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Design of an instructional module on Basic Life Support for homeschooled children

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Abstract: Basic Life Support (BLS) can increase a victim's chances of survival when administered promptly and correctly. Cardiac and respiratory arrests occur more frequently when the victim is at home far from clinical support. Hence, prompt action by family members trained in BLS can save the victim's life. In this study, the requirements for the design of a module for teaching BLS as an important life skill to homeschooled children is investigated using Taba's model of curriculum design. The Fuzzy Delphi technique was used to obtain consensus among 10 experts for the design, content, strategies, activities and assessment for the instructional module. The experts agreed that BLS should be taught to children above 15 years, with content focusing on the techniques of proper chest compression, rescue breath and rescue of drowning victims. The findings indicate that the preferred strategies were observation of demonstrations and hands-on return demonstrations with activities using manikins to simulate emergency scenarios. The preferred methods of assessment were practical demonstrations, multiple choice questions and online assessment. The findings provide insights for the design of a BLS module which could be developed for homeschooled children.

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PUBLIC INTEREST STATEMENT

This article is useful for determining aspects of knowledge, skill and delivery of instruction for Basic Life Support (BLS) and cardiopulmonary resuscitation (CPR) which may be taught to children outside of the school context. This is a necessary life skill which will enable students to save the lives of adults requiring this emergency procedure. This research can provide input for parents, curriculum developers, educational institutions, members of the public and other stakeholders on important aspects such as the age when BLS should be taught to children, and the components, strategies, activities and assessment approaches which are appropriate to be taught.

Subjects: Education; Humanities; Medicine, Dentistry, Nursing & Allied Health

Keywords: homeschooling; Basic Life Support; cardiopulmonary resuscitation; Fuzzy Delphi method; instructional module

1. Introduction

Injuries and life-threatening incidents are always unexpected. The failure to take prompt action may escalate an emergency situation and lead to the mortality and morbidity of the victim. However, early intervention may be effective in preventing further deterioration of the patient's condition, and may even reverse the life-threatening condition (Savastano & Vanni, 2011). Basic Life Support (BLS) is an emergency procedure required for victims of cardiac arrest, respiratory arrest and foreign-body airway obstruction (Smith, Cronenwett, & Sherwood, 2007). Prompt administration of BLS increases the patient's chances of recovery. It is believed out-of-hospital mortality could be significantly reduced if at least 15% of the population had knowledge of BLS (Maconochie, Simpson, & Bingham, 2007).

Cardiopulmonary resuscitation (CPR) is a main component of BLS. After a catastrophic injury, CPR allows for temporary circulatory support for the continuous delivery of oxygen to the brain so that there is a better chance of survival. According to the American Heart Association (AHA) Guidelines, early recognition and response to a sudden cardiac arrest can improve the chances of survival by as much as 50% (Travers et al., 2010). However, the situation is normally chaotic and confusing when a sudden cardiac arrest occurs and a rescuer who is not adequately skilled in BLS may not be effective in saving the victim's life. The rescuer's confusion may delay the emergency response required for CPR (Travers et al., 2010). On the other hand, increased knowledge results in increased confidence by the rescuer when attempting resuscitation (Colquhoun, 2012). Training more lay people in BLS could reduce mortality rates as there would be more people prepared to respond in emergency situations (Assar et al., 1998). Hence, it is important to train members of the public in BLS in order to save lives.

In Malaysia, homeschooling is an alternative form of education that emphasises quality education based on beliefs in inculcating moral values and strong family ties in a community (Alias, Abdul Rahman, & Siraj, 2014). In 2002, it was estimated that there were 5,000 homeschooled children in Malaysia with the number increasing at an exponential rate in the last 20 years (Alias, Siraj, Abdul Rahman, & DeWitt, 2013; Goh, 2013). There are essentially three variations of homeschooling in Malaysia: parents tutoring their children at home; a few families meeting together to teach their children in a casual setting; and a teaching centre which applies the homeschooling approach and syllabus (Alias et al., 2014). Technology enables homeschooled children to acquire knowledge while away from the traditional school environment. Curriculum materials for online learning such as blogs, webquests, videos and digital stories delivered on the internet can be utilised in teaching and learning activities for homeschooled children (Alias, Abdul Rahman, Siraj, & Ibrahim, 2013).

BLS should be taught to homeschooled children as children who are homeschooled are constantly surrounded by older adults. The chances of being exposed to emergency conditions such as cardiac arrests at home are high. Travers et al. (2010) reported that 88% of the 383,000 out-of-hospital sudden cardiac arrests a year happen at home. Most cases are unexpected as victims would appear healthy, without any history of heart-related ailments. Immediate provision of BLS often determines whether the victim survives or has an early death (Savastano & Vanni, 2011). Hence, BLS is an essential life skill which needs to be learnt by lay people in order to handle emergency situations effectively.

Many countries incorporate BLS as part of the school curriculum. The Resuscitation Council of the United Kingdom's (2010) call for CPR to be made mandatory was addressed when BLS was made part of the National Curriculum in England. However, learning CPR is not compulsory in Malaysia. BLS was introduced in 1998 in primary and secondary schools as an extracurricular activity for developing students' confidence. At present, the Malaysian Red Crescent Society is one of the organisations

which teaches BLS to students and employs the AHA Guidelines in handling CPR for Emergency First Aid (Ibrahim, 2010).

Research shows that children can acquire the knowledge and skill for learning BLS. An international study showed that 86% of children aged 9 to 18 could perform CPR correctly (Fiore, 2009). However, other researchers argue that the physical limitations and level of maturity of the rescuer have an equally important role in ensuring the survival of the unconscious patient (Bollig, Wahl, & Svendsen, 2009). Although younger children may be unable to perform BLS, they could use their knowledge of BLS to instruct an adult on the appropriate technique (Van Raemdonck, Monsieurs, Aerenhouts, & De Martelaer, 2013). Hence, younger children should be taught to assess whether a victim requires BLS and to apply the necessary emergency response with adult assistance. This allows them to apply the skills and knowledge for use in the future.

Homeschooling as an alternative form of education in Malaysia seems to be a fast-growing trend. This means that there is a need to ensure that homeschooled children are exposed to BLS to enable them to handle emergency situations. This study investigates the experts' opinion on the design of an instructional module for teaching BLS as an essential life skill in the homeschool curriculum for the use of parents and facilitators. The input from experts would ensure guidelines for effective instruction in BLS for parents of homeschooled children to plan teaching and learning activities for the learners (Alias, Abdul Rahman et al., 2013).

2. BLS

BLS is defined as emergency treatment given to a victim of cardiac or respiratory arrest using CPR or emergency cardiac care (Mosby Medical Dictionary, 2013). BLS supports breathing and circulation in an unconscious patient to preserve their life while waiting for professional emergency medical attention. According to the AHA Guidelines (2010), the basic components of BLS are the immediate recognition of an emergency situation whether sudden cardiac arrest or respiratory arrest, the activation of the emergency response system, administration of early CPR, and application of rapid defibrillation with an automated external defibrillator (AED) (Travers et al., 2010). In the AHA Guidelines for BLS, recognition and response to heart attacks and strokes is the first level (Travers et al., 2010) (see Table 1). In this study, the extent of knowledge and skills on BLS that homeschooled children need to know would be determined.

Knowledge of only the theory and procedures of BLS is insufficient. Instructors need to provide practice for performing BLS. The BLS sequence involves several techniques and up to 50 psychomotor skills are required for effective BLS (Assar et al., 1998; Chamberlain et al., 2002). However, most

Table 1. Summary of key BLS component of adult, children and infant

Component	Unconscious (all ages)			
	Adult	**Children**	**Infant**	
Recognition	No breathing, not breathing normally (e.g. only gasping)	No breathing or only gasping		
CPR sequence	Circulation/Airway/Breathing	Circulation/Airway/Breathing	Circulation/Airway/Breathing	
Compression rate	At least 100/min			
Compression depth	At least 2 inches (5 cm)	At least 1/3 AP Depth About 2 inches (5 cm)	At least 1/3 AP Depth About 1 ½ inches (4 cm)	
Airway	Head tilt–chin lift			
Compression: ventilation ratio	30:2 (1 or 2 rescuers)	30:2 (Single rescuer)		30:2 (Single rescuer)
		15:2 (2 Rescuers)		15:2 (2 Rescuers)
Defibrillation	Attach and use AED as soon as available. Minimise interruptions in chest compressions before and after shock, resume CPR beginning with compressions immediately after each shock			

Source: American Heart Association 2010: Guidelines for Cardiopulmonary Resuscitation & Emergency Cardiovascular Care in Travers et al. (2010).

instructors simplify the technique into manageable steps to be memorised when teaching compression and ventilation (Chamberlain et al., 2002). While the average lay person can be taught how to approach the patient and check breathing, more difficult techniques like chest compression and ventilation requires several sessions of instruction (Chamberlain et al., 2002).

2.1. Cardiopulmonary support

CPR is a basic emergency procedure consisting of manual artificial respiration and external cardiac massage (Mosby Medical Dictionary, 2013). It is used to establish a temporary means for ventilation and circulation to prevent irreversible brain damage due to anoxia or lack of oxygen supply to the brain. During external cardiac massage, the compression and decompression of the chest allow for the filling of the heart and dispersion of blood through the circulatory system. The circulatory system is the main mode of oxygen distribution from the lung to the rest of the body. Mouth-to-mouth breathing or any form of artificial ventilation is administered with cardiac massage to oxygenate the blood in the lungs before being pumped to the rest of the body. A summary of the standard practice for CPR as suggested by the AHA is shown in Figure 1.

2.2. Taba's model of curriculum design

Taba's model of curriculum design will be the framework for the development of the instructional module on BLS. Taba's model is based on five mutually interactive elements: objectives, content, learning activities, teaching strategies and assessment measures (Lunenberg & Irby, 2005). The experts' knowledge and experience in teaching BLS with different learners can be utilised for designing this module and in determining the content taught and the teaching strategies, activities and assessment employed.

Instruction on BLS has previously been given to lay people. In a mandatory course for learner drivers in Denmark, the learners (with an average age of 20 years) improved in both knowledge acquisition and performance in BLS (Adelborg, Thim, Secher, Grove, & Løfgren, 2011). Other studies have shown mixed results as the effectiveness of training lay persons in BLS depends on the instructional strategies used (Hamilton, 2005). Researchers also recommended the need for more studies in determining the instructional strategies and tools which could improve performance in BLS and reduce instruction time (Iserbyt, Elen, & Behets, 2009).

Several teaching strategies have been employed for teaching BLS among trainee nurses: direct instruction using lectures, peer tuition in groups or pairs, simulation, computer-aided learning and gaming (Hamilton, 2005). However, there appears to be limited consensus on which is the most appropriate strategy for teaching lay persons. A survey of 195 nursing education schools which offered nursing education programmes in the United States of America indicated commonly used pedagogical strategies in teaching nursing education were readings (84%), lectures (83%), clinical studies (75%), case studies (57%), paper assignments (56%), course modules (52%), web-based learning (52%), problem-based learning (49%), interprofessional learning (43%), simulations (43%) and

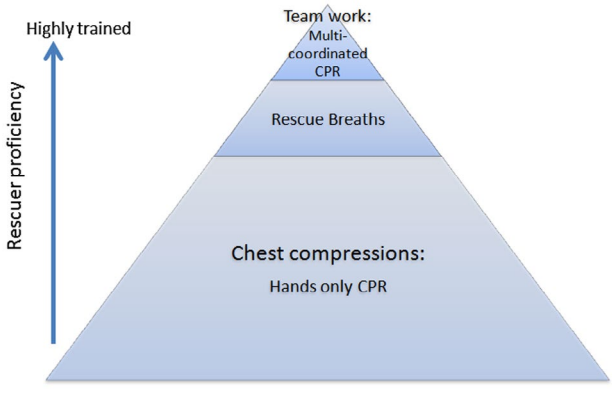

Figure 1. Building block of CPR (American Heart Association Guidelines, 2010) in Travers et al. (2010).

return demonstrations (36%) (Smith et al., 2007). However, when teaching safety components in the nursing courses, different strategies were emphasised: clinical studies (89%), lectures (89%), readings (89%) and return demonstrations (83%) (Smith et al., 2007). Although this study may indicate clinical studies, lectures and readings were suitable strategies for trainee nurses, other strategies which may be more effective for teaching CPR skills need to be considered (Sarac & Ok, 2010).

The traditional approach of direct instruction through lectures is useful in transferring theoretical knowledge and can be supplemented with notes and other materials. Web-based materials using a combination of audio and video in the traditional lecture approach appear to have better results for skill acquisition (Done & Parr, 2002; Sarac & Ok, 2010). However, when traditional lectures and self-instruction using videos are compared, the traditional lecture seems to enable students to have better performance (Sarac & Ok, 2010). This is probably because instructors are able to identify students' misunderstandings and errors immediately. The traditional lecture enables some form of interaction as learners' non-verbal cues can be interpreted to determine if further explanation is required. Hence, the didactic nature of the lecture seems to be effective for learning (Assar et al., 1998).

Self-instruction using digital resources has been used for training BLS. Hamilton (2005) notes that the advantage of video lectures was that it seemed economically viable as videos could be viewed repeatedly to ensure understanding. Self-instruction may be suitable for motivated lay persons who are motivated because they faced the risk of performing CPR at home, but not for those less motivated. In the latter, the activities selected for training the skill would be important (Done & Parr, 2002; Hamilton, 2005).

Group work is another strategy used to teach BLS. Peer tuition in groups or pairs could be an effective strategy especially when the peer tutors in the group possess excellent teaching experience (Hamilton, 2005). The reciprocal learning model of instruction where students work in pairs to master lesson content has been used in several cases. In this model, one learner performs the task while the other learner teaches and provides feedback based on the information from task cards (Iserbyt, Mols, Charlier, & De Meester, 2014). This appears to be effective and can be used in secondary schools and universities, especially when there is a lack of competent instructors (Iserbyt et al., 2014). Reciprocal learning may be able to address the problem of a lack of knowledge in BLS in the peer tuition method (Hamilton, 2005).

Another strategy which has been used is simulation. Simulation allows the application of theory in a safe and controlled environment (Hope, Garside, & Prescott, 2011). Videos can be used for the simulation of emergency scenarios and may prove to be effective for gaining confidence and learning. Human–patient simulation has been conducted among undergraduate nursing students for practice and evaluation of the skills of BLS (Ackermann, 2009). A manikin is a life-sized human anatomical model which has been used for the simulation of BLS. Some manikins may have Cardiac Arrest Simulation (CAS) to mimic the emergency situation during a cardiac arrest. Simulation has been shown to improve performance and confidence as well as humanistic and problem-solving skills among trainee nurses (Hamilton, 2005; Hope et al., 2011).

There needs to be sufficient hands-on practice for performing BLS. In an experimental study between two groups: one group had interactive training with computer and instructor-led (hands-on) practice, while the other group used only the computer program, the group of students who received the hands-on practice were more successful at CPR performance (Reder, Cummings, & Quan, 2006). While computers can be used for teaching the theoretical aspect of BLS, enabling repetition and feedback to highlight areas for improvement, hands-on practice is still an important aspect in training for BLS (Done & Parr, 2002; Hamilton, 2005; Reder et al., 2006).

The assessment of BLS is measured based on the achievement of the following criteria: average compression rate, percentage of correct chest compressions, the number of too-low hand positions and wrong hand positions, the number of incomplete releases, the average number of ventilations,

the average volume of ventilations, the minute volume ventilations, the number of too-fast ventilations, the total number of ventilations and the percentage of correct ventilations (Sarac & Ok, 2010). Return demonstration is an assessment technique where a student demonstrates what has been taught for the trainer to evaluate whether he has mastered the skills effectively (Smith et al., 2007). Assessment is done with the trainer making observation notes or using a skill-observation checklist (Sarac & Ok, 2010). A skill-reporter manikin, which is a manikin connected to a computerised system to measure and report students' performance on ventilation and chest compression can also be used in assessment (Sarac & Ok, 2010).

The success of any BLS program depends on the willingness and motivation of the learner to perform this procedure (Flint et al., 1993). Flint et al. (1993) suggested that lay persons enrolled in the BLS course need not be given any formal evaluation on the procedure while health care providers and instructors should be tested formally because of the critical nature of the skills in their profession. On the other hand, the importance of practice was noted. When there was less opportunity for practice in a BLS course, performance would be poorer (Parnell & Larsen, 2007). Another contributor to success of a BLS course could be the duration of the course. When lay persons were trained over three sessions in stages on BLS, they seemed to retain the skills better (Sarac & Ok, 2010). Hence, staged training, where the skills are taught in isolation over several sessions may be effective for lay persons (Sarac & Ok, 2010). Another consideration is the need for refresher courses after training. Isbye, Meyhoff, Lippert, and Rasmussen (2007) reported that adults attending a course had higher BLS retention scores over a three-month period as compared to school children attending the same course. This indicates that younger children may require more frequent refresher courses with more human–patient simulation to improve skill retention.

2.3. Purpose of study

The purpose of this study is to design an instructional module on BLS for homeschooled children. This instructional module will be used as a guide for parents and facilitators of homeschooled children in Malaysia to provide the knowledge and skills of BLS according to the needs of homeschooled children.

2.4. Objectives of the study

The objectives of the study are:

(1) To determine the appropriate age for teaching BLS to children, according to the experts.\
(2) To identify the core knowledge components for parents to teach BLS among homeschooled children according to the experts.
(3) To prioritise the instructional strategies for teaching BLS to homeschooled children according to the experts.
(4) To select suitable activities for teaching BLS to homeschooled children according to the experts.
(5) To design assessment for homeschooled children's competency after learning BLS according to the experts.

2.5. Research Questions

The study was implemented in order to answer the following research questions:

(1) What is the appropriate age for teaching BLS to children according to the experts?
(2) What are the core knowledge components for parents to teach BLS among homeschooled children according to the experts?
(3) What are the effective instructional strategies teaching strategies for teaching BLS to homeschooled children according to the experts?
(4) What are the activities for teaching BLS to homeschooled children according to the experts?

(5) What are the assessment approaches to ensure homeschooled children's competency after learning BLS according to the experts?

3. Methodology

The study was conducted using the Fuzzy Delphi Method (FDM) to obtain consensus among experts. This method is an objective and time-efficient method for obtaining consensus (Murray, Pipino, & van Gigch, 1985). This method can be used with Taba's curriculum design model for the development of modules using experts' opinions (Lunenberg & Irby, 2005). The FDM method is based on principles of the Delphi technique and fuzzy number theory (Murray et al., 1985). The experts' opinions are analysed using fuzzy numbers, which is based on the concepts of cumulative frequency distribution and fuzzy integral (Ishikawa, Amagasa, Shiga & Tomizawa 1993). This method has been used to obtain consensus to generate ideas for designs for innovative modules and solutions (Mohd Jamil, Hussin, Mat Noh, Sapar, & Alias, 2013; Rosman, Alias, Abdul Rahman, & DeWitt, 2013). Hence, the FDM is a suitable method to gather experts' opinion in this study as there does not seem to be any module in BLS among homeschooled children.

3.1. Gathering expert opinion

A panel of 10 experts was selected as part of the decision-making group. The criterion for selection was a minimum of five years teaching experience in the clinical field with specialisation in BLS, or experience in homeschooled organisations. Five of the experts were invited to participate in the initial interview, and agreement was sought from the panellists to participate in the FDM and respond to the questionnaire. In this study, the experts were five lecturers and clinical instructors for BLS in a tertiary educational institution in a cardiac centre, two teachers in homeschooling institutions and three parents of homeschooled children who were actively involved in educating homeschooled children. There was difficulty in obtaining experts who had expertise in both BLS and homeschooling in Malaysia. The number of experts in a FDM expert panel can range from 10 to 50 (Adler & Ziglio, 1996, Jones & Twiss, 1978). In this study, 10 experts were sufficient to validate the reliability of data collected and a defuzzification value of 75% and above would be used to indicate consensus (Adler & Ziglio, 1996).

The experts' opinions were gathered in a two-step process: an interview session in the first stage, followed by the administration of the FDM questionnaire developed from data from the interview in the second stage. In the first stage, the five experts were interviewed using open-ended questions to determine important aspects which needed to be included such as the age required to learn BLS, content which needed to be covered, as well as strategies, activities and assessment methods which could be used in the module. The feedback provided from the experts was used to design the items for the FDM questionnaire. The questionnaire employed a five-point Likert scale and was used to obtain consensus

3.2. Analysis of data

The data collected from the questionnaire was analysed using the FDM as proposed by Ishikawa, Amagasa, Shiga, and Tomizawa (1993). Noorderhaven (1995) indicated that applying the FDM to obtain a group decision can solve the fuzziness of common understanding among experts. The result and score for each question were arranged according to hierarchy. The analysis of the questionnaire used one cycle of Fuzzy Delphi approach and Triangular Fuzzy Number and a Defuzzification Process. In this study, the researcher used a five-point linguistic scale (see Table 2).

Table 2. Five point linguistic scale

Strongly agree	0.6	0.8	1.0
Agree	0.4	0.6	0.8
Moderately agree	0.2	0.4	0.6
Disagree	0.1	0.2	0.4
Strongly disagree	0.0	0.1	0.2

The Triangular Fuzzy Number involves three mean points ($m1$, $m2$, $m3$): the minimum, the most reasonable value and the maximum value from a graph of means, while the defuzzification process enables the ranking of the consensus to be done. The triangular fuzzy numbers were used to calculate the evaluation value and all the data were tabulated to obtain the average value ($m1$, $m2$, $m3$) (Kaufmann & Gupta, 1988; Abdul Rahman et al., 2014).

Next, the distance between two fuzzy numbers and threshold value, d, is determined. The requirement is that if $d \leq 0.2$, the result indicates that there was consensus among all members of the panel. If the results differ, a second round is required (Kaufmann & Gupta, 1988; Abdul Rahman et al., 2014). In this case, the values of $d \leq 0.2$, and the percentage of consensus was above 75% which is acceptable. Group consensus is achieved when the percentage of consensus is 75% and above, otherwise a second questionnaire needs to be administered.

Finally, the defuzzification process is done. In this study, the geometric mean model, ($m1$, $m2$, $m3$) proposed by Klir and Yuan (1995) for FDM to find out the common understanding of a group decision is used. The FDM was chosen for this study because of the validity of the approach when experts are selected, even when the number of experts is small (Siraj & Ali, 2008).

4. Findings and discussions

The findings from this study will provide the guidelines for the design of a module for teaching BLS among the parents of homeschooled children. Data were obtained from the first round of interviews and analysed thematically to determine the important elements in the design of the module. The themes were then used to develop the FDM questionnaire and further analysed.

The experts unanimously agreed that a module for teaching BLS was required as part of the curriculum for homeschooled children as it was an important life skill and children needed to be prepared to face life-threatening situations such as a victim with cardiac or respiratory arrest.

4.1. Appropriate age for teaching BLS

The first research question was on the appropriate age for teaching BLS to homeschooled children. The experts' consensus was highest for 15 years of age (defuzzification value of 0.77), followed by above 13 years (defuzzification value of 0.67) (see Table 3). The results seem to contradict Fiore's (2009) view that children as young as nine years could perform CPR correctly. The experts agreed that teenagers above 15 years of age had the physical strength and level of maturity to perform proper and effective chest compression on a victim during resuscitation.

These limitations were similar to Bollig et al.'s (2009) arguments that the physical limitation of a child and his level of maturity is equally important when saving the life of an unconscious patient. Children between the ages of six to seven years old could perform the basic first aid measures: checking for victim responsiveness and breathing, calling for help, giving correct information to the emergency medical service and establishing the recovery position for an unconscious patient, but the experts did not seem to have taken this into consideration (Bollig et al., 2009).

4.2. Core knowledge components for parents to teach BLS among homeschooled children

In determining the core knowledge components for teaching BLS among homeschooled children, experts agreed that the most important content was techniques of proper chest compression and rescue breath (defuzzification value of 0.77 each), and rescuing drowning victims (defuzzification value of 0.77). Other equally important components which had high consensus are the proper ratio of ventilation to compression (defuzzification value of 0.73), and the proper method of rescuing a choking victim (defuzzification value of 0.63) (see Table 4).

These findings differed slightly from the fundamental components of BLS required by the AHA Guidelines (2010) which placed equal importance on the recognition of sudden cardiac arrest, and

Table 3. The age to start teaching BLS

Questionnaire items (years)	Fuzzy evaluation	Defuzzification value
Above 8	(2.30, 3.90, 5.80)	0.33
Above 10	(3.50, 5.20, 7.20)	0.45
Above 13	(5.00, 7.00, 9.00)	0.67
Above 15	(5.80, 7.80, 9.80)	0.77

Table 4. Knowledge components in BLS

Questionnaire items	Fuzzy evaluation	Defuzzification value
Proper chest compression	(5.60, 7.60, 9.60)	0.77
Proper rescue breath	(5.20, 7.20, 9.20)	0.77
Ratio of ventilation to compression	(5.00, 7.00, 9.00)	0.73
Rescuing drowning victims	(5.40, 7.40, 9.40)	0.77
Rescuing choking victims	(4.60, 6.60, 8.60)	0.63

rapid defibrillation with an AED. An AED would not be easily accessed by the student and requires an experienced professional to use it. Hence, the use of AED need not be included in the curriculum. On the other hand, the proper rescue procedures for activation of the emergency response system and CPR were considered important (Travers et al., 2010). Chest compression and ratio of ventilation to compression are more difficult techniques, but the experts still considered these to be important skills for homeschooled children to acquire (Chamberlain et al., 2002).

4.3. Instructional strategies for teaching BLS to homeschooled children

There are different teaching strategies which could be used for teaching BLS. Consensus could not be established on the most effective strategy as the strategy employed had to be adapted to the learners and their home environment. However, consensus on the use of observation of practical demonstrations and hands-on return demonstration for practice (defuzzification value of 0.73 each) appeared to be higher (see Table 5).

Observation of demonstrations by the trainer is a strategy for direct instruction which has been proven effective in teaching BLS to trainee nurses (Sarac & Ok, 2010). While the trainer demonstrates the techniques, the learners observe the procedure and take notes. The trainer would be able to get both verbal and non-verbal feedback from the learners during the demonstration and he would be able to focus his instruction on areas which the learners require more training. The interactions during the demonstration would improve the effectiveness of the training and hence, learning (Assar et al., 1998).

Hands-on practice is an important strategy for practical skill development and was required to train learners to develop the psychomotor skills required for BLS (Maconochie et al., 2007). The hands-on return demonstration was considered as an effective strategy by the experts. Return demonstration is an instructional strategy frequently used for teaching components related to safety in nursing education (Smith et al., 2007). Other strategies for teaching components related to safety included clinical studies, lectures and readings (Smith et al., 2007). Lectures and readings may be

Table 5. Teaching strategies for BLS

Questionnaire items	Fuzzy evaluation	Defuzzification value
Observation of practical demo by trainer	(5.20, 7.20, 9.20)	0.73
Video presentation	(5.00, 7.00, 9.00)	0.70
Hands-on return demo by participants	(5.60, 7.60, 9.60)	0.73

useful, but is more for the theoretical knowledge of BLS. Hence, the experts seemed to be concerned on having sufficient practice in BLS (Parnell & Larsen, 2007).

Video presentation was another strategy recommended by the experts. However, practice was not incorporated in videos. Video presentations have been used for BLS instruction. When combined with direct instruction through lectures, this seems to be an effective strategy (Sarac & Ok, 2010). However, a module designed with video presentation needs to have activities for practice, which will be discussed next.

4.4. Activities for teaching BLS to homeschooled children

The fourth research question addresses activities which should be used to teach BLS. Practice was considered important for learning BLS, but there did not seem to be many activities suggested for practice. The experts agreed that using a manikin for practice is the most appropriate activity for a practical session of BLS in the module for homeschooled children (defuzzification value of 0.77). An emergency scenario for children to model could also enhance the children's understanding of how to combat the chaotic condition which could arise during the rescue of a victim (defuzzification value of 0.70) (see Table 6).

In nursing education, manikins for the practice of BLS have been an important aspect of training. This practice seems to improve CPR skills (Parnell & Larsen, 2007; Reder et al., 2006). With a manikin, learners can be made aware of hand positions, compression rates, ventilations and other practical aspects for training in the skills and techniques of BLS (Assar et al., 1998; Chamberlain et al., 2002; Sarac & Ok, 2010).

Simulation of emergency scenarios is also important for practice. When used, trainee nurses appeared to have increased confidence and problem-solving skills (Hope et al., 2011). Hence, it is believed that children would also be more confident and skilled when they have experienced emergency scenarios during practice. Manikins with computerised systems which enable simulation of cardiac arrest can be used for simulation of emergency scenarios and can provide a realistic human–patient simulation among the learners (Ackermann, 2009; Hope et al., 2011).

It should be noted that the experts did not seem to consider peer tuition and computer-aided learning as activities for this module (Hamilton, 2005). This might be because peer tuition requires at least one of the learners to have some expertise in BLS to be able to tutor the others (Hamilton, 2005; Iserbyt et al., 2014). This might also be because the experts believed the learners did not have any expertise in this field. The use of computers for learning was also not considered. This might have been because computers were only considered as a medium of delivery of the videos for teaching BLS. A more practical and hands-on approach for teaching BLS was preferred by the experts.

4.5. Assessment for homeschooled children's competency after learning BLS

The final research question addresses the assessment of the BLS module. The experts agreed that Practical Return Demo is the most valid method of assessment for skill competency (defuzzification value of 0.77). Practical Return Demo is a demonstration practice activity in which the student has to demonstrate to the evaluator what he has learnt. The practical return demo is an important assessment method as the trainer can determine whether the learner has achieved the required criteria (Sarac & Ok, 2010; Smith et al., 2007). However, in this method the instructor has to be present and evaluate by using a checklist to identify and correct procedures and techniques (Sarac & Ok, 2010) (see Table 7).

Table 6. Activities for teaching BLS

Questionnaire items	Fuzzy evaluation	Defuzzification value
Practice on a Manikin	(5.00, 6.90, 8.80)	0.77
Emergency scenario with model	(4.20, 6.10, 8.00)	0.70

Table 7. Assessment approaches for BLS

Questionnaire items	Fuzzy evaluation	Defuzzification value
Multiple choice question	(5.20, 7.20, 9.20)	0.73
Practical return demo	(5.80, 7.80, 9.80)	0.77
Online assessment	(4.20, 6.20, 8.20)	0.70
Compulsory biannual reassessment of parents and children	(4.00, 5.80, 7.80)	0.70
Exposure to latest update in BLS is important for parents/children	(5.40, 7.40, 9.40)	0.77

The experts are also of the opinion that multiple choice questions (MCQ) (defuzzification value of 0.73), followed by online assessment (defuzzification value of 0.70) is a valid form of assessment of children's understanding of the subject matter. However, the assessment used will be influenced by the level of maturity of the learner being assessed. MCQ with the "abstract thinking" component could most probably be used for learners who were above ten years old. Theoretical knowledge of BLS is important for younger learners to acquire. Maconochie et al. (2007) believed that once children are physically able, the transition from theoretical knowledge to practical skills should be relatively easy.

Flint et al. (1993) did not believe in the need for formal assessment for lay persons learning BLS as there was sufficient motivation among lay persons who choose to learn BLS. The experts may have considered formal assessment to be important among children as the children who learn BLS may not possess the same level of motivation as the adults in Flint et al.'s (1993) study. It was also important to ensure that children had sufficient theoretical knowledge, which could be tested through formal assessment methods such as pencil tests and online assessments.

The experts believed that the exposure to the latest techniques and knowledge in BLS was important for parents and children (defuzzification value of 0.77), and that biennial reassessment could be used to ensure the BLS technique was current and effective in real emergency situations (defuzzification value of 0.70). To ensure continued success and retention of skills taught, frequent refresher courses are required (Isbye et al., 2007). As adults had higher retention than children for BLS, the module for homeschooled children should permit frequent practice among the younger learners (Isbye et al., 2007).

5. Implications and conclusions

The instructional module on BLS for parents of homeschooled children should include structured teaching and learning activities and include a schedule of learning activities, and assessment of the right techniques (Lunenberg & Irby, 2005).

The experts suggested that the most important knowledge components for parents to teach BLS among homeschooled children should include techniques of proper chest compression, rescue breaths and rescue of drowning victims. Proper chest compression and rescue breaths are difficult to learn, and yet needs to be included in the module as these skills are important to ensure survival of the victim (Savastano & Vanni, 2011). Both parents and homeschooled children should be taught these techniques to be prepared to perform BLS when needed (Assar et al., 1998). The proper technique ensures that sufficient oxygen gets to the brain and prevents further deterioration (Travers et al., 2010). Proper chest compression and rescue breaths are similar techniques and can be used for victims of drowning, cardiac arrest, respiratory arrest and foreign-body airway obstruction (Smith et al., 2007).

The experts believe that the rescue of drowning victims is important. This may be because of the high incidence of drowning among children in Malaysia. There does not seem to be a database for childhood drowning in Malaysia but in Asia, drowning among children occurs at a rate of approximately 30 per 100,000 children, with children aged one to four being at the highest risk (Hss, Tan, &

Hashim, 2014). Deaths due to drowning in rivers, and at-sea during the rainy monsoon seasons as well as at home seem to be common occurrences. Hence, this component needs to be addressed in the BLS module.

In designing the instructional strategies, experts who trained nurses and lay people used their expertise to determine the best approach. The module would be designed to focus on suitable instructional strategies, activities and assessment. Teaching strategies could vary according to the learners' learning style, but the experts were of the opinion that sufficient practice should be provided. Observations of practical demonstrations by the trainer or through a video presentation, as well as hands-on return demonstration were favoured by the experts. A direct instruction strategy seemed to be preferred. This might be because the need for correct techniques which are accurately performed, is important and would determine the life or death of a victim. It was crucial for the experts to present accurate skills and techniques and to allow for the practice and demonstration of these skills at a later stage.

Hands-on practice was considered important for developing the 50 psychomotor skills required for BLS (Assar et al., 1998; Chamberlain et al., 2002; Maconochie et al., 2007). Activities for practice on a manikin, as well as a simulation of an emergency situation were preferred activities. The ability of the child to administer effective chest compressions can be assessed using a manikin which is similar to the actual victim (Jones et al., 2007). One of the strategies preferred by the experts for practice and assessment was return demonstration. Manikins can be used for return demonstration. In addition, manikins with CAS could also be used to accurately assess chest compression and ventilation.

However, one consideration for using manikins is the cost. A normal adult manikin is expensive and costs more than US$400, making it unaffordable for many institutions. Adding a simulation feature would be even more expensive. Hence, consideration would have to be made on the best means of obtaining a manikin for practice and assessment. Suggestions include having a manikin as a shared resource among several homeschool centres, or loaned from certified institutions for use during training.

The use of digital resources such as videos and web pages could be applied for presentation of knowledge and procedures, and for assessment (Alias, Abdul Rahman, et al., 2013). The MCQs can also be posted online and used as an online assessment using applications for creating quizzes example *Socrative*. In addition to digital resources, the Red Crescent Society's manual and AHA Guidelines could be a guide for first aid procedures (Ibrahim, 2010). However, it has to be noted that the field of medical knowledge and practice is fast advancing and there are continuous improvements to these skills and techniques. Therefore, the trainers, parents and learners may need to undergo refresher courses and reassessment of skills and knowledge to update and revise what they have learnt every few years. Training can be provided by certified nursing bodies.

Therefore, the design of a module on teaching BLS as a life skill in the homeschool curriculum to guide parents and facilitators should have guidelines for parents of homeschooled children to plan teaching and learning activities based on their priorities and needs (Alias, Abdul Rahman, et al., 2013). The findings indicate that the experts believed that it was possible to teach BLS as a life skill to homeschooled children and that teenagers can fully utilise the knowledge and skill of BLS for life saving due to their physical strength and maturity level. However, younger child can still learn this life skill to help them detect, instruct and assist other unskilled persons in rescuing victims on the proper technique of BLS rescue. The recommendations on the content of BLS for teaching can guide the parents in selecting important materials for their lessons and emphasising the core learning skill for the learners to apply and practice in real life situations, should the need arise.

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References

Abdul Rahman, M. N., Patahol Wasli, M. M., Ahmad, Z., Mohd Said, A., Alias, Siraj, S., & Hussin, Z. (2014). Aplikasi pendekatan Fuzzy Delphi untuk membangunkan pembelajaran kanak-kanak homeschooling menggunakan media animasi interaktif. [Application of the Fuzzy Delphi technique for development of an interactive animation media for homeschooled children]. *Jurnal Kurikulum dan Pengajaran Asia Pasifik, 2*. 34–40. Retrieved from http://juku.um.edu.my

Ackermann, A. D. (2009). Investigation of learning outcomes for the acquisition and retention of CPR knowledge and skills learned with the use of high-fidelity simulation. *Clinical Simulation in Nursing, 5*, e213–e222. http://dx.doi.org/10.1016/j.ecns.2009.05.002

Adelborg, K., Thim, T., Secher, N., Grove, E. L., & Løfgren, B. (2011). Benefits and shortcomings of mandatory first aid and basic life support courses for learner drivers. *Resuscitation, 82*, 614–617. http://dx.doi.org/10.1016/j.resuscitation.2010.12.018

Adler, M., & Ziglio, E. (1996). *Gazing into the oracle: The Delphi method and its application to social policy and public health*. London: Kingsley.

Alias, N., Abdul Rahman, M. N., & Siraj, S. (2014). *Homeschooling: Pendidikan Alternatif di Malaysia. [Homeschooling: Alternative education in Malaysia]*. Kuala Lumpur: Pearson Malaysia Sdn. Bhd.

Alias, N., Abdul Rahman, M. N., Siraj, S., & Ibrahim, R. (2013). A model of homeschooling based on technology in Malaysia. *The Malaysian Online Journal of Educational Technology, 1,* 10–16. Retrieved from http://www.mojet.net

Alias, N., Siraj, S., Abdul Rahman, M. N., & DeWitt, D. (2013). Homeschooling in Malaysia: The implications for teacher services. *Malaysian Online Journal of Educational Management, 1*, 10–18. Retrieved from http://www.mojem.um.edu.my

Assar, D., Chamberlain, D., Colquhoun, M., Donnelly, P., Handley, A. J., Leaves, S., ... Mayor, S. (1998). A rationale for staged teaching of Basic Life Support. *Resuscitation, 39*, 137–143. http://dx.doi.org/10.1016/S0300-9572(98)00140-3

Bollig, G., Wahl, H. A., & Svendsen, M. V. (2009). Primary school children are able to perform basic life-saving first aid measures. *Resuscitation, 80*, 689–692. http://dx.doi.org/10.1016/j.resuscitation.2009.03.012

Chamberlain, D., Smith, A., Woollard, M., Colquhoun, M., Handley, A. J., Leaves, S., & Kern, K. B. (2002). Trials of teaching methods in Basic Life Support: Comparison of simulated CPR performance after first training and at 6 months, with a note on the value of re-training. *Resuscitation, 53*, 179–187. http://dx.doi.org/10.1016/S0300-9572(02)00025-4

Colquhoun, M. (2012). Learning CPR at school–Everyone should do it. *Resuscitation, 83*, 543–544. http://dx.doi.org/10.1016/j.resuscitation.2012.03.004

Done, M. L., & Parr, M. (2002). Teaching Basic Life Support skills using self-directed learning, a self-instructional video, access to practice manikins and learning in pairs. *Resuscitation, 52*, 287–291. http://dx.doi.org/10.1016/S0300-9572(01)00449-X

Fiore, K., (2009, August 9). Should your kids learn CPR? *ABC News*. Retrieved from http://www.abcnews.go.com/Health/Parenting/story?id=8240127

Flint, L., Billi, J. E., Kelly, K., Mandel, L., Newell, L., & Stapleton, E. R. (1993). Education in adult Basic Life Support training programs. *Annals of Emergency Medicine, 22*, 468–474. http://dx.doi.org/10.1016/S0196-0644(05)80479-2

Goh, L. (2013, May 19). My home, my school. *The Star Online*. Retrieved from http://www.thestar.com.my/news/nation/2013/05/19/my-home-my-school/

Hamilton, R. (2005). Nurses' knowledge and skill retention following cardiopulmonary resuscitation training: A review of the literature. *Journal of Advanced Nursing, 51*, 288–297. http://dx.doi.org/10.1111/jan.2005.51.issue-3

Hope, A., Garside, J., & Prescott, S. (2011). Rethinking theory and practice: Pre-registration student nurses experiences of simulation teaching and learning in the acquisition of clinical skills in preparation for practice. *Nurse Education Today, 31*, 711–715. http://dx.doi.org/10.1016/j.nedt.2010.12.011

Hss, A. S., Tan, P. S., & Hashim, L. (2014). Childhood drowning in Malaysia. *International Journal of Injury Control and Safety Promotion, 21*, 75–80. doi:10.1080/17457300.2013.792284

Ibrahim, H. (2010). *Manual pertolongan cemas: Persatuan bulan sabit merah [Emergency manual: Red Crescent Society]* (4th ed.). Kuala Lumpur: Persatuan Bulan Sabit Merah.

Isbye, D. L., Meyhoff, C. S., Lippert, F. K., & Rasmussen, L. S. (2007). Skill retention in adults and in children 3 months after Basic Life Support training using a simple personal resuscitation manikin. *Resuscitation, 74*, 296–302. http://dx.doi.org/10.1016/j.resuscitation.2006.12.012

Iserbyt, P., Elen, J., & Behets, D. (2009). Simulation and education: Peer evaluation in reciprocal learning with task cards for acquiring Basic Life Support (BLS). *Resuscitation, 80*, 1394–1398. http://dx.doi.org/10.1016/j.resuscitation.2009.07.006

Iserbyt, P., Mols, L., Charlier, N., & De Meester, S. (2014). Reciprocal learning with task cards for teaching Basic Life Support (BLS): Investigating effectiveness and the effect of instructor expertise on learning outcomes. A randomized controlled trial. *The Journal of Emergency Medicine, 46*, 85–94. http://dx.doi.org/10.1016/j.jemermed.2013.04.034

Ishikawa, A., Amagasa, M., Shiga, T., & Tomizawa, G. (1993). The max-min Delphi Method and Fuzzy Delphi Method via fuzzy integration. *Fuzzy Sets and Systems, 55*, 241–253. http://dx.doi.org/10.1016/0165-0114(93)90251-C

Jones, H., & Twiss, B. C. (1978). *Forecasting technology for planning decision*. London: MacMillan Press. http://dx.doi.org/10.1007/978-1-349-03134-4

Jones, I., Whitfield, R., Colquhoun, M., Chamberlain, D., Vetter, N., & Newcombe, R. (2007). At what age can schoolchildren provide effective chest compressions? An observational study from the Heartstart UK schools training programme. *British Medical Journal, 334*. doi:10.1136/bmj.39167.459028.DE

Kaufmann, A., & Gupta, M. M. (1988). *Fuzzy mathematical models in engineering and management science*. New York, NY: Elsevier Science.

Klir, G. J., & Yuan, B. (1995). *Fuzzy sets and fuzzy logic–Theory and application*. Upper Saddle River, NJ: Prentice-Hall.

Lunenberg, F. C., & Irby, B. J. (2005). *The principalship: Vision to action*. Belmont, CA: Thomson Higher Education, Cengage Learning.

Maconochie, I., Simpson, S., & Bingham, B. (2007). Teaching children Basic Life Support skills. *British Medical Journal, 334*, 1174. doi:10.1136/bmj.39218.422650.80

Mohd Jamil, M. S., Hussin, Z., Mat Noh, N. R., Sapar, A. A, & Alias, A. (2013). Application of Fuzzy Delphi Method in educational research. In S. Siraj, N. Alias, D. Dewitt, & Z. Hussin (Eds.), *Design and developmental research: Emergent trends in educational research* (pp. 85–92). Kuala Lumpur: Pearson Malaysia.

Mosby Medical Dictionary. (2013). *Mosby Medical Dictionary* (9th ed.). St Louis, MO: Elsevier.

Murray, T. J., Pipino, L. L., & van Gigch, J. P. (1985). A pilot study of fuzzy set modification of Delphi. *Human Systems Management, 5*, 76–80.

Noorderhaven, N. (1995). *Strategic decision making*. Wokingham: Addison-Wesley.

Parnell, M. M., & Larsen, P. D. (2007). Poor quality teaching in lay person CPR courses. *Resuscitation, 73*, 271–278. http://dx.doi.org/10.1016/j.resuscitation.2006.09.008

Reder, S., Cummings, P., & Quan, L. (2006). Comparison of three instructional methods for teaching cardiopulmonary resuscitation and use of an automatic external defibrillator to high school students. *Resuscitation, 69*, 443–453. http://dx.doi.org/10.1016/j.resuscitation.2005.08.020

Rosman, F., Alias, N., Abdul Rahman, M. N., & DeWitt, D. (2013). The design of video games in the implementation of Malay language learning among foreign students in an institution of higher learning. *Malaysian Online Journal of Educational Technology, 3*, 20–32.

Saraç, L., & Ok, A. (2010). The effects of different instructional methods on students' acquisition and retention of cardiopulmonary resuscitation skills. *Resuscitation, 81*, 555–561. http://dx.doi.org/10.1016/j.resuscitation.2009.08.030

Savastano, S., & Vanni, V. (2011). Cardiopulmonary resuscitation in real life: The most frequent fears of lay rescuers. *Resuscitation, 82*, 568–571. http://dx.doi.org/10.1016/j.resuscitation.2010.12.010

Siraj, S., & Ali, A. (2008). Principals projections on the Malaysian secondary school future curriculum. *International Education Studies, 1*, 61–78.

Smith, E. L., Cronenwett, L., & Sherwood, G. (2007). Current assessments of quality and safety education in nursing. *Nursing Outlook, 55*, 132–137. http://dx.doi.org/10.1016/j.outlook.2007.02.005

Travers, A. H., Rea, T. D., Bobrow, B. J., Edelson, D. P., Berg, R. A., Sayre, M. R., & Swor, R. A. (2010). American Heart Association guidelines for cardiopulmonary resuscitation and emergency cardiovascular care science. *Circulation Journal, 122*, S639–S946. Retrieved from http://circ.ahajournals.org/content/122/18_suppl_3/S676

Van Raemdonck, V., Monsieurs, K. G., Aerenhouts, D., & De Martelaer, K. (2013). Teaching Basic Life Support: A prospective randomized study on low-cost training strategies in secondary schools. *European Journal of Emergency Medicine, 21*, 284–290.

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