ORIGINAL ARTICLE

Retention of Cardiopulmonary Resuscitation (CPR) Knowledge among Undergraduate Teacher Student in Malaysian University

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ABSTRACT

Introduction: There is global support for the teaching of cardiopulmonary resuscitation (CPR) in schools, and teachers are expected to play a leading role in a medical emergency. For effective resuscitation, retention of CPR knowledge after training is paramount. This study aimed at assessing the retention of CPR knowledge among student teachers at pre-, post-immediate, 8th-, and 14th-week post-training. **Method:** A quasi-experimental study using non-probability convenience sampling was conducted to select 41 respondents from the Department of Physical and Health Education, Faculty of Education (UiTM). A validated American Heart Association's 2015 Basic Life Support (BLS) multiple-choice questions (MCQ) were utilised to measure the retention of knowledge among the participants. **Results:** This study demonstrated a significant lack of CPR knowledge during pre-test with the mean scores of M=8.02 despite half of the participants had prior knowledge in CPR. Nevertheless, the paired t-test revealed a significant improvement in the post-scores following the intervention at M=16.20, t(40) = -18.56, p < 0.001, and d=3.91. The one-way RM-ANOVA results showed a decline in the retention rate at the 8th week (M=13.06; p < 0.001) and an improvement at the 14th weeks (M= 5.74; p < 0.001). **Conclusion:** The knowledge of CPR among the student teachers following the intervention program was appropriate, but the deterioration of retention suggested that all student teachers should undergo comprehensive routine CPR courses to avoid the immediate loss of CPR knowledge and skills. The governing bodies in Malaysia should implement CPR training as part of the curriculum for teachers.

Keywords: Student Teacher, Basic Life Support, Knowledge Retention, Cardiopulmonary Resuscitation (CPR)

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INTRODUCTION

A well-recognised medical procedure known as cardiopulmonary resuscitation (CPR), involving chest compression and artificial ventilation for persons suffering from cardiac or respiratory arrest, is intended to restore cardiac function by ensuring sufficient blood flow to the brain and vital organs. To date, an estimated 17.5 million people died each year from cardiovascular diseases (CVD) such as stroke and heart attack, known to be the world's leading cause of death (1). A common immediate medical emergency, such as cardiac arrest, occurred in all groups, from adults to infants, comprising 70% of cases of high mortality risk outside hospital settings (2-3).

As CPR is the considered the second link in the chain of survival, this vital life-saving first aid technique should be taught and practised across the globe as it helps to improve the survival rate of a victim when properly administered by a trained individual before the arrival of medical personnel (4-5). A quick response by a trained individual could ensure the success of saving a victim's life when performed accurately and effectively (6-7).

Recently, an increase in the number of cases of road traffic accidents, fractures, sudden cardiac arrest, seizures, and physical injuries are observed in the school settings (8). Such medical emergencies call for immediate action before the arrival of medical personnel. Therefore, increasing the baseline knowledge, especially in school teachers and students could help manage such unforeseen circumstances better and has the potential to reduce morbidity and mortality from common injuries (8-9). Because students remain at school for a significant period of the day, basic knowledge of CPR among them is essential (10). The teaching of CPR has now been extended to secondary school students, which is internationally encouraged (11). These skills are now being taught as an optional component of the curriculum in some countries, in both primary and secondary schools (11-12). These are consistent with the recommendations of the American

Heart Association (AHA) and the American Academy of Paediatrics, in accordance with the guidelines of the International Liaison Committee on Resuscitation (ILCOR), which strongly recommended the Basic Life Support (BLS) syllabus in the school curriculum (13-14).

The American Academy of Paediatrics and AHA have issued guidelines that stressed the need for school teachers to have emergency response measures to address life-threatening emergencies (10). Thus, in this regard, the training of school teachers will facilitate the learning process for students. School teachers form an integral part of our society, as they are the ones who educate the future generation. Heightened awareness among school teachers will enhance the knowledge of the students, which they can share back home, creating a ripple effect and increase awareness in the community as a whole. In the long run, this will contribute significantly to the individual trained to perform CPR when necessary (13-14).

Research has shown that school teachers are expected to play a vital role in performing CPR on students in any medical emergency. Teachers should acquire adequate knowledge and skills to provide effective resuscitation, as they are often the immediate individual to identify the occurrence of cardiac arrest in an individual on the scene (15). Malaysia has over 10,000 schools with an estimated 5 million students enrolled, along with 420,000 teachers employed from pre-school to high school (16). However, the curriculum of Malaysian schools today still lack such topics, together with the resources to implement teaching (17). Over the years, CPR training in schools has been conducted by people of different vocations, such as physicians, firefighters, medical students, and paramedics (18). However, the most appropriate person to provide this information is yet to be determined (19).

A study by Tanaka et al. (18) indicated that school teachers were suggested to primarily lead CPR training because they know their students' characteristics, learning habits, and environment, but they do so in only 20% of the schools. However, in some studies, 50% of teachers were not willing to teach CPR because they lacked knowledge (20) and CPR teaching skills (18). Teachers are expected to be trained adequately to teach students; however, the actual capacity of teachers to perform CPR has rarely been documented in the literature. Therefore, this study aimed to assess the efficacy of the CPR intervention program, followed by a retention rate of CPR information following the initial introduction at the beginning of the semester among undergraduate student teachers from one of the Malaysian universities (UiTM).

MATERIALS AND METHODS

Research Design
This quantitative study employed quasi-experimental design involving undergraduate Year 1 (Part II) student teachers from the Department of Physical and Health Education (PHYSED), Faculty of Education, (UiTM). The study used a pre-test, intervention, post-immediate test, and a re-test at 8 (RT1) and 14 (RT2) weeks before the end of the semester to determine the retention rate of CPR knowledge. Figure 1 depicts the overall design of the study.
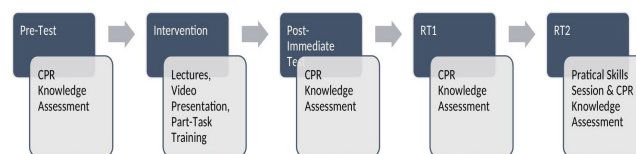

Figure 1: Study Design

Settings & Samples
This study was conducted for 14 weeks, which began from September to December 2019 in the Faculty of Education and Faculty of Health Sciences, Nursing Department, (UiTM). The samples were recruited from the Department of Physical and Health Education (PHYSED), Faculty of Education using non-probability convenience sampling with a total of 41 student teachers. The inclusion criteria include first-year undergraduate students from the respective PHYSED, Faculty of Education (UiTM) and without any physical disabilities. The exclusion criteria include students from different programs from the Faculty of Education (UiTM), and students who attended any additional first aid or emergency science course following the intervention within the study period. Approval of ethical research in human was obtained from the Faculty of Education, Universiti Teknologi MARA (UiTM) Research Committee [UiTM/200-FP(PT.3/3)] The details of the study were described accordingly following the protocol to the student teachers before the interventions. Consent was acquired prior to the commencement of the study, and a 100% response rate was obtained in terms of participation.

Data Collection Procedures
The CPR knowledge was assessed based on the scores in a multiple-choice questions (MCQ) test. The assessment was completed before the intervention (pre-test), immediately upon completion of the intervention (immediate-post), and re-testing at 8 (RT1) and 14 weeks (RT2) following the recommendation given on international guidelines that advocated repeat assessment to ensure adequate retention (21).

CPR Knowledge Assessment
Knowledge of CPR was obtained in a 20-item MCQ. The questions were based on the theory of the BLS Resuscitation Guidelines (Adult, Child & Infant) by the AHA and previously validated by selected professionals in terms of its face validity, construct, criterion, content validity, and tested in several studies for its reliability (22-

24) . A passing mark of 84% for the MCQ was adopted in this study, consistent with the official AHA guidelines. One mark was awarded for each correct answer, while no penalty was given for incorrect answers. A different set of questions with similar contents was used for immediate post and re-testing assessment to minimise independent learning from repeated testing.

Assessment Sequence

Before the intervention, initial demographic data such as age, gender, academic qualification, and prior CPR training were collected, followed by the CPR knowledge assessment. Next, the intervention session was conducted by a single researcher for 180 minutes, which included a CPR lecture using Microsoft PowerPoint to deliver CPR practice theory and skill steps, along with multiple video presentations to help deliver lectures, followed by a hands-on demonstration by the instructor using part-task training method. The part-task training was divided into three sections, concentrating primarily on effective chest compression, opening and sustaining airways, followed by the use of Automated External Defibrillator (AED). Each task was demonstrated by the instructor for approximately 20 minutes, and selected students were invited to practice the task while feedback was given as they performed the task accordingly. Lastly, all students were invited to perform each task alternately towards the end of the session. Participants' knowledge was assessed immediately after completion of the intervention, and another re-test was conducted at RT1 to re-evaluate the retention rate of their CPR knowledge. At week 13, all participants were invited to participate in a 60-minute refresher course conducted by a certified BLS instructor, with four participants per manikin to allow individual exposure to the technical skills training session. A week later, all participants were re-evaluated (RT2) for their final assessment.

Statistical Analysis

The demographic data were reviewed, organised, tabulated, and statistically analysed using descriptive statistics. The mean MCQ test scores from pre and immediate-post testing were compared using the dependent t¬-test to measure the effect of intervention while the retention rate among pre, immediate-post, and re-testing of MCQ test scores was compared using repeated measure one-way ANOVA (RM-ANOVA) analysis with a p-value < .05 to be statistically significant. All statistical analyses were performed using the Statistical Package of Social Sciences (SPSS) version 26 program.

RESULTS

Approximately 68.3% of the study population of 41 Malaysian student teachers were male, and 31.7% were female, and a majority of them possessed a diploma (90.2%) over STPM (9.8%). The participants were categorised into two age categories, i.e., 18–22

and 23–27. The participants indicated that they gained information about CPR from lectures (65.9%), the Internet (17.1%), television (14.6%), and healthcare professionals (2.4%). About 53.7% of the participants reported previous CPR training, while 46.3% of them had no training (Table I).

Table I: The teacher students' demographic characteristics

Demographics		N (%)
Sex	Male	28 (68.3)
	Female	13 (31.7)
Level of Education	STPM	4 (9.8)
	Diploma	37 (90.2)
Nationality	Malaysian	41 (100)
Sources of information about CPR	Lectures	27 (65.9)
	TV	6 (14.6)
	Internet	7 (17.1)
	Healthcare Professionals	1 (2.4)
Previous CPR Training	Yes	22 (53.7)
	No	19 (46.3)
		Mean	(S.D)
Age-Group	18-22	1.34	.481
	23-27	1.00	.000

A mean score of 8.02 in the pre-test CPR knowledge MCQ indicated poor acquisition of theoretical knowledge despite half of the participants had prior CPR knowledge. However, scores from the post-immediate test revealed a considerable improvement immediately after the training intervention, with a mean score of 16.20 (Table II). Despite the significant improvement, the knowledge scores dropped to 13.06 after eight weeks in RT1. Nonetheless, an improved score of 15.74 was recorded after a short refresher course at week 13 prior to the re-test at RT2.

Table II: Mean scores for CPR knowledge assessment of pre-test, post-immediate test and re-test (RT1 & RT2)

Variables	Mean	S.D	N
Pre-Test	8.02	2.47	41
Post-Immediate Test	16.20	1.70	41
RT1 (8 Weeks)	13.06	1.98	41
RT2 (14 Weeks)	15.74	1.95	41

To determine the effectiveness of the intervention program, a two-tailed paired samples t-test with an alpha level of 0.05 was used to compare the pre-test (M = 8.02, SD = 2.47) and post-immediate test (M = 16.20, SD = 1.70) of CPR knowledge among 41 student teachers. Visual inspection of the relevant histograms indicated that neither the normality nor the normality of differences scores assumptions was violated. On average, the participants' scores of the post-immediate test were 8.171 points higher than their pre-test scores,

95% CI (-9.06, -7.28). The difference was statistically significant, t (40) = -18.56, p < 0.001 and the Cohen's d for this test was 3.91, which can be described as large effect size (Table III).

To determine the retention rate of CPR knowledge, RM-ANOVA was used to compare CPR knowledge scores of the 41 student teachers in four different types of test (pre, post-immediate, RT1, and RT2). Boxplots and Shapiro-Wilk statistics indicated that the assumption of normality was supported, i.e., the Fmax was 2.11, demonstrating homogenous variances. Meanwhile, Mauchly's test indicated that the assumptions of sphericity were not violated. The ANOVA results showed a significant difference in the test scores ranging from the pre to re-test, F (3,120) = 159.17, p < 0.001, partial χ^2 = .799 (Table IV). The pairwise comparison (Table V) revealed that the retention rates are significantly different, with an immediate improvement between the pre-test (M = 8.02, SD = 2.47) and the post-immediate test (M = 16.20, SD = 1.70) p < 0.001, a slight decrease at RT1 (M = 13.06 , SD = 1.98) p < 0.001, and an improvement at RT2 (M = 15.74 , SD = 1.95) p < 0.001.

DISCUSSION

This study showed marked deficient CPR knowledge among student teachers prior to the intervention, although more than half of the respondents had previous CPR training. The mean pre-test scores merely indicated that they failed to achieve the standard AHA passing mark guidelines. Nevertheless, despite the significantly poor pre-test scores, the respondents' post-immediate

scores had significantly improved after the intervention program. This result is consistent with several studies, which suggested that a half-day CPR program integrated with lectures, presentations, and part-task training is sufficient to provide adequate theoretical knowledge (25-26). In this study, re-assessment of participants' knowledge at eight weeks showed a decline in knowledge level, indicating that the participants failed to retain their knowledge within the two months following the intervention program.

Research has shown that the knowledge and skills of healthcare workers decrease within three months following training (27-28). In this study, participants were considered laymen, would have higher rates of decline compared to healthcare workers, indicating a much faster rate of decline. Moreover, CPR training incorporates both cognitive and psychomotor abilities in which all components could be integrated and best learned through practice for an effective outcome (26, 29). Studies have consistently shown that CPR training programs that do not provide psychomotor skills sessions result in an inadequate level of proficiency (29-30) and that these skills are essential components of the CPR training program. Therefore, the lack of the above elements explained the participants' declining rate of comprehension during the re-assessment test.

Despite the declining rate, this study indicated that the respondents were able to demonstrate substantial progress in their knowledge scores during the final re-testing after an hour of the refresher course. The major highlight of the refresher course was the introduction

Table III: Dependent-t test of pre & post-immediate differences of CPR knowledge scores

Variable	Paired Differences							
				Confidence Interval				
	Mean	S.D	Mean Difference	Lower	Upper	t	df	Sig
CPR Knowledge	Pre (8.02)	2.47	- 8.171	-9.060	-7.281	-18.561	40	.000
	Post (16.20)	1.70						

Table IV: One-way repeated measures analysis of variance (ANOVA) of CPR knowledge scores

Variable	Tests of Within-Subjects Effects				
	F	df	df (error)	Sig	Partial Eta Squared
CPR Knowledge	159.17	3	120	.000	.799

Table V: Pairwise comparison between CPR knowledge test scores

Test Scores	Mean Difference	Std Error	Sig
Pre & Post Immediate	-8.171	.440	.000
Pre & RT1	-5.039	.504	.000
Pre & RT2	-7.717	.533	.000
Post Immediate & RT1	3.132	.326	.000
Post Immediate & RT2	.454 *	.356	1.000
RT1 & RT2	-2.678	.310	.000

* The mean difference is significant at the .05 level

to simulated CPR training using manikin to each participant. During this training, participants were given a chance to practice the skills related to resuscitation. In addition, the certified BLS instructor performed a low-fidelity simulated scenario in groups with a duration of five minutes using a heart attack case. This was followed by a 15- to 20-minute debriefing session to all participants using the Gather-Analyse-Summarise (GAS) model to discuss their performance in providing adequate resuscitation, such as correct hand placement, rate of compression, and proper use of AED to provide effective and high-quality resuscitation.

To date, the use of simulation, especially in CPR training, has been shown to benefit the development of cognitive and psychomotor skills of learners that are educationally effective. This also confirmed that regular training, such as refresher courses integrated with simulation, can be a useful and effective way to help retain CPR knowledge and skills (31-32). Aside from it, many researchers reported the effect of CPR refresher course on knowledge and psychomotor skills, in which CPR knowledge tends to be retained more rather than psychomotor skills (33-35).

Overall, the student teachers demonstrated a weak retention capacity of CPR knowledge in this study. In merely eight weeks, the knowledge starts to decrease to a level that is no longer satisfactory. Despite the declining rate, this study presented a range of knowledge that was beneficial for future studies. Due to the low level of CPR information retention, the majority of researchers have started to emphasise the need for refresher course. For most non-medical community providers, yearly courses over two years would be necessary and have been implemented in most of the first aid response courses (36). However, based on the results of this study, the scope and duration of the existing procedure were not decided upon. According to the retention trend in this study, the authors would suggest that an appropriate refresher course be conducted within 15 weeks and might be conducted periodically throughout the entire academic year with a duration of one hour to prevent the deterioration of CPR knowledge.

Lastly, the effectiveness of our intervention program is another finding that requires further investigation. Overall, the 180 minutes training of theoretical and part-task training would be the ideal teacher training program despite the lack of further evaluation by other programs from different universities in Malaysia. Additionally, this study also proves that the introduction of refresher course infused with simulation exercises for effective resuscitation should be emphasised as part of innovative teaching techniques in CPR to promote better retention of knowledge and skills.

The findings of this study suggest that it is highly recommended that further studies be performed to determine the best and highly effective approach to delivering a resuscitation training program for prospective Physical Education teachers. The identification of the ideal duration of the training program, together with modules, methods, and teaching techniques, such as simulation, to be incorporated as part of the training, should be central to the delivery of the program. To ensure the sustainability of the knowledge and skills in the provision of effective resuscitation during an emergency, the retention rate between teachers should also be considered as an additional criterion in the design of refresher courses, which can be delivered later in a more appropriate duration. As per evidence, the rate of retention among school teachers is expected to deteriorate within three months, suggesting that intervention, e.g., refresher courses conducted over a period, would help prevent further decline. A brief refresher course incorporated in an hour simulation exercise could be a potential solution to be implemented periodically during the academic year as a routine training for all teachers. Furthermore, recurrent practice and drills or mock drills should also be included frequently to ensure that teachers are appropriately prepared to manage emergencies. In the meantime, physical educators need to be well prepared to deal with medical emergencies, and subsequently, to initiate proper life-saving techniques based on the standard emergency plan, as they are often the first responders in the field besides other school members. Therefore, the importance of including CPR and first aid knowledge and skills as part of the teacher education curriculum is imperative, for this is the time to make CPR and first aid training compulsory training for all teacher training, even to the extent of the school curriculum, from the perspective of teachers. These are following the Guidance Documents from The Society of Health & Physical Educators (SHAPE), America which promotes best practice in health education, including the certification of qualified health educators who teach health at all levels, as per its core principle. It is time for the Malaysian government agencies, such as the Ministry of Education (MOE) and the Ministry of Health (MOH) to collaborate formally, share ideas and workforce to sustain formal CPR and first aid teacher training courses. It is also hoped that the knowledge will be conveyed to the students so that each trained member will become competitive enough to deliver first aid independently and spontaneously in real-life situations.

Despite the findings, our study is not without limitations. Firstly, the study examined only one university in Malaysia (UA). Therefore, the results cannot be generalised to all student teachers in Malaysia. Furthermore, although the short intervention program coupled with different types of methods yielded an effective outcome in delivering the contents, the short duration of the course may impact the validity of the standard structured program recommended by the AHA BLS, which is a full-day course. Despite the significant

differences identified in our training program, the results should be interpreted with caution, since they focus only on theoretical and neglected the practical training, which should be emphasised as part of the program initially. Lastly, the training program has not been tested elsewhere previously, even in other universities in Malaysia; thus, no further evaluation of the efficacy of the program was done.

CONCLUSION

It is shown that the degree of awareness of CPR between student teachers following the intervention program was appropriate. Nevertheless, the low level of retention rate perceived by the declining scores indicated that the ideal two-years refresher course was not considered to be optimal. All student teachers must receive regular, periodic refresher course with possible integration of simulated exercise as an alternative training method to avoid immediate deterioration in CPR knowledge and skills. Finally, the higher authorities need to start implementing CPR teaching as part of the curriculum of school teachers, which will benefit the children and societies for a better tomorrow.

ACKNOWLEDGEMENTS

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