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ORIGINAL ARTICLE

Learning to Resuscitate: A Feasibility Study of using Kids Save Lives Malaysia (KSLM) Course for Indigenous Primary School Students in Pahang, Malaysia

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ABSTRAK

Peningkatan global dalam serangan jantung merupakan cabaran kesihatan awam yang besar, khususnya bagi komuniti orang asli (OA) dengan akses terhad kepada penjagaan kesihatan kecemasan, yang mengakibatkan kematian di luar hospital yang tinggi. Kajian ini bertujuan untuk menilai bagaimana kursus 'Kids Save Lives Malaysia' (KSLM) dapat meningkatkan pengetahuan, kemahiran dan sikap terhadap resusitasi kardiopulmonari (CPR) dalam kalangan pelajar OA sekolah rendah. Kajian kuasi-eksperimen dilaksanakan menggunakan reka bentuk pasca-penilaian-bukan-setara melibatkan 74 pelajar berumur 10-12 tahun. Perbezaan dalam kalangan pelajar berumur 10-12 tahun adalah signifikan secara keseluruhan ($p < .001$). Terdapat perbezaan terhadap pengetahuan ($p < .001$), di mana pelajar 12 tahun mencatatkan skor purata tertinggi ($M = 6.26$) diikuti oleh pelajar 11 tahun ($M = 4.78$) dan pelajar 10 tahun ($M = 3.96$). Selain itu, perbezaan signifikan juga diperhatikan dalam kemahiran teknikal ($p = .008$), di mana pelajar 10 tahun mencatatkan purata tertinggi ($M = 10.25$) diikuti oleh pelajar 11 tahun ($M = 9.13$) dan pelajar 12 tahun ($M = 8.48$). Variasi sikap terhadap CPR juga signifikan ($p < .001$), dengan pelajar 11 tahun mencatatkan purata tertinggi ($M = 44.1$), diikuti oleh pelajar 10 tahun ($M = 41.29$) dan pelajar 12 tahun ($M = 39.04$). Kajian kebolehlaksanaan membantu meningkatkan kualiti kursus KSLM menerusi bebanan kognitif terhadap penilaian dan penyampaian. Ini

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menyumbang kepada penggubal dasar dari aspek implementasi dan pelaksanaan secara menyeluruh, menandakan langkah penting dalam memajukan pendidikan kesihatan di Malaysia.

Kata kunci: AED; Kids Save Lives Malaysia; pelajar orang asli; resusitasi kardiopulmonari

ABSTRACT

The global rise in cardiac arrests is a major public health challenge, especially for indigenous communities with limited emergency healthcare, resulting in higher out-of-hospital deaths. This study aimed to assess how the "Kids Save Lives Malaysia" (KSLM) course improved cardiopulmonary resuscitation (CPR) knowledge, skills and attitudes among Indigenous primary school students. A quasi-experimental study was conducted using post-assessment non-equivalent-design involving 74 students aged 10-12. Differences among 10-12-year-old students were significant overall ($p < .001$). Notable variations emerged in knowledge ($p < .001$), where 12-year-olds scored the highest mean (M = 6.26), followed by 11-year-olds (M = 4.78) and 10-year-olds (M = 3.96). Additionally, differences were observed in technical skills ($p = .008$), with 10-year-olds having the highest mean (M = 10.25), followed by 11-year-olds (M = 9.13) and 12-year-olds (M = 8.48). Attitudinal variations were also significant ($p < .001$), showing 11-year-olds with the highest mean (M = 44.1), followed by 10-year-olds (M = 41.29) and 12-year-olds (M = 39.04). The feasibility study refines the Malaysian KSLM course for schoolchildren by addressing cognitive overload in assessment and delivery. It provides policymakers with insights for future improvements and supports widespread implementation, marking a crucial step in advancing healthcare education in Malaysia.

Keywords: AED; CPR; indigenous students; Kids Save Lives Malaysia; resuscitation

INTRODUCTION

In recent times, a global upsurge in cardiac arrests (CA) has emerged as a significant public health challenge (Guo et al. 2024). Cardiopulmonary resuscitation (CPR) stands as a pivotal intervention, facilitating blood circulation and mitigating brain damage during such emergencies (Nikolaou et al. 2024). The urgency for early CPR and widespread public education in its application has garnered attention to improve outcomes for out-of-hospital cardiac arrest (OHCA) incidents (Nikolaou et al. 2024; Cho & Kim 2021). Bystander CPR significantly elevates both survival rates and neurological outcomes for OHCA victims (Li et al. 2024). Studies emphasise that at least 15% of the population being proficient in CPR could notably enhance survival rates for OHCA. Yet, achieving this through voluntary means poses a challenge, prompting consideration of mandatory CPR education, especially targeting schoolchildren (Böttiger & Van Aken 2015a).

Early CPR education within schools

is proposed as an effective strategy, capable of instilling lasting changes in societal response to cardiac emergencies (Calicchia et al. 2016; De Buck et al. 2015). The World Health Organisation (WHO) acknowledged the "Children Save Lives" declaration crafted in 2015 by the European Resuscitation Council (ERC), the European Safety Foundation, the International Liaison Committee on Resuscitation, and the World Federation of Anaesthesiologist Societies (Böttiger & Van Aken 2015a; Böttiger & Van Aken 2015b). This declaration strongly recommends annual CPR training for students in schools worldwide (Bhanji et al. 2010). Moreover, in 2011, the American Heart Association (AHA) issued an advisory proposing mandatory CPR instruction for schoolchildren (Cave et al. 2011). In the last 20 years, numerous programs have emerged aiming to teach CPR within classrooms. Notably, the AHA in 2011 advocated for mandatory CPR training emphasising high-quality chest compressions with minimal interruptions (Cave et al. 2011). Studies have demonstrated that even 9-year-old children can grasp the significance of continuous CPR, acquire basic life support skills, maintain airways and effectively perform chest compressions. However, they often struggle to achieve the compression depth recommended by AHA and ERC guidelines (Plant & Taylor 2013). Since then, discussions have revolved around various aspects such as the optimal age for training, physical attributes, methodologies in training, strategies for retention, trainer styles and the inclusion of automated external defibrillator (AED) training, all considered as predictors of successful high-quality CPR education (Plant & Taylor 2013).

The "Kids Save Lives" (KSL) initiative in Europe introduced the concept that children, considering their age and physical attributes, can effectively perform CPR. The school children are envisioned to become potential advocates, disseminating CPR principles and skills within their communities. Recently, KSL became an integral part of the "Systems Saving Lives" initiative outlined in the ERC Guidelines of 2021 (Semeraro et al. 2021). This movement by KSL has been influential globally, reshaping the mindset of citizens towards empowering bystanders with CPR skills through education across all levels. In 2020, CPR training found its place in the official curriculum of British schools, marking a significant milestone in the integration of life-saving education. Similarly, the United States has made strides in incorporating CPR training into the secondary and high school curricula, implemented across 35 states (Semeraro et al. 2021). These initiatives mark substantial progress in promoting CPR education on a widespread scale.

The Indigenous people, known as "Orang Asli" (OA) in Malay, are the original inhabitants of Peninsular Malaysia, comprising the Negrito, Senoi, and Proto-Malay tribes. Malaysia is home to 953 Indigenous communities, totalling 206,777 individuals (Department of Orang Asli Development 2022). In Malaysia, Indigenous groups enjoy similar rights as other ethnicities, including opportunities for growth, social progression and education (Singar & Zainuddin 2017). Jabatan Kemajuan Orang Asli (JAKOA) is the Malaysian government agency entrusted to oversee the affairs of the OA. According to the OA population census by

JAKOA, Pahang houses a total of 89,172 OA household members, spread across 262 OA Villages (Department of Orang Asli Development 2022). The government and various organisations are actively working to enhance living conditions and safeguard the rights of the OA community. The Ministry of Education (MOE) is dedicated to supporting the younger generation of Indigenous people through the implementation of "Transformasi Pendidikan Orang Asli dan Pribumi" within the framework of "Pelan Pembangunan Pendidikan Malaysia (PPPM) 2013-2025" (Bernama 2022). These efforts aim to ensure that Indigenous children can seamlessly integrate into the existing educational system, especially as Malaysia advances towards the Fourth Industrial Revolution (IR 4.0). The initiatives reflect a commitment to provide equal educational opportunities and prepare Indigenous youth for the evolving socio-economic landscape.

Despite development efforts or resettlement into more modern settings, the 'OA' continue to grapple with enduring challenges like discrimination, marginalisation, and inadequate access to essential services such as education, healthcare and clean water. This limited access to healthcare, especially during emergencies, contributes to higher rates of out-of-hospital deaths within Indigenous communities (Khairunjauhari et al 2023). In such situations, prompt access to emergency care, including CPR, becomes critical. Introducing CPR education early on to Indigenous students becomes imperative. Not only does this benefit these students directly, but it also empowers the broader Indigenous population with life-saving skills that hold significant sway in emergency situations.

Malaysia boasts a vast educational landscape encompassing more than 10,000 schools, catering to around five million students and facilitated by approximately 420,000 teachers across preschools to high schools (Ministry of Education 2022). CPR training initiatives have historically been offered in Malaysian schools, often as part of extracurricular activities conducted by professionals like doctors, firefighters, medical students and paramedics (Tanaka et al 2012). Presently, CPR education is exclusively integrated into the secondary school curriculum within the subject "Pendidikan Kesihatan" (Health Education). However, there's a notable absence of CPR teaching in Malaysian primary schools. Hence, this feasibility study endeavours to evaluate the effectiveness of the "Kids Save Lives Malaysia" (KSLM) program on enhancing the knowledge, technical skills and attitude towards CPR among Indigenous primary school students.

MATERIALS AND METHODS

Study Design and Participants

This study employed a quasi-experimental approach using a post-assessment non-equivalent dependent variable (NEDV) framework within the academic period of 2023, ranging from September to December. The participants were drawn from a Malaysian government school and were within the age range of 10 to 12 years. Utilising an a priori analysis through G*Power Software version 3.9.1, employing a significance level of = 0.05, power (1-β) = 0.80, and an effect size of 0.25 (medium), the anticipated sample

size was determined to be 36 students, accounting for a 5% projected attrition rate further divided into three (3) groups comprised of a minimum of 12 students from years 4, 5, and 6. Exclusion criteria included non-native individuals, those with significant physical limitations impacting their performance, individuals lacking proficiency in Bahasa Malaysia (both in speaking and comprehension), and participants without parental consent.

Kids Save Lives Malaysia Course

We engaged three instructors certified by the AHA, including medical professionals, paramedics, and health educators – for each group representing years 4, 5 and 6. Their teaching backgrounds in Basic Life Support (BLS) varied. The instructional material used for the program was the KSLM-"Panduan Resusitasi Kardiopulmonari", available in the Bahasa Melayu (national language). This guide comprised lesson plans encompassing compression-only CPR, the utilisation of AEDs, a knowledge assessment, a practical skill checklist and instructional videos integrated through virtual reality (VR) technology (Fariduddin et al. 2022; Fariduddin et al. 2023). The content of this guide was adapted from the AHA 2020 Heartsaver program, forward-backwards translated and rigorously validated with excellent content validity index (CVI) ratings of (1.0) assessed by six experts from diverse domains (Fariduddin et al. 2022). Throughout the course, we employed the Laerdal Little Anne QCPR Manikin and Laerdal AED Training equipment (Product no 124-01050).

Course Implementation

Preceding the study commencement by 2 months, official permissions were obtained from JAKOA and MOE entities to visit and conduct the study in a rural elementary school. The study obtained clearance from the research ethics committee of Universiti Teknologi MARA (UiTM), under the ethical approval number REC/11/2021(MR/886). Upon endorsement from the school principal, the researchers informed the students about the study's objectives and procedures and distributed consent forms to both students and their parents. Prior informed consent was acquired from all participants before their engagement in the study. The study took place during regular school hours from 8 am to 1 pm, inclusive of a 30-minute break. It was structured into three distinct phases. Initially, instructors guided discussions among participants using the KLSM handbook, focusing on recognising cardiac arrest victims and the initial steps in managing such cases. This phase occupied a duration of 2 hours per facilitator. Subsequent attention was directed toward practicing compression-only CPR and proper AED usage on manikins, with students engaging for 90 minutes under a watch-and-do method based on facilitator demonstrations. The student-facilitator ratio maintained was 6 students per manikin with dedicated feedback given to each individual as they practiced. The final phase comprised individual assessments of technical skill performances. Following this evaluation, students responded to multiple-choice questions (MCQs) and a program-related questionnaire gauging their attitudes upon completion.

Technical Skills Assessment

Upon completion of the course, students participated in individual assessments involving a simulated cardiac arrest scenario within a school environment. To ensure consistency among raters in evaluating technical skills assessments, prior discussions were held to align their approaches and understanding of the rubric used, thereby maintaining uniformity throughout the assessment process. These evaluations were conducted privately, with each student assessed separately in a designated room to ensure privacy and focus. The assessment criteria mirrored those of the AHA Heartsaver course and comprised 10 specific components i.e. (i) establishing a safe environment; (ii) assessing the patient's response; (iii) initiating emergency protocols; (iv) executing effective chest compressions; (v) activating the AED; (vi) correctly applying AED pads; (vii) analysing heart rhythm; (viii) following AED instructions accurately; (ix) administering a shock by pressing the designated button; and (x) promptly resuming chest compressions post-shock. Each of these assessment items was rated as either "YES" or "NO." To pass the assessment, students had to receive a "YES" for all items, indicating successful completion of the evaluation.

Knowledge Assessment

The Multiple-Choice Questions (MCQs) were formulated based on information sourced from the validated KSLM handbook, which underwent meticulous validation procedures by designated professionals to ensure its face, content, construct and criterion validity. Additionally, the reliability of these MCQs was thoroughly examined using 38 primary school students with the KR_{20} of 0.83. Each set of MCQs contained 10 questions, with a scoring system of 1 point for a correct response and 0 points for an incorrect one, allowing for a score range between 0 and 10. A higher score denoted a more comprehensive knowledge base. For this study, an MCQ passing threshold of 84% was established, following the official guidelines outlined by the AHA (Fariduddin et al. 2022).

Attitude Assessment

Following the MCQ test, students were presented with a validated questionnaire consisting of 10 statements centred on attitudes regarding CPR performance (De Smedt et al. 2019), which utilised a 5-point Likert scale (ranging from 1 denoted 'strongly disagree' to 5 indicated 'strongly agree') to evaluate attitudes. Collating each student's responses to the 10 attitude statements resulted in an aggregate attitude score, ranging from 10 (indicating the least positive attitude) to 50 (indicating the most positive attitude). Elevated scores signified a greater inclination toward positively embracing CPR performance (Lieven et al. 2019).

Data Analysis

Demographic information was structured, tabulated, and subjected to descriptive statistical analysis. The scores representing MCQ knowledge, technical skills, and attitude were illustrated through frequency counts (%) and post-course means. For the attitude scores, scales of 4-5 were categorised as "agree,"

3 as "neutral," and 1-2 as "disagree. Following the course, a chi-square test of independence was employed to investigate potential associations between knowledge, technical skills and attitude across diverse age groups. Additionally, a one-way multivariate analysis of variance (MANOVA) was utilised to compare students' knowledge, technical skills and attitude toward CPR, considering both age and gender as factors. Assumptions essential for MANOVA analysis, including univariate normality confirmed via Shapiro-Wilk tests and box plots, were met. The absence of multivariate outliers indicated multivariate normality. Moreover, minimal correlations between dependent variables indicated no multicollinearity. The linear relationship among these variables was established. At a significance level of $\alpha = 0.001$, Box's M test showed non-significance, affirming homogeneity in the variance-covariance matrices. The statistical analyses were performed using IBM SPSS V.28.0 software, with statistical significance set at $p < 0.05$.

RESULTS

A total of 74 students attended the course, with 30 being male (40.5%) and 44 female (59.5%). The participants, all belonged to the Semai tribe, were distributed by age as follows: 24 (32.4%) were 10 years old, 23 (31.1%) were 11 years old, and 27 (36.5%) were 12 years old, comprising a total of 74 participants. In terms of religion, 38 students had no religious affiliation (51.5%), 25 were Christians (33.7%), and 11 were Muslims (14.8%) (Table 1).

TABLE 1: Demographic profiles

Profiles	n (%)
Age	24 (32.4)
10	23 (31.1)
11	27 (36.5)
12	
Gender	30 (40.5)
Male	44 (59.5)
Female	
Native	74 (100)
Semai	
Religion	11 (14.8)
Muslim	25 (33.7)
Christian	38 (51.5)
Animism	

Level of CPR and AED Knowledge among Students

Table 2 presented data on CPR and AED knowledge levels post-course. Overall, only 6 students (22.2%) aged 12 passed the test ($p = .054$), with the highest mean scores ($M = 6.26 \pm 1.83$), followed by 11-year-olds ($M = 4.78 \pm 1.08$) and 10-year-olds ($M = 3.96 \pm 1.68$), respectively.

Level of CPR and AED Skills among Students

In Table 3, post-course CPR and AED technical skill data were presented. Overall, only a small number of students from each age group passed the test ($p = .729$). The highest mean scores were attained by 10-year-olds ($M = 10.25 \pm 1.42$), followed by 11-year-olds ($M = 9.13 \pm 2.00$) and 12-year-olds ($M = 8.48 \pm 1.94$).

Level of Attitude towards CPR among Students

Table 4 exhibited the post-course attitudes toward CPR. Overall, the highest mean

TABLE 2: Level of CPR and AED Knowledge

Knowledge	10 years old	11 years old	12 years old	(Sig)
	Correct N (%)			
Correct chest compression rate	15 (62.5)	21 (91.3)	27 (100.0)	<.001*
Correct position of hand during chest compression	14 (58.3)	21 (91.3)	22 (81.4)	.021*
Correct depth compression	18 (75.0)	19 (82.6)	22 (81.4)	.778
Correct first action when someone fell on the floor	1 (4.1)	2 (8.6)	16 (59.2)	<.001*
When to stop CPR	19 (79.2)	13 (56.5)	13 (48.1)	.068
Correct abbreviation of AED	11 (45.8)	12 (52.1)	24 (88.8)	.002*
Correct function of AED	6 (25.0)	5 (21.7)	12 (44.4)	.165
The right sequence of performing CPR	3 (12.5)	3 (13.0)	10 (37)	.051
Correct location of placing the AED pads	3 (12.5)	8 (34.7)	15 (55.5)	.006*
The right sequence of using AED	5 (20.8)	6 (26.0)	8 (29.6)	.772
Pass	0 (0)	0 (0)	6 (22.2)	.054
Mean (S.D)	3.96 (1.68)	4.78 (1.08)	6.26 (1.83)	

* Chi-Square value significant at the level of $p < .05$

TABLE 3: CPR and AED technical skills

Knowledge	10 years old	11 years old	12 years old	(Sig)
	Correct N (%)			
Scene Setting is safe - look around	21 (87.5)	1 (4.3)	24 (88.8)	<.001*
Evaluate the response of the patient	20 (83.3)	18 (78.2)	26 (96.3)	.153
Call for HELP	19 (79.1)	13 (56.5)	24 (88.8)	.026*
Push rate - 100 to 120 per min	5 (20.8)	4 (17.3)	2 (7.40)	.372
Correct hand position	24 (100.0)	17 (73.9)	12 (44.4)	<.001*
Depth rate - 5 CM	5 (20.8)	10 (43.4)	11 (40.7)	.199
Minimise interruption	15 (62.5)	19 (82.6)	8 (29.6)	<.001*
Press the ON button and follow the instruction	19 (79.2)	23 (100.0)	27 (100.0)	.004*
Attach the AED Pad correctly	23 (95.8)	22 (95.6)	27 (100.0)	.554
Allow AED to analyze	21 (87.5)	21 (91.3)	23 (85.2)	.803
Follow the next instructions by AED	24 (100.0)	22 (95.6)	16 (59.3)	<.001*
Press the SHOCK button	24 (100.0)	23 (100.0)	25 (92.5)	.167
Resume CPR based on instruction	24 (100.0)	15 (65.2)	4 (14.8)	<.001*
Pass	2 (8.3)	2 (8.6)	1 (3.7)	.729
Mean (S.D)	10.25 (1.42)	9.13 (2.00)	8.48 (1.94)	

* Chi-Square value significant at the level of $p < .05$

TABLE 4: Level of Attitude towards CPR

Knowledge	10 years old	11 years old	12 years old	(Sig)
If somebody collapses, I am ready to assist, n (%)				
Disagree				.012*
Neutral			5 (18.5)	
Agree	24 (100)	23 (100)	22 (81.5)	
Will assist a victim who is not breathing, n (%)				
Disagree				.001*
Neutral			5 (18.5)	
Agree	24 (100)	23 (100)	22 (81.5)	
Assist if needed, n (%)				
Disagree	1 (4.2)			.002*
Neutral	4 (16.7)		6 (22.2)	
Agree	19 (79.1)	23 (100)	21 (77.8)	
Can evaluate if the victim needs help, n (%)				
Disagree	1 (4.2)			.008*
Neutral	4 (16.7)		6 (22.2)	
Agree	19 (79.1)	23 (100)	21 (77.8)	
Always think about what the best way is to offer help, n (%)				
Disagree				.002*
Neutral	2 (8.3)	23 (100)	5 (18.5)	
Agree	22 (91.7)		22 (81.5)	
If the victim is surrounded by people but no help is given, I will come forward and assist, n (%)				
Disagree	3(12.5)			.006*
Neutral	2(8.3)	1(4.3)	6(22.2)	
Agree	19(79.2)	22(95.6)	21(77.7)	
I am aware, that if I offer help to unconscious victim, I can save their life, n (%)				
Disagree	1(4.2)		1(3.7)	.043*
Neutral		2(8.7)	5(18.5)	
Agree	23(95.8)	21(91.3)	21(77.8)	
If my friend needs help during CPR, I will assist, n (%)				
Disagree	1(4.2)			.098
Neutral			3(11.1)	
Agree	23(95.8)	23(100)	24(88.9)	
I have performed CPR on victims and that is a generous practice, n (%)				
Disagree				.011*
Neutral	1(4.2)		3(11.1)	
Agree	23(95.8)	23(100)	24(88.9)	
Providing CPR to victim gives a satisfaction to me, n (%)				
Disagree	2(8.3)			<.001*
Neutral			7(25.9)	
Agree	22(91.7)	23(100)	20(74.1)	

* Chi-Square value significant at the level of $p < .05$

scores were observed among 11-year-olds (M = 44.1 ± 1.60), followed by 10-year-olds (M = 41.29 ± 3.54) and 12-year-olds (M = 39.04 ± 5.49).

Effectiveness of KSLM Course among Students

A MANOVA analysis examined the impact of the KLSM course on students' CPR knowledge, technical skills and attitude, considering their age and gender. Significant differences were found among 10-12-year-old students (F = 10.04, df = 6, $p < .001$). With a Bonferroni-corrected alpha level of .017, notable differences emerged in knowledge (F = 12.94, df = 2, $p < .001$), with 12-year-olds scoring the highest mean (M = 6.26), followed by 11-year-olds (M = 4.78) and 10-year-olds (M = 3.96). Similarly, differences were observed in technical skills (F = 5.26, df = 2, $p = .008$), where 10-year-olds had the highest mean (M = 10.25), followed by 11-year-olds (M = 9.13) and 12-year-olds (M = 8.48). Attitudinal variations were also significant (F = 9.67, df = 2, $p < .001$), with 11-year-olds exhibiting the highest mean (M = 44.1), followed by 10-year-olds (M = 41.29) and 12-year-olds (M = 39.04) (Table 5).

DISCUSSION

Early bystander CPR plays a crucial role in saving cardiac arrest patients, subsequently promoting the survival rate and reducing out-of-hospital death. School-based CPR education has been advocated by the AHA and the WHO and has been proven to be efficient in the upper grades of elementary schools, and their education has significant ripple effects on the people around them (Fariduddin et al. 2023; Lieven et al. 2019; Robert et al. 2015). In this study, the efficacy of the KSLM course was investigated on the CPR knowledge, technical skills on CPR, and the attitude towards performing CPR among primary school students in Malaysia specifically focusing on the indigenous group. The findings suggest that the KSLM course contributes to the acquisition of theoretical knowledge on CPR and AED, but additional support or enhancements may be necessary to achieve a more comprehensive and uniform level of competency. The training

TABLE 5: Multivariate test of knowledge, technical skills, and attitude towards age & gender

Source	Value	F	Hypothesis *df*	Error *df*	Sig	Partial η^2
Pillai's Trace (Age)	.620	10.043	6	134	<.001**	.310
Pillai's Trace (Gender)	.013	.285	3	66	.836	.013
Source	**Type III Sum of Squares**	**df**	**Mean Square**	**F**	**Sig**	**Partial η^2**
Knowledge	67.65	2	33.82	12.94	<.001**	.276
Technical Skills	34.55	2	17.27	5.26	.008*	.134
Attitude	282.98	2	141.49	9.67	<.001**	.222

* Significant at the level of p < .05; ** Significant at the level of p <.001

program led to a noticeable acquisition of theoretical knowledge regarding effective chest compression techniques, covering compression rate, depth and hand positioning during CPR. They exhibited a commendable understanding of when to stop the CPR. However, a significant majority struggled to comprehend the crucial aspect of ensuring a safe scene during CPR. This discrepancy appeared rooted in the school environment, where students habitually prioritise informing teachers within the school premises over prioritising their safety before approaching a victim. This is substantiated by the outcomes of the knowledge assessment, which revealed that a significant majority of students indicated a preference for seeking assistance from teachers when encountering a situation where someone has fallen. This practice might be attributed to the ingrained belief that teachers bear the responsibility for student safety, potentially normalising this behaviour among the students (Graham et al. 2005). Regarding the theoretical understanding of AED, most students aged 10 to 11 inaccurately defined AED, misunderstood its function, and struggled to identify the correct placement of AED pads on a patient. Factors contributing to these inaccuracies included varying levels of English proficiency among students, challenges in reading comprehension, and a limited grasp of the AED machine's functionality. Notably, many students held the misconception that AED administers medication through the pad, a belief which was also substantiated by the outcome of the knowledge assessment. Furthermore, visualising the correct placement of the pad proved challenging for a majority, leading to incorrect responses (Kutsyuruba et al. 2015). Furthermore, the students' struggle with correctly identifying the sequence of CPR steps and operating an AED machine was linked to cognitive overload. Reading difficulties, visualisation challenges, and comprehension barriers appeared to hinder their ability to comprehend and answer questions accurately (Ringh et al. 2018; Swor et al. 2013). Therefore, adapting question formats by incorporating diagrams, and images, or simplifying the answer options could significantly aid students in better understanding and responding to the questions more accurately.

However, the pass rate among students was notably low, predominantly observed within the older age group. This aligns with prior research indicating that students aged 12 and above tend to exhibit superior intellectual capacities compared to those aged 10 to 11 (Stokes et al. 2012). Nevertheless, the average performance of most students following the CPR course mirrored outcomes from previous studies, underscoring the necessity for early CPR education (Hori et al. 2016; Park 2017; Suwanpairoj et al. 2020). Surprisingly, younger school children displayed a notable aptitude for learning CPR, potentially surpassing older peers. Evidence from a German study demonstrated that 10-year-old students exhibited similar CPR knowledge implementation as their 13-year-old counterparts (Park et al. 2006). Similarly, an Italian study indicated that young schoolchildren might even outperform adults in acquiring CPR knowledge (Aaberg et al. 2014). This emphasises the rationale behind introducing CPR education to younger students, foregoing the wait until they reach adolescence or

adulthood (Baldi et al. 2015; Hori et al. 2016; Plant & Taylor 2013). It's essential to acknowledge that this study examined a relatively brief period of theoretical exposure preceding the assessment. Therefore, future investigations incorporating longer intervention periods and subsequent follow-ups are imperative to comprehensively explore the enduring impact of CPR education. Such studies could illuminate the longitudinal effects and sustainability of CPR knowledge among students.

In terms of technical skills proficiency, many students encountered challenges in achieving high-quality CPR, particularly in executing effective chest compressions. The attainment of adequate compression depth, along with maintaining an appropriate compression rate, holds paramount importance due to its direct correlation with survival outcomes (Martinez et al. 2022). Notably, the physical attributes of students within this age bracket, strongly linked with anthropometric growth, posed a significant barrier. Meeting the recommended compression depth proved arduous for children under 13 years old (Abelairas et al. 2014; Considine et al. 2020). This difficulty could stem from younger children's physiological characteristics, which facilitate thoracic decompression, making it more challenging to restrict the manikin chest's recoil. Notably, the majority of children only reach the recommended compression depth around the age of 14 (Baldi et al. 2015). Moreover, the variation in students' ability to maintain an appropriate compression rate is intricately tied to their level of psychomotor development. This divergence accounts for the disparities observed among students in achieving consistent compression rates (Anderson et al. 2019; Baldi et al. 2015; Fariduddin et al. 2023).

While emphasising correct compression depth during CPR instruction is crucial, it's equally imperative to foster a trajectory of continuous improvement in CPR skills. Utilising a mastery learning approach can facilitate a transition from skill acquisition to skill mastery, thereby enabling students to attain and sustain excellence in CPR proficiency progressively (Banfai et al. 2017). Regarding AED usage, despite students' lack of theoretical knowledge about AED functionality, most demonstrated adeptness in operating the device, successfully following instructions to attach the pads correctly to the victim's chest. This disparity between theoretical knowledge and practical application highlights the necessity for refining the content of assessment questions in this context. Nevertheless, some students encountered challenges in resuming CPR based on AED instructions, potentially attributed to difficulties comprehending the English vocal prompts of the device. The students' limited proficiency in the English language likely hindered their comprehension of the instructions, consequently affecting their ability to comply effectively (Nakagawa et al. 2021). The KSLM course yields marked shifts in students' attitudes, self-efficacy and confidence. This improvement in CPR knowledge and technical skills appears to correspond with a positive shift in attitudes, as evidenced in this study. Previous research aligns with these findings, suggesting that CPR education correlates with heightened confidence levels (Fariduddin et al. 2023; So et al. 2020). Moreover, CPR education not

only bolsters technical prowess but also fosters an increased sense of self-worth and moral obligation toward others. Additionally, it diminishes the fear of errors, amplifies confidence, and cultivates a proactive disposition toward aiding others (Greif et al. 2015). Nonetheless, within the youngest cohort of students in this study, there exists a certain reluctance to perform CPR in public. Several factors might underpin this hesitancy. A previous study noted that while CPR education augments knowledge and skills, it doesn't directly translate into a willingness to execute bystander CPR (Naqvi et al. 2011). Moreover, a predominant belief among the students in this study suggests a preference for teachers or older adults to intervene and administer CPR in emergency scenarios. This notion implies a perceived greater responsibility for older adults in such situations. Consequently, it becomes imperative to emphasise bolstering confidence specifically in executing bystander CPR throughout the course (Naqvi et al. 2011).

When assessing the effectiveness of the KLSM course, notable differences emerge across different age groups concerning knowledge acquisition, technical skills and attitudes toward CPR. The 12-year-old cohort achieved the highest scores in knowledge, likely due to their higher cognitive maturity compared to other groups (Stokes et al. 2012). Interestingly, prior studies have shown a strong correlation between knowledge, technical skills and attitudes toward performing CPR (Lubrano et al. 2005; Mao et al. 2021). However, this study did not exhibit such a correlation, which may be attributed to several factors. One potential factor is the method of assessment and limitations in comprehending the questionnaire's content and measurement scale. Students encountered difficulties in reading and understanding the questionnaire, potentially impacting the accurate measurement of intended aspects. Consequently, what was meant to be measured might not have been adequately captured, leading to discrepancies among the groups. Moreover, despite the utilisation of high-technology manikins and experienced facilitators, inconsistencies emerged in evaluating skills due to differing situational interpretations when assigning scores. Addressing these issues is crucial to ensure more effective measurements following the KLSM course. Attention should be directed toward improving questionnaire clarity and comprehension, as well as establishing clearer criteria for evaluating practical skills, to enhance the reliability and accuracy of course assessments.

The feasibility study contributes significantly to refining the KSLM course for schoolchildren in the Malaysian context. Managing cognitive overload emerges as a critical consideration during both assessment and course delivery (Johannessen et al. 2020). Alterations are necessary for the question format, advocating for shorter, more succinct queries and answers, complemented by visuals like diagrams and pictures to aid comprehension. Additionally, adapting the training content to suit the students' environment, rather than relying solely on school-based scenarios, is pivotal. Revamping the training concept by integrating mastery learning principles tailored to different age groups stands out as a potential enhancement (Banfai et al. 2017). Breaking down the training

into shorter sessions, dividing by age groups on a small scale, could mitigate cognitive overload. This approach allows students to concentrate and refine their skills before progressing to subsequent sections. Repetitive sessions spread across time, rather than a single-day event during the school session, could prove more beneficial. To enhance assessment, integrating body mass index (BMI) measurements could offer valuable insights, particularly concerning high-quality CPR. Ensuring consensus among facilitators when evaluating students' varying skill levels is essential to maintain score consistency. Additionally, employing alternative forms of scale measurement could assist students in comprehending questionnaire items and further augment their understanding of the provided statements.

However, the feasibility study is also subjected to limitations. First, the students may have difficulties in truly understanding the delivery of the course in a short duration due to cognitive differences, language proficiency, and challenges in reading the materials. In this study, despite utilising Bahasa Melayu as a medium of instruction, some of the indigenous students experience difficulties interpreting the language as most resort to the original dialect of "OA" during the interaction which hinders the delivery of information. Secondly, the number of students recruited in this study was relatively low and since it is a feasibility study, the inferences drawn should be interpreted cautiously. Thirdly, the student-to-instructor-to-manikin ratio was insufficient leading to difficulties in delivering the course content within the stipulated time frame lastly, in measuring the effectiveness of the course, the retention rate at different intervals should be measured. Thus, the result of this study provides a foundation for policymakers to adopt and improvise for future research and implement the course in a large-scale setting across the country.

CONCLUSION

The outcomes of this feasibility study indicate the beneficial effects of the KSLM course on primary school students from indigenous backgrounds. The study enabled students to grasp CPR and AED theory, execute good chest compressions, utilise AEDs, and develop a favorable attitude toward CPR post-training. We suggest enhancing this course further by emphasising mastery learning to improve students' understanding of theory and practical aspects while refining assessment elements. In the future, expanding this program with regular implementation across all Malaysian schools before integrating it into the national curriculum could significantly elevate the number of capable Malaysian bystanders, positively impacting public health.

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COMPETING INTERESTS

The authors declare that they have no

competing interests.

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