

Teaching the Skill of Interpreting Common ECG Rhythms for Undergraduate Nursing Students at Cairo University: Tecnology Based Versus Traditional Method.

By

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Background: Electrocardiography (ECG) continues to be one of the most commonly used procedure for the diagnosis of heart disease. However, errors in ECG reading are common, and may lead to serious consequences. Evidencies suggest that nurses' and physicians' ECG interpretation skills are suboptimal. Therefore, proficiency in the interpretation of ECGs is an essential skill for medical and nursing professionals. Despite the importance of ECG - training, clinical tutors seem to have increasing difficulties in meeting the need for training in ECG interpretation. Thus, alternative and flexible ways of interpreting ECG are needed. Learning styles differ among medical and nursing students; individualization of teaching methods has been shown to be viable and may result in improved learning. Variety and innovative teaching methods have been shown to facilitate learning in a relaxed manner.

Aim: The aim of the current research is to study and compare the effect of using three different strategies of teaching ECG rhythm interpretation (lectures, self-instructional interactive CD, and a combination of both) on undergraduate nursing students' ability to interpret ECGs at Cairo University.

Methods: To achieve the aim of this study a pre/posttest quasi- experimental research design was utilized. A sample of convenience of 122 second year nursing students was included in the current study and randomly assigned into three groups: lecture, self-instructional interactive CD, and a combination of both(lecture & self-instructional interactive CD). All of the three groups undergone pre - post test and taught the same content.

Tools of data collection:The following tools were used to collect data pertinent to the current study: Personal and background data sheet. Pre / post knowledge assessment sheet and Teaching effectiveness opinionnaire

Hypothesis:

H1: There is no significant statistical difference in the mean post test knowledge scores of the lecture group as compared to the CDgroup.

H2: There is no significant statistical difference in the mean post test knowledge scores of the CD group as compared to the Combined lecture and CDgroup.

H3: There no significant statistical difference in the mean post test knowledge scores of the lecture group as compared to the Combined lecture and CDgroup.

Results: The study revealed that students undergone a combination of the technology based teaching and the traditional lecture methods of teaching ECG interpretation achieved higher mean posttest knowledge score (57.68 ± 17.48) as compared to those undergone the technology based teaching strategy alone (22.70 ± 22.52) and the lecture alone (49.17 ± 13.94). ANOVA indicated high significant statistical difference between the three groups. Thus inspite of the benefits of using technology in nursing education it has its limitations that can be overcome when combined with aother teaching method.

Conclusion: Students ranked the lecture complemented with interactive CD about ECG-interpretation as a useful instrument to learn ECG. Furthermore, it may be more effective than traditional lecture method only due to greater immediacy, improved visualization, guidance and interactivity

Key Words: Technology - Based education, Traditional teaching method, ECG

Introduction:

Cardiovascular disease is one of the leading causes of death worldwide despite recent advances in resuscitation and cardiac life support (American Heart Association. 2000). Electrocardiography (ECG) is the most commonly used laboratory procedure for the diagnosis of heart disease (Einthoven, 1908 In Nilsson et al (2008). The information obtained from an ECG can be used to discover different types of heart disease and other cardiovascular problems. It may be useful for seeing how well the patient is responding to treatment (Phillips, 1997). However, errors in reading ECG are common, and may lead to serious consequences (Davey, 2011). Studies have estimated 20-50% discordance between the initial ECG interpretation and final interpretation by a senior cardiologist (Murray, Lopes & Eds, 1996 & Little, Mainie, Ho KJ & Scott, 2002). Therefore, proficiency in the interpretation of ECGs is an essential skill for medical and nursing professionals (Jeffries, PR.; Woolf, S. Linde, B, 2003 & Kadish, 2001).

Physicians and nurses in most clinical specialties, including general practice are expected to have sufficient knowledge about ECG interpretation to be able to make accurate diagnoses, decide on patients' management or further referrals. As well ECG is a prerequisite course to the practice of critical care nursing. An adequate knowledge base should include the ability to define, recognize, and understand the basic patho-physiology of certain electrocardiographic abnormalities (Kadish, et al, 2001). The study of ECG consists of analysis and interpretation of waveforms created by the heart's electrical system. This interpretation is necessary to diagnose heart problems such as ischemia, dysrhythmias, and infarction (DeWitt, 2004). However, most nursing students do not feel competent in their interpretation of ECG which could negatively influence patient management decisions and could threaten patient safety (Little, Mainie & Scott, 2002, Trzeciak, Erickson, Bunney & Sloan 2002 & Brady, Perron & Chan 2001).

Despite the importance of ECG-training, clinical tutors seem to have increasing difficulties in meeting the need for more training in ECG interpretation due to shortage of time or other reasons. Thus, alternative and flexible ways to learn and practice ECG interpretation are needed (Keller & Zakowski, 2000). Traditional education emphasizes teacher-directed learning and generally uses non interactive modes of teaching such as lectures and textbook readings. More specifically, ECG interpretation is traditionally taught via lectures and textbooks in a compartmentalized, static way, rather than in a dynamic, case-based approach. Widely available instructional materials do not routinely integrate ECG interpretation into specific contexts where waveform findings must be correlated with other clinical data (Robert, De Lorenzo, Col Cynthia, Abbott, 2004). Recently, more interactive software become available and can be used as instructive materials for students to learn ECG interpretation (Patuwo, Wagner, Ajijola, 2007).

The utility of ECG in clinical decision making depends on the effectiveness with which the principles and interpretive techniques of ECG are learned. It is therefore important that institutions educating future medical professionals are successful in teaching this highly useful clinical tool effectively. The method used by medical and nursing trainees for learning how to read ECGs will influence early comprehension. An integrated combination of traditional and recent methods of teaching ECG interpretation is required to be used by most nursing institutions (Harris, Salasche & Harris, 2001, Rao & DiCarlo, 2001).

Significance of the Study

There is evidence that misdiagnosis of cardiac arrhythmias or other problems is common in critical-care and telemetry units. Drew, Ide, & Sparacino (1991) in Jeffries, PR.; Woolf, S. Linde, B (2011) suggested the need to address training about ECG electrode placement and rhythm interpretation as a serious educational problem for current clinical practice of critical care nursing. As well there is a great need for teaching ECG interpretation as a basic requirement for the practice of critical care nursing; however, little researches have been conducted to examine the effect of teaching ECG interpretation, as well as using different teaching strategies to interpret ECG rhythms on students' academic achievements. As well, few researches assessed the use of multimedia in teaching other skills related to nursing practice.

Aim of the Study

The aim of the current research is to study and compare the effect of using three different strategies of teaching ECG interpretation (lectures, self-instructional interactive CD, and a combination of both lectures, and self-instructional interactive CD) on undergraduate nursing students' ability to interpret ECGs at Cairo University.

Research hypotheses:

To achieve the aim of the current study, the following research hypotheses were formulated:

H1: There is no significant statistical difference in the mean post test knowledge scores of the lecture group as compared to the CD group.

H2: There is no significant statistical difference in the mean post test knowledge scores of the CDgroup as compared to the Combined lecture and CD group.

H3: There no significant statistical difference in the mean post test knowledge scores of the lecture group as compared to the Combined lecture and CD group.

Subjects and Methods:

Research Design

A pre-post test quasi-experimental research design was utilized in the current study.

Subjects

A sample of convenience of 122 second year nursing students during the critical care nursing rotation was included in the current study and randomly assigned into three different groups: lecture, self-instructional interactive CD, and a combination of both (lecture & self-instructional interactive CD). All of the three groups undergone pre - post test and taught the same content.

Setting

The current study was carried out at faculty of nursing cairo university, during the academic year 2009 – 2010.

Tools of data collection:

Three tools were used to collect data pertinent to the current study: Personal and background data sheet, pre / post knowledge questionnaire, and teaching effectiveness opinionnaire sheets

- 1- Personal and background data sheet: covers data related to age, sex, academic year, previous education, and attended ECG courses.
- 2- Pre / post knowledge questionnaire sheet: This sheet is classified into two parts: Part one: includes 15 multiple choice questions covering theoretical content of electrophysiology of heart, normal ecg waves, intervals, and common dysrhythmias. As regards part two it is concerned with interpretation of 10 different ECG rhythm strips. Each rhythm strip was analysed through answering 7 guided questions about presence of electrical activity, calculation of ventricular (QRS) rate, identification of the regularity or irregularity of the QRS rhythm, if the QRS complex width is normal, narrow, or prolonged, if the atrial activity present or not , and if atrial activity related to ventricular activity or not and finally naming the

provided ECG rhythm.

Scoring:

Two scores were assigned for each question in part one, giving a total of 30 scores. In part two each rhythm strip requires answering seven sub items (one score for each item giving a total of 7 scores) , thus the total scores for part two were 70 scores and the overall knowledge score were out of 100 scores (the sum of part one and two).

- 3- Teaching effectiveness opinionnaire to assess students' attitudes toward efficiency of the training course. It includes 20 questions about the teacher's level of knowledge, teacher – students interaction, using a variety of teaching strategies, engaging and maintaining students' attention, using clear directions, explanations, demonstrations, questions, selecting or developing and implementing students' learning activities that integrate technology. providing feedback to students in a timely and helpful manner.

Protection of Human Rights:

An official permission to conduct the study was obtained from the dean of the faculty of nursing–Cairo university, as well as the vice dean of students' affairs. Verbal consents were obtained from the head of Medical Surgical Nursing Department in addition students' agreements to be included in the study were obtained after explanation of the nature and purpose of the study. Student were assured that participation is volunteer and they have the right to withdraw from the study at any time without any rational; Also, students were informed that data will not be included in any further researches without another new consent. Confidentiality and anonymity of each student were assured through coding of all data. The level of students' knowledge and performance will be used only for research and will not affect their evaluation.

Procedure:

The current study was done on three phases: preparation phase, implementation phase, and evaluation phase.

Preparation phase

This phase was concerned with obtaining permissions to carry out the study, preparation of different educational materials (handouts and interactive CD), teaching aids, and simulation models. As well extensive review of literature was carried out through searching the internet and national data base, in addition to developing data collection instruments.

Implementation Phase

During this phase data collection was carried out. ECG rhythm interpretation is one of the topics taught during the allocated time in the theory schedule of critical care nursing, which is one of three different clinical rotations (surgery, medicine, and critical care nursing) in the medical surgical nursing department, during the academic year 2009/2010. Students were randomly assigned to one of the three clinical rotations, and during their routine clinical rotation distribution to critical care settings they taught ECG rhythm interpretation. Critical care nursing groups were randomly distributed to lecture alone group, interactive CD group, and a combination of both (lecture alone, and interactive CD). Before utilizing any of the three different teaching strategies students' personal background and knowledge about ECG interpretation were assessed using tool I & II followed by provision of the educational contents then obtaining immediate post test.

Each student was provided with the educational material either handout or the interactive CD. Equivalency of the interactive CD contents and the lecture content was confirmed by the researchers. A brief explanation was given regarding how to proceed in the contents of the interactive CD. In addition, students were asked to read carefully the provided instructions and they had the opportunity to ask any question regarding the provided materials, then they were asked to study the contents independently as a matter of self study. Students' pretest/posttest scores were used only for purposes of the study and were not part of the course grade.

Evaluation phase:

This phase was concerned with evaluating the effectiveness of the utilized teaching strategy through obtaining students' opinionnaire (tool III).

Results:

Data of the current study were analyzed using the SPSS program. The level of significance was set at 0.05. Statistical analysis revealed that more than half of the three studied groups (54.9%) was females while approximately the other half (45.1%) was males. Females also represented approximately two thirds of the lecture group, approximately the same proportion of the interactive CD group, and the combined (lecture and interactive CD) group. Comparing the proportion of male to female among the three studied groups indicated no significant statistical difference: The lecture group to the CD group (Chi square = 0.217), the lecture group to the combined group (Chi square = 0.333), and the CD group to the combined group (Chi square = 0.248) respectively (Figure 1& 2). The great majority of the studied groups had secondary school education (n=103/ 84.4%), while rest had technical nursing institute education (n= 19/15.6%) (figure 3). All of the three studied groups (100%) indicated that they didn't attend any preparatory courses about ECG interpretation.

Comparison of the studied groups' pre and posttest mean knowledge scores revealed that the mean posttest knowledge scores increased as compared to that of pretest scores among the studied groups: lecture only group, CD only group, combined lecture and CD group (49.17, 22.70, & 57.68 as compared to 10.89, 4.92, & 7.319 respectively). It can be also noticed that the group who taught ECG interpretation using a combination of the traditional lecture and interactive CD showed higher mean posttest knowledge scores (Mean = 57.68 \pm SD=17.48), followed by the group who taught ECG interpretation using the traditional lecture alone (Mean = 49.17 + SD = 13.94) . However, the CD only group showed the lowest posttest mean knowledge scores as compared to the other two groups (Mean = 22.70 \pm SD=22.52). Comparison of mean scores of the three studied groups indicated high significant statistical difference, at $p < 0.05$ (Table 1).

Comparisons of the three studied groups' pretest mean knowledge scores indicated high significant statistical differences ($F = 4.959$, at $P \leq 0.009$). The highest mean difference of pretest knowledge scores was between the lecture group and the CD group (mean difference =5.976) indicating a significant statistical difference at $p \leq 0.05$ (Table 2). Regarding the posttest mean scores, table (3) shows high significant statistical differences between the three groups ($F = 40.02$, at $P < 0.000$). The highest mean difference of posttest knowledge scores was between the combined group (lecture & CD) and the CD group (mean difference =34.98) indicating a significant statistical difference at $p \leq 0.000$. Significant statistical differences were found in the posttest mean knowledge scores of the three studied groups.

As regards the relationship between gender and the posttest knowledge scores, figure (4) indicated that gender in general didn't seem to affect the posttest scores among the entire studied group. The same picture was found among the CD only group and the combined lecture and CD

groups (figure 5 b and 5 c). However, Chi square test indicated a significant statistical difference (at $p \leq 0.029$) in the post test knowledge scores in relation to gender (figure 5a).

As regards students' opinion toward using different teaching strategies for ECG interpretation, the great majority (84%) of students recommended integration of interactive CD with lectures (figure 6). The entire lecture group (100%) appreciated the teacher's systematic and clear explanation with giving examples and using graphs. A minority (22.6%) indicated that the lecture time was too long and lead to decreased attention span. More than half of the studied groups (51.6%) indicated that ECG interpretation requires repeated training & practice.

Figure (1): Classification of the entire studied groups as regards their gender (N =122).

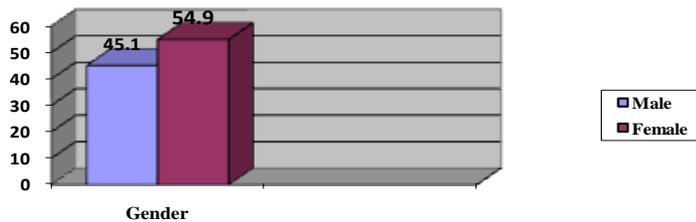


Figure (2): Classification of the three Studied Groups as Regards Their Gender.

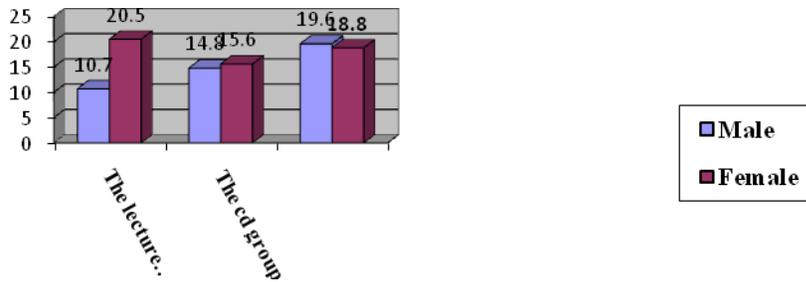
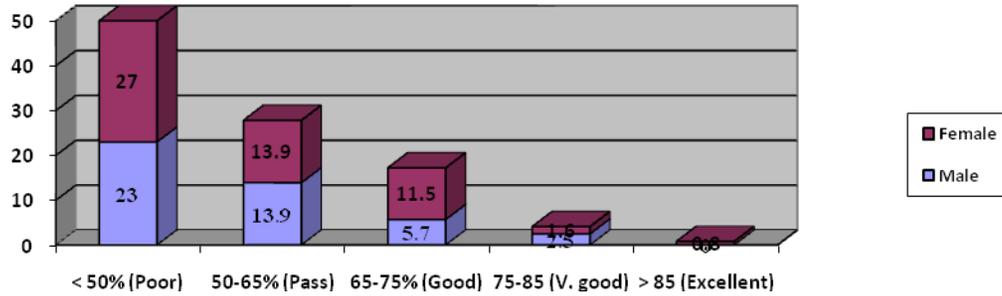


Figure (3): Educational preparation of the entire studied group (N= 122).



Figure (4): Relationship between Gender and Post Test Knowledge Scores among the Entire Studied Group (N=122).



Chi square = 2.79 $P \leq 0.594$

Table (1): Comparison of the Studied Groups' Pre and Posttest Mean Knowledge Scores.

Groups	N	Min. scores	Max. scores	Mean \pm SD	Paired t test	P
Pretest lecture only	38	0.00	38.00	10.89+8.96	-16.38	.000
Posttest lecture only		8.00	72.00	49.17+13.94		
Pretest CD only	37	0.00	36.00	4.92 \pm 6.78	- 4.78	.000
Posttest CD only		0.00	65.00	22.70 \pm 22.52		
Pretest L + CD	47	0.00	33.00	7.319 \pm 8.77	-22.68	.000
Posttest L + CD		6.00	85.00	57.68 \pm 17.48		

Table (2): One Way ANOVA for Comparison of Pretest Mean Knowledge Scores among the Three Studied Groups

Timing of the test/group	Mean \pm SD	t	p	F	p
1.00	Pretest CD only	1.372	0.174 Ns	4.959	0.009 **
	Pretest L + CD				
2.00	Pretest lecture only	1.816	0.073 Ns		
	Pretest L + CD				
3.00	Pretest lecture only	3.25	0.002*		
	Pretest CD only				

Ns = No

significant statistical difference

*Significant statistical difference at $p \leq 0.05$

** Significant statistical difference at $p \leq 0.001$

Table (3) One way ANOVA for Comparison of Posttest Mean Knowledge Scores among the Three Studied Groups.

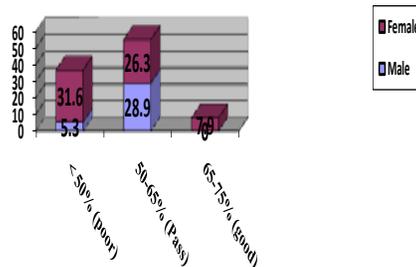
Timing of the test/group		Mean + SD	t	p	F	p
1.00	Posttest CD only	22.70+22.52	8.017	0.000***	40.02	0.000
	Posttest L + CD	57.68+17.48				
2.00	Posttest lecture only	49.17+13.94	2.364	0.020*		
	Posttest L + CD	57.68+17.48				
3.00	Posttest lecture only	49.17+13.94	6.137	0.000***		
	Posttest CD only	22.70+22.52				

*Significant statistical difference at $p \leq 0.05$

*** Significant statistical difference at $p \leq 0.000$

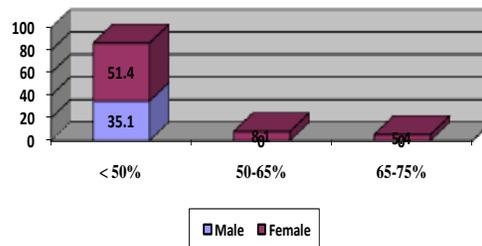
Figure (5a, b & c): Relationship Between Gender and Post Test Mean Knowledge Scores among the Three Studied Groups.

Fig. 5.a-The lecture only group (N=38).



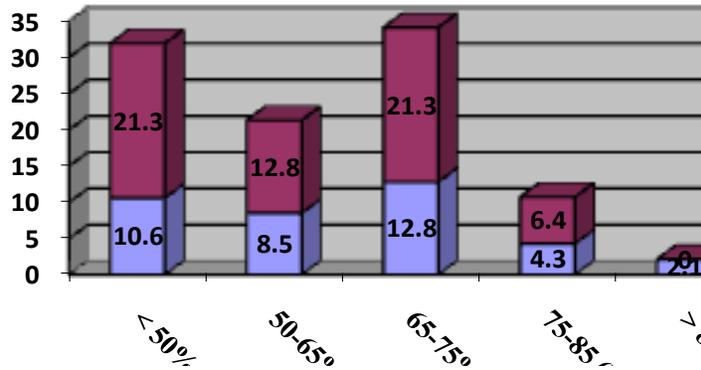
Chi square = 7.110, $P \leq 0.029^*$

Fig.5.b-The CD only group (N =37)



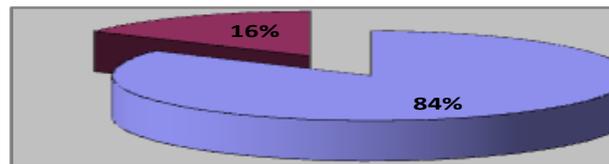
Chi square = 3.132 $P \leq 0.209$ (Ns)

Fig. 5.c-The Combined Lecture and CD group (N = 47).



Chi square = 1.79 P ≤ 0.774 (Ns)

Fig. 6- Students Opinion toward using Different Teaching Strategies for ECG interpretation, (N =122)



Discussion:

The use of ECG in clinical diagnosis is an important topic taught in medical and nursing schools. The current research aimed at studying and comparing the effect of using three different strategies of teaching ECG interpretation on undergraduate nursing students' ability to interpret ECG rhythms. In this regards Arnold (2001) indicated that when teaching incorporates strategies of student self-direction toward goals of practical relevance for the future, they refer to adult learning. They generally incorporate problem or case-based learning, small group discussions, and multisensory delivery of instruction. This approach of learning is considered a state of the art for professional health education, including emergency medical services (EMS) and out-of-hospital care (Department of Transportation 2000, in Robert, De Lorenzo, COL Cynthia & Abbott 2004).

The current study revealed increased mean posttest knowledge scores as compared to pretest scores of the three studied groups: lecture only group, CD only group, combined lecture and CD group. The group who taught ECG interpretation through using a combination of the traditional lecture and interactive CD showed higher mean posttest knowledge scores followed in rank by the group who taught ECG interpretation using the traditional lecture alone. Findings of the current study were

contradicted by those of a study done by Henderson, et al (1998) who compared between lecture, video, and self-guided instruction in paramedic pediatric airway management. They concluded that all methods were effective but the lecture was most effective.

The current study indicated that the interactive CD only group had the lowest mean post test knowledge scores as compared to the other two groups. These findings are contradicted by Lamb & Henderson, 1993 in Robert, De Lorenzo, COL Cynthia & Abbott (2004) who found self directed learning application of an advanced cardiac life support course to be effective in improving dysrhythmia recognition. Learning in this way resulted in improvement in cognitive evaluation scores, students' course grades, and final written examination scores over traditional teaching methods.

Unexpectedly, the group who taught ECG interpretation through attending traditional lecture only achieved high mean post test knowledge scores which came in rank after the combined lecture and interactive CD group. In this regards Robert, De Lorenzo, COL Cynthia & Abbott (2004) indicated that traditional education emphasizes teacher-directed learning and uses non interactive modes of teaching such as lectures and textbook readings. As well, Adib-Hajbaghery & Aghajani, (2011) indicated that traditional lectures are still the most popular instructional method in the universities. According to Brown (2003), most of the university teachers have been taught in learning environments that were instructor centered, therefore, they teach in this way too. Factors such as simplicity of lecture presentation, its appropriateness for crowded classes, limitation of time and the massive amount of theoretical content which should be presented (Bligh 2000, Adib-Hajbaghery et al. 2004, Adib-Hajbaghery 2005, & Farhadian et al. 2007).

In recent years, several researchers have compared lectures and more active teaching methods. Conflicting results then were reported. For example, some researchers have reported that no significant differences were observed between students' scores in traditional lectures versus active methods like working in small groups and multimedia or computer assisted teaching methods (Jeffries, PR.; Woolf, S. Linde, B et al. 2003, McDonald 2003, Salimi et al. 2007). However, some other investigators have indicated that the students' scores in nursing and other fields were higher when they were taught using problem based learning, group discussions or role playing, than groups taught with traditional lectures (Johnson & Mighten 2005, Hazavehei & Taghdisi 2006, Dehkordi 2008). Consequently, we can conclude that more active teaching methods can bring more effective learning than traditional lectures.

Studies have shown that teacher-centered teaching methods are not appropriate to teach students in nursing or other fields that training involves context and gives it meaning (Caudron 2000). Other studies have also shown that nursing students prefer teaching methods with more student involvement (Salsali 2005, Abu-Moghli et al. 2005). Conflicting results have also reported when academic investigators have compared the effects of lectures and more active teaching methods (Perkins & Saris 2001, Qualters 2001, Hunt et al. 2003, Barnes & Blevins 2003, Yoder & Hochevar 2005, Riggio 2007 & Saville 2009).

Researchers have also been compared the effects of lecture and other teaching methods like computer managed instruction (Halloran 1995), teaching in small groups (Salimi et al. 2007) technology-based instruction (Jeffries, PR.; Woolf, S. Linde, B. 2003), and individual instruction (Coleman 2001) and reported that no significant differences were observed. A study done by Qualters (2001) has also suggested that students do not favor active learning methods for the fear of not covering all of the material in the course, and anxiety about changing from traditional classroom expectations.

It is believed that such engagement will deepen the students' understanding of the course material, encourage them to assume a major responsibility in the learning process, help them improve their intellectual, interpersonal and team work skills; improve their ability and skills to search, obtain, and organize information; improve their ability to identify and solve problems; and help them set the foundation for life-long learning (Wilke 2003, O'Shea 2003, Debessay & Lerner 2004, Joyce et al. 2005).

Some reports contradicted with the current study findings and have shown that students' inactivity in traditional teacher-centered classes would make them bored and exhausted that consequently would decrease their concentration and learning and finally would result in their absence from the classroom (Fasihi-Harandi et al. 2007). So, active teaching methods could decrease the students' anxiety and increase their motivation and learning if implemented with a good design and preparations. This finding is consistent with the reports of Andrew (2006); Tang & Pan (2004); and McFadden (2001) who reported that involving students in teaching process may reduce their anxiety in learning courses.

The CD group showed the lowest posttest mean knowledge scores as compared to the other two groups. Comparison of mean scores of the three studied groups indicated high significant statistical difference ($F = 40.02$, at $P < 0.000$). The highest mean difference of posttest knowledge scores was between the combined group (lecture & CD) and the CD group (mean difference = 34.98) indicating a significant statistical difference at $p \leq 0.000$. In this regards' scientists in education see learning as a process of actively exploring information and formation of meaning by linking it to previous knowledge and experience (Alesandrini & Larson 2002).

Accordingly, the teachers are encouraged not to teach the contents but to teach the students how to learn (Palmer 2003). Hence, students' participation in the education/learning process and substitution of self-directed learning opportunities for the traditional lecture are emphasized (Glenn 2000).

Findings of the current study are contradicted with that of Devitt, Worthley, Palmer & Cehic, (1998) who found that computer-based-training package on ECG interpretation was more successful in helping clinicians interpret ECGs. In this regards Jeffries, PR.; Woolf, S. Linde, B, 2003, McDaniel, & Vaughn, (1998) & Jeffries, PR.; Woolf, S. Linde, B, (1999) In Jeffries, PR.; Woolf, S. Linde, B,

Woolf, & Linde, (2008) indicated that repetitive content is an ideal material to move from traditional instructional methodology to computer-based virtual reality for first-line instruction. They added that interactive learning systems may improve the quality of education, facilitate visualization and understanding and also increase the effectiveness of the education.

Based on findings of the current study the three null hypotheses were rejected. They indicated that there is no significant statistical difference in the mean post test knowledge scores of the three studied groups as compared to each other.

As regards the relationship between gender and the posttest knowledge scores, the current study indicated that gender in general didn't seem to affect the posttest scores among the entire studied group. The same picture was found among the CD group and the combined lecture and CD groups (figure 5 b and 5 c). However, Chi square test indicated a significant statistical difference (at $p \leq 0.029$) in the post test knowledge scores in relation to gender (figure 5a).

Regarding students' opinion toward using different teaching strategies for ECG interpretation the use of interactive CD was enjoyable for students. They indicated that they had fun with the learning process and the teaching staff saved time by not having to repetitively teach the same contents. However, the great majority of students recommended integration of interactive CD with lectures (figure 6). The entire lecture group appreciated the teacher's systematic and clear explanation with giving examples and using graphs. More than half of the studied groups indicated that ECG interpretation requires repeated training & practice. Although students' perception of performance is not a substitute for objective measures, this information may assist educators in tailoring course delivery to help coverage expectations and performance.

Conclusions

Based on findings of the current study we can conclude that verifying and /or combining different methods of teaching ECG and common dysrhythmias interpretation are useful teaching strategies that facilitate students understanding and academic achievements. As well, in spite of its importance, greater immediacy, improved visualization, guidance and interactivity, technology based education could limit students' ability to understand and to proceed in the educational process. That is why technology requires facilities.

Recommendations

- Technology based education must be used as an integral part in the teaching nursing theoretical and practical contents.

- Nurse educators should design teaching methods and learning activities in which the students are challenged and actively involved in learning. They should act as facilitators of learning and should ensure the availability of resources and opportunities for practice.
- Self learning must be emphasized to teach nursing concepts.
- Further studies may be needed to explore specific approaches for allowing students to take a more active role in the teaching/learning process in the classroom.
- Future research is needed to investigate how a variety of active teaching methods can be implemented in nursing.
- Further study is required to compare the tree used teaching strategies considering students grades (related to the taught part) in the final exam.

Limitations

- Unavailability of personal computers among certain students hindered their ability to use the interactive CD, therefore, this teaching method didn't prove to have the expected impact on students' outcome in the current study.

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