
Total Performance (2 weeks follow up)	35.9000	1.0034	33.5000	3.1650	5.599	0.000**
Total Performance (6 weeks follow up)	34.7000	2.0936	30.5500	2.6389	9.543	0.000**

Test : student's paired t test

* Significant ($p < 0.05$)

** Highly significant ($p < 0.01$)

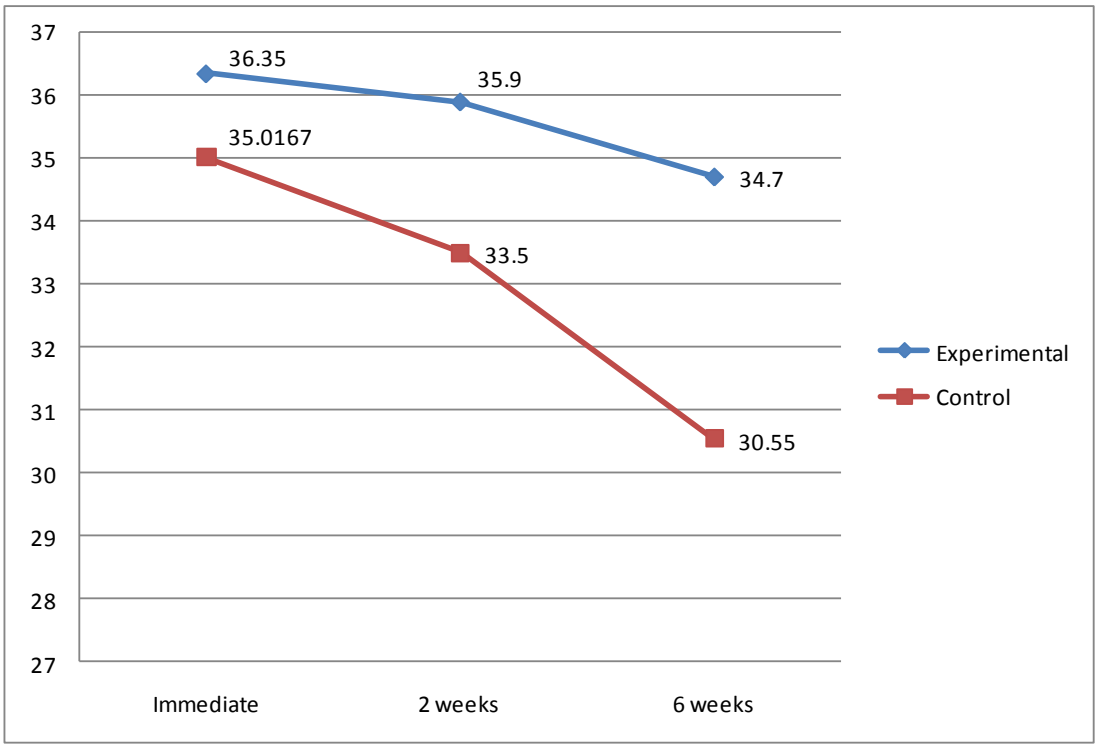


Figure (1): Mean Total performance of experimental and control groups over time

Table (III) Changes in knowledge mean in both experimental and control groups over time and comparison between both of them

Knowledge differences	Experimental group				Control group				Comparison between Experimental & Control	
	Difference in Mean	Std. Deviation	t[a]	p	Difference in Mean	Std. Deviation	t[a]	p	U[b]	P
Knowledge (immediate follow up) – Knowledge (prior intervention)	8.8167	1.7707	38.569	0.000**	8.2333	1.8445	34.575	0.000**	1.95	0.05*
Knowledge (2 weeks follow up) – Knowledge (immediate follow up)	-0.5500	1.4073	3.027	0.004**	- 0.7167	1.0430	5.322	0.000**	1.03	0.3

Knowledge (6 weeks follow up) – Knowledge (immediate follow up)	-1.1500	0.8601	10.356	0.000**	- 2.2500	1.0989	15.860	0.000**	5.04	0.000**
Knowledge (6 weeks follow up)– Knowledge (2 weeks follow up)	-0.6000	1.4046	3.309	0.002**	- 1.5333	1.0809	10.988	0.000**	1.27	0.2

Test: - a: student's paired t test - b: mann-whitney test

* Significant (p< 0.05)

** Highly significant (p< 0.01)

Table (IV) Change of Total skill Performance in experimental and control groups over time and comparison between both of them

Total Performance differences	**Experimental group**				**Control group**				**Comparison between Experimental & Control**	
	Differen-ce in Mean	**Std. Deviat-ion**	**t[a]**	**Sig. (2-tailed)**	**Differen-ce in Mean**	**Std. Deviat-ion**	**t[a]**	**Sig. (2-tailed)**	**U[b]**	**P**
Total Performance (2 weeks follow up) - Total Performance (immediate follow up)	- 0.4500	0.7686	4.535	0.000**	- 1.5167	2.9544	3.976	0.000**	3.89	0.000**
Total Performance (6 weeks follow up) - Total Performance (immediate follow up)	- 1.6500	1.7547	7.284	0.000**	- 4.4667	3.4566	10.009	0.000**	8.3	0.000**
Total Performance (6 weeks follow up) - Total Performance (2 weeks follow up)	- 1.2000	1.8208	5.105	0.000**	- 1.2000	1.8208	5.105	0.000**	6.65	0.000**

Test: - a: student's paired t test - b: mann-whitney test

* Significant (p< 0.05)

** Highly significant (p< 0.01)

Discussion:

The effect of CBL on knowledge acquisition:

It is revealed from the result that the students in both groups had similar scores in endotracheal airway suctioning knowledge test prior teaching intervention and this may be explained by the same studying of adult endotracheal airway suctioning in the previous year. This precludes difference in base line knowledge accounting for subsequent differences.

The present study found that both teaching methods resulted in knowledge gains but CBL method produce significant cognitive gains for experimental students at immediate follow up.These students learned more and managed to take the advantages of CBL. The graphic and videos helped to clarify the content [(8-11)]

These findings are in agreement with the findings of **Tsai et al2004**[(12)] **Durkin, 2008**[(13)] **and Fernandz Aleman et al., 2011**[(14)] who found that the CAL course had a significant effect on knowledge at immediate posttest. While, these findings are in contrast to the findings of **Bloomfield et al., 2010** [(15)] who found no significant differences between experimental group who used CAL course and control group who used traditional learning method in knowledge acquisition at immediate follow up.

The effect of CBL on performance scores: The present study revealed that the students using CBL achieved higher skill performance scores compared to traditional learning methods due to more interest provoked by new learning environment.These findings are in agreement with the findings of **Beeckman et al., 2008**[(16)] **Kaveevivitchai et al., 2009** [(17)] **and Lu et al., 2009**[(18)] who reported that students achieved higher skill performance scores using CAL compared to traditional learning methods. While, these findings are in contrast to the findings of **Kelly et al., 2009**[(19)] **and Bloomfield et al., 2010**who found equivalent results in skill performance outcomes in addition to the findings of **Reime et al., 2008**[(20)] who found lower skill performance outcomes for students taught using CAL.

The effect of CBL on knowledge and skill retention:

The findings of the current study demonstrate that the retained knowledge at 2 weeks follow up in experimental group who used CBL was almost similar to retained knowledge in control group who used traditional learning method meanwhile; it was higher in CBL at 6 weeks follow up.

Computer instruction allows a person to interact in the learning situation; he or she can find information, respond to questions, manipulate variables, solve problems, and create plans and strategies. This type of active approach makes learning more interesting and memorable and may lead to students spending more time on task. (**Sheridan**

et al., 2008; Deyoung, 2009; **Smaldino et al., 2012**).

These findings are in the same line with the results documented by **Beeckman et al., 2008; Bloomfield et al., 2010**, who found that Nursing students achieved better knowledge retention when using an e-learning program. These results refute previous studies of **Kelly et al., 2009; Fernandz Aleman et al., 2011,** which claim that both teaching methods resulted in similar knowledge retention.

On the other side, the findings of the current study demonstrate that nursing students achieved better skill performance retention when using CBL method at 2 weeks and 6 weeks follow ups. The significantly higher skill performance scores achieved by the experimental group may be due to being influenced by the opportunity of self-direct their own learning experiences. Being able to focus on specific aspects of the learning materials and watch endotracheal airway suctioning video more than once may have reinforced key elements of the endotracheal airway suctioning procedure, thereby enhancing skill development and retention (**Deyoung, 2009**).

These findings are supported by **Bauer and Huynh, 1998**[21] who investigated the effectiveness of CAL for the acquisition of blood pressure measurement skills and **Bloomfield et al., 2010**, who reported performance skill Significant differences emerged at the 8-week follow-up in favor of the intervention group when investigating the effectiveness of CAL versus conventional teaching methods on the acquisition and retention of hand washing knowledge and skills.

On a global view, the CBL method has had a more obvious effect on endotracheal airway suctioning skill performance than on endotracheal airway suctioning knowledge because of its nature as a motor skill.

Limitations:

The major limitation in this study was the lack of randomization that was intended to be used after ascending sorting of students' previous achievements. This could help to avoid bias by making two equal student level groups with shoes lace strapping technique but we couldn't use it. The reason for this may be explained by the closure of electronic result of the students' previous learning achievements during the Egyptian 25/ January Revolution in order not to be violated, the date of the semester study beginning was postponed by the Egyptian ministry of higher education, the strike of the students in the front of the faculty that shortened the period of time allocated to the semester for more week, and finally students were keen to stay in the alphabetical rotation groups and separation didn't appeal to them.

All these reasons forced us to use convenient sampling to save time. Furthermore, CBL module preparation took much more time and needed professional programmers.

Despite this limitation, the strength of this study lies in presenting a modern learning instruction to be integrated in any nursing course.

Conclusion:

In conclusion, CBL method used in the present study produced significant cognitive gains for the students and also better knowledge and skill retention than in case of traditional learning method. So, the findings support the superiority of CBL method over traditional learning method.

The most important recommendations of the present study include:

1. Strategies and policies should be established to train the staff members on how to make theoretical with clinical e-learning courses.
2. The faculty administration should make use of the facilities that e- learning can give like:
   - The facility of getting over staff shortage.
   - The facility in which the student can use a media containing a wide variety of clinical skills beside the clinical book.
   - The possible statistics that can be made to detect students' weak points through online tests in each skill.
3. Further studies are needed to:
   - Replicate this study on a random sample.
   - Validate these findings on different nursing specialties.
   - Investigate CBL in health education field.
   - Evaluate the effect of CBL on different population like intern nurses in their training or staff nurses in staff development.

References:

1) Kelsey, J. & Carey, M. (Clinical skills in child health practice: Suctioning. Churchill Livingstone, London.2008; 21, 214-220.
2) Deyoung, S. Strategies for Nursing Education, 2nd ed. Prentice Hall, United State of America. 200;9 (3), 137-1.
3) Dixon, M.: Practices in Children's Nursing, 2nd ed. Churchill Livingstone, London. 2006;12(2), 273-76.
4) Jeffries, P.R., Rew, S., Cramer, J.M. A comparison of student-centred versus traditional methods for teaching basic nursing skills in a learning laboratory. Nursing Education Perspectives2008; 23 (1), 14–19.

5) Jeffries, P.R. Computer versus lecture: a comparison of two methods of teaching oral medication administration in a nursing skills laboratory. Journal of Nursing Education 2001; 40 (7), 323–29.
6) Joint Information Systems Committee. (2003): Effective Practice with e-Learning. http://www.elearning.ac.uk/effprac/html/start_aims.htm accessed 10/7/2010.
7) Bloomfield, J., While, A., Roberts, J. Using computer assisted learning for clinical skills education in nursing: integrative review. Journal of Advanced Nursing 2008; 63 (3), 222–35.
8) Simpson, R.L. See the future of distance education. Nursing Management 2006; 37 (2), 42-51.
9) Sheridan. C., Gorman, T., Claffey. N.: Dental nursing education and the introduction of technology-assisted learning. European Journal of Dental Education 12 2008;(4), 225-232
10) Carroll. C. Booth, A., Papaioannou, D., Sutton. A., Wong, R. UK health-care professionals' experience of on-line learning techniques: a systematic review of qualitative data. Journal of Continuing Education in the Health Professions 2009: 29 (4),235-241.
11) Smaldino,E.S., Lowther, L.D., Russell, D.J. International Technology and Media for Learning, pearson education, USA, 2012;9(1), 123-10.
12) Tsai, S.L., Tsai, W.W., Chai, S.K., Sung, W.H., Doong, J.L., Fung, C.P. Evaluation of computer-assisted multimedia instruction in intravenous injection. International Journal of Nursing Studies 2004;41, 191–98.
13) Durkin, G.j. MEd, RN. A Comparison of the effectiveness of Computer-Based Learning courses among nursing staff. Journal for Nurses In Staff Development 2008;24, (2), 62-66.
14) Fernandez Aleman, J.L, Carrillo de Gea, J.M., Rodriguez Mondejar, J. J. Effects of competitive computer – assisted learning versus conventional teaching methods on the acquisition and retention of knowledge in medical surgical nursing students. Nurse Education Today2011; 31(3), 866-871.
15) Bloomfield, J., Roberts, J., While, A. The effect of computer-assisted learning versus conventional teaching methods on the acquisition and

retention of handwashing theory and skills in pre-qualification nursing students: a randomized controlled trial. International Journal of Nursing Studies2010; 47 (3), 287-294.

16) Beeckman, D., Schoonhoven. L., Boucque, H., Maele, G.V., Defloor, T.;Pressure ulcers: e-learning to improve classification by nurses and nursing students. Journal Clinical Nursing 2008;17 (13), 1697-1707.
17) Kaveevivitchai,C., Chuengkriankrai, B.. Luecha, Y., Thanooruk, R., Panijpan, B., Ruenwongsa, P. Enhancing nursing students' skills in vital signs assessment by using multimedia computer-assisted learning with integrated content of anatomy and physiology. Nurse Education Today 2009;29 (1), 65-72.
18) Lu, D.-F., Lin, Z.-C. Li, Y.-J.): Effects of a web-based course on nursing skills and knowledge learning. Journal of Nursing Education 2009;48 (2), 70-77.
19) Kelly, M., Lyng, C., McGrath, M.. Cannon. G. A multi-method study to determine the effectiveness of, and student attitudes to, online instructional videos for teaching clinical nursing skills. Nurse Education Today2009; 29 (3), 292-300.
20) Reime, M.H., Harris. A., Aksnes, J., Mikkelsen, J. The most successful method in teaching nursing students infection control—e-learning or lecture? Nurse Education Today 2009;28 (7). 798-806.
21) Bauer, M.D., Huynh, M.V. (1998): Nursing students' blood pressure measurement following CD-ROM and traditional classroom instruction: a pilot study. International Journal of Medical Informatics 50 (1), 103–109.