Journal of Infrastructure, Policy and Development 2024, 8(9), 5424.
https://doi.org/10.24294/jipd.v8i9.5424

Article

The validation of a smart CPR training module: The preliminary process of a technology-based CPR training approach

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CITATION

Wider W, Ahmad N, Kadir F, et al. (2024). The validation of a smart CPR training module: The preliminary process of a technology-based CPR training approach. Journal of Infrastructure, Policy and Development. 8(9): 5424. https://doi.org/10.24294/jipd.v8i9.5424

ARTICLE INFO

Received: 25 March 2024
Accepted: 28 April 2024
Available online: 5 September 2024

Abstract: Introduction: In contemporary healthcare education, the integration of technology has emerged as an essential factor in enhancing the efficiency and efficacy of training methodologies. Particularly within the domain of cardiopulmonary resuscitation (CPR) training, the adoption of technology-driven approaches holds considerable potential for enriching the skills and proficiencies of healthcare practitioners. Through the utilization of innovative technologies, such as simulation software and leveraging smartphones as primary tools, CPR training programs can be customized to provide immersive, interactive, and authentic learning experiences. This study aims to validate a comprehensive CPR training module tailored explicitly for healthcare professionals, to integrate it into smartphones as a medium for delivering CPR training. **Methods:** Two validity tests, namely content validity and face validity were conducted to evaluate the validity of the Smart-CPR training module. A self-constructed measurement scale was utilized to assess four parameters: consistency, representativeness, clarity, and relevancy. Content validity employed the content validity ratio, with scores ranging between 1 and −1, indicating the level of consensus among experts regarding the significance of each item. Face validity was assessed using two indices: the item face validity index and the scale face validity index. Ratings of 3 or 4 were given a score of 1, while ratings of 1 or 2 received a score of 0. **Result:** The content validity shows that CVI values for 'consistency' and 'representativeness' were 0.99 for the module and questionnaire, and 0.96 and 0.97, respectively. 'Clarity' scored 0.99 for the module and 0.96 for the questionnaire, while 'relevance' achieved 0.99 for both. All 44 items exceeded the 0.83 threshold for face validity. The Lawshe's content validity ratio (CVR) and content validity index (CVI) value were used to evaluate the content validity of both the CRSTP module and questionnaire, with CVR values result ranging from 0.80 to 0.99 across dimensions. These findings demonstrate robust content validity. Additionally, high CVI scores, mostly exceeding 0.95, suggest favorable outcomes and indicate no need for revisions. In face validity method, all 44 items surpassed the minimum threshold of 0.83, signifying a favourable outcome. Thus, all items were deemed acceptable. **Conclusion:** The Smart-CPR training module and questionnaires were meticulously developed to meet both face and content validity standards. All 44 items demonstrated appropriate levels of validity, ensuring they effectively enhance and maintain CPR competency among healthcare providers and potentially benefit the broader community. The positive results of the Smart-CPR training module confirm the high validity of the CPR competency assessment. Content validity, evaluated by experts, received a perfect score, demonstrating agreement on the relevance of each module component. Similarly, face validity, assessed by healthcare professionals, also received a flawless score, indicating consensus on

the module's clarity and relevance. These findings validate the module's effectiveness in teaching CPR techniques to a diverse audience and ensuring compliance with established standards. With such strong validity, digitizing the module becomes more straightforward, facilitating easier sharing and use across digital platforms. Ultimately, the module's high validity facilitates its integration into digital platforms, thereby enhancing CPR education and improving outcomes during real emergencies.

Keywords: content validity; face validity; Smart-CPR training; technology-based CPR training; digitalize conventional training; mental health

1. Introduction

Creating a technology-based CPR training module necessitates the incorporation of advanced simulations and interactive tools for immersive learning, with real-time feedback enhancing skill acquisition. This innovative approach promotes practical CPR training and ensures widespread accessibility, equipping individuals with life-saving knowledge (Ming et al., 2022). The significance of technology-based CPR training lies in its ability to enhance accessibility, efficacy, and provision of real-time feedback (Aranda-García et al., 2023). This methodology ensures a dynamic learning experience by employing advanced simulations and interactive tools. Its broader impact extends to empowering individuals with life-saving skills, thereby fostering widespread CPR proficiency across diverse settings (Gugelmin-Almeida et al., 2021). Developing a forward-looking CPR training module encompasses the integration of interactive simulations, real-time feedback mechanisms, and adaptive learning paths (Kim and Cho, 2023). Incorporating cutting-edge technology is pivotal to ensuring an engaging and efficacious learning experience (Kong et al., 2022). The primary objective of the module is to furnish users with life-saving skills, achieved through immersive scenarios, thereby cultivating confidence and proficiency in CPR application.

Incorporating technology-based training modules is increasingly prevalent in the dynamic education and professional development landscape. In their pursuit of optimizing CPR education experiences and operational efficiency, organizations recognize the imperative to develop software applications derived from these current CPR training modules. However, before widely deploying a technology-based training module as a software application, validation becomes a crucial aspect of the development process (Roebianto et al., 2023). This validation process ensures that the module aligns not only with its designated objectives but also caters to the diverse needs of its intended audience. The validation process encompasses a comprehensive evaluation, considering various facets such as functionality, usability, effectiveness, and relevance (Calvo-Francés et al., 2023). This critical phase bridges the conceptualization of a training module and its transformation into a robust software application capable of seamlessly integrating into diverse learning environments. By subjecting the technology-based training module to rigorous validation, developers can identify and address potential challenges, refine content, and optimize the user experience, thereby maximizing the impact of the educational tools.

A comprehensive cardiopulmonary resuscitation (CPR) training module has been meticulously developed to impart enduring cognitive knowledge and proficient

psychomotor skills in cardiac resuscitation specifically tailored for healthcare professionals. Employing an advanced learning and training methodology through a technology-based approach, the module aims to facilitate teaching, motivate learners, and enhance confidence among healthcare providers. The outcomes of the systematic review conducted in phase 1 have yielded an evidence-based module, encompassing essential concepts that empower users to master both CPR theory and practical skills. The module's clarity is of paramount importance to ensure its feasibility and effectiveness (Chantarasombat and Rooyuenyong, 2020). In the pursuit of ascertaining the feasibility and credibility of the Smart CPR training, a thorough validity and reliability test has been conducted (Shafie et al., 2020). Validity assesses the accuracy of a research instrument, while reliability gauges the consistency of results (Leung, 2015). Essentially, reliability underscores the measurement's consistency and capability. This study aims to validate the Smart-CPR training module, guiding the digitalization of the conventional CPR training approach. The imperative has driven the development of technology-based CPR training programs to enhance the efficacy, accessibility, and scalability of CPR education. Traditional CPR training methods often face limitations in providing consistent, immersive learning experiences to a wide audience due to logistical constraints, such as limited access to training facilities and qualified instructors. Additionally, the dynamic nature of healthcare and advancements in medical practices underscore the necessity for CPR training programs to evolve accordingly, ensuring that healthcare professionals and laypersons alike are equipped with the most current knowledge and skills. By leveraging technology, such as simulation software, virtual reality, and mobile applications, CPR training can be delivered in a more flexible, interactive, and personalized manner, transcending geographical barriers and accommodating diverse learning styles. Furthermore, technology-based CPR training allows for real-time feedback and performance tracking, enabling learners to monitor their progress and proficiency more effectively. Ultimately, the development of technology-based CPR training initiatives aims to democratize access to life-saving skills, empower individuals with the confidence and competence to respond effectively to cardiac emergencies, and ultimately contribute to improved outcomes in cardiac arrest situations.

2. Literature review

The profound impact of the digital revolution and the rapid advancement of technology over the past three decades have significantly shaped the landscape of education, offering promising tools for innovative learning. Emerging forms of technology-enhanced learning, ranging from electronic modules to sophisticated simulations, are meticulously crafted to enhance the acquisition of academic knowledge and performance (Dankbaar and de Jong, 2014). Consequently, the utilization of various technologies in education has experienced exponential growth, aiming to facilitate learning, enhance skill coordination, provide diverse perceptual experiences, foster effective decision-making, facilitate practice in critical events, refine psychomotor skills, and bolster confidence in executing critical procedures (Guze, 2015). Within the realm of healthcare, the evolution of technology has primarily been driven by the exigencies encountered in medical education and the

imperative to demonstrate proficiency among learners (Guze, 2015). The overarching objective of contemporary teaching curricula is to educate trainees efficiently within a secure learning environment (Barsom, 2016). Diverse technological mediums such as podcasts, videos, mobile applications, video games, simulations, virtual/augmented reality, and wearable devices (e.g., Google Glass) are employed to fulfill this objective (Guze, 2015). For practicing nurses, resuscitation training is imperative to mitigate knowledge decay, enhance skills proficiency, and augment self-efficacy in resuscitation scenarios. A study conducted by Delasobera et al. (2010) utilizing simulation-based resuscitation training demonstrated that integrating computer-based methods into an active learning format effectively bolstered confidence in executing resuscitation procedures in real-world situations. Consequently, the adoption of various technology adjuncts as simulation modalities for training is recommended to optimize outcomes, particularly in enhancing confidence levels for performing such procedures.

The acquisition of effective cardiopulmonary resuscitation (CPR) skills is vital for healthcare professionals and laypersons alike, particularly in light of the increasing integration of CPR training modules into digital-based environments. However, ensuring the efficacy and validity of these modules is crucial for their successful implementation. This literature review delves into the significance of validating CPR training modules in digital contexts and the methodologies utilized for such validation. Validating these modules in digital environments has profound implications for healthcare education and patient outcomes. Firstly, validation ensures that the content and instructional design adhere to established CPR guidelines and best practices, enhancing the accuracy and relevance of the training material and facilitating skill acquisition and retention. Secondly, validation assesses the effectiveness of the digital platform in delivering CPR training by evaluating factors such as user interface design, interactivity, and accessibility, thereby optimizing the learning experience. Moreover, validation contributes to the credibility of CPR training modules, vital in healthcare settings where accuracy is paramount. Various methodologies, including expert review, user testing, skills assessment, and comparative studies, are employed to validate these modules, ensuring their effectiveness and superiority over traditional training methods. In conclusion, rigorous validation of CPR training modules in digital environments is essential for their accuracy, effectiveness, and credibility, ultimately enhancing patient outcomes and necessitating further research and collaboration in the field of digital-based CPR education and training.

3. Smart-CPR training module

The CRSTP module comprises four primary components, namely the ‘actual cardiac arrest event (ACAE),’ ‘CPR theory module (CPR-TM),’ ‘CPR practical module (CPR-PM),’ and ‘training reminder module’ (TRM).’ All the informational content within the module is predicated upon the guidelines established by the American Heart Association (AHA) in 2020. The selection of the AHA guideline as the principal reference is attributable to its widespread applicability and global recognition. The principal innovation of this investigation resides in the incorporation of two supplementary modules, namely the actual cardiac arrest event module and the

training reminder module. The initial innovative feature introduced within this module is the ACAE module, which concentrates on the execution of CPR procedures on an authentic cardiac arrest victim. Within this module, users undertake CPR procedures aided by visual directives and metronome audio. Moreover, this module incorporates several functionalities aimed at enhancing its utility during genuine cardiac arrest scenarios, including direct access to the Malaysian Emergency Response Services (MERS, 999), expedited access to CPR procedure flowcharts, criteria for discontinuation of CPR, and an incident log to document real-time activities. The second novel aspect, TRM, is a module devised to tailor a personalized retraining regimen based on the user's preferred frequency of training sessions. While the AHA (2020) guideline does not stipulate the specific frequency for CPR retraining, various studies advocate for organizing retraining sessions as frequently as feasible (Brown and Halperin, 2018). Within this module, users can elect their desired training frequency from options such as weekly, bi-weekly, monthly, and bi-monthly (Sand et al., 2021). Subsequently, once the frequency is chosen, the smartphone will automatically set reminders according to the selected frequency. CPR-TM is a module that underscores crucial information pertaining to CPR protocols for both adult and pediatric populations. It incorporates three principal theories: 'CPR guidelines for adults,' 'CPR guidelines for pediatrics,' and 'high-quality CPR' for both adult and pediatric cases. To assess comprehension, users are required to undergo pre- and post-tests related to CPR procedures. CPR-PM is a module engineered to cultivate CPR psychomotor skills. It encompasses three submodules presented in video format accompanied by metronome audio, including 'hands-only CPR,' 'chest compressions with rescue breaths,' and 'full CPR (DRSCAB)'. Users can select their preferred mode of training utilizing this submodule.

4. Development of a scale for content and face validity

Contents and face validity refer to the process of assessing how effectively the components and aspects of the Smart-CPR training module are recognized (Ghazali et al., 2017). This method of validity is also effective for evaluating individual items in a newly developed tool, allowing for statistical quantification (Rubio et al., 2003). In this investigation, content validity questionnaires were distributed to experts for their assessment and critique, while face validity was confirmed by the target population. These questionnaires encompassed various sections, including an introductory overview of the study, response format, instructions, descriptions, and space for expert suggestions (Rubio et al., 2003). The introduction section outlined the research title and objectives, elements necessary for expert evaluation, items to be assessed, rationale for scoring, and the instrument itself. Among these components, the instrumentation was particularly crucial as it significantly influenced the experts' evaluations.

In assessing items, this study has employed four criteria recommended by Rubio et al. (2003) and Yaghmaie (2003): consistency, representativeness, clarity, and relevance. 'Clarity' pertains to the understandability of language and instructions, ensuring that items are not vague and can be interpreted consistently by raters (Yusoff, 2019). 'Consistency' refers to the ability to carry out a task systematically to fulfill the

item's objective (Sürücü and Maslakci, 2020). 'Representativeness' is defined as the capacity of an item to reflect the instrument's concept in an observable manner (Roebianto et al., 2023). Meanwhile, 'relevance' denotes the appropriateness of the information presented in the item with respect to the instrument's concept (Roy et al., 2023).

Each item is rated on a scale ranging from 1 to 4, with higher scores indicating greater significance according to the specified criteria. These criteria were selected based on expert advice, affirming their importance as essential elements (Roebianto et al., 2023). A self-developed instrument was created based on the domains identified in phase 1 of a comprehensive study, which involved a systematic review to identify effective content and feasible approaches for developing the Smart-CPR training module. These domains encompassed cognitive knowledge, psychomotor skills, and retention of competency. The instrument, developed in English, comprised two sections and was tailored to evaluate the Smart-CPR training content module and questionnaire's ability to measure the defined constructs of interest, namely cognitive knowledge and psychomotor skills of CPR. To assess content and face validity, the instrument consisted of two sections: Section A for the Smart-CPR training module and section B for the Smart-CPR training questionnaire.

Section A of the module was segmented into five (5) components: 'Actual cardiac arrest event,' 'CPR theory module,' 'CPR practical module,' 'CPR training reminder module,' and 'general questionnaire module.' Descriptive information for each component was provided to ensure that experts comprehended the requirements and standards for each segment. Similarly, section B comprised 40 questionnaires aimed at evaluating individuals' CPR-related knowledge levels. **Figure 1** represents the developed scale for content and face validity.

CARDIAC RESUSCITATION SIMULATION TRAINING PROGRAM MODULE FOR SELF-MAINTENANCE					
This module and questionnaire was developed to establish sustainable cardiac resuscitation cognitive (knowledge) and competency using systematic advanced learning and training methode through technology-based approach for healthcare professional and layman.					
Domain 1: Actual cardiac arrest event module **Definition: This module determine the work flow in the event of actual cardiac arrest episode occur.**					
	CONSISTENCY	REPRESENTATIVE	CLARITY	REELEVANT	COMMENTS
TESTED ITEM	→ More consistent 1 2 3 4 Less consistent ←	→ Highly represenatative 1 2 3 4 Less representative ←	→ More clarity 1 2 3 4 Less clarity ←	→ Highly relevant 1 2 3 4 Less relevant ←	
	Is this item in the module consistent with what it intend to do in the event of actual cardiac arrest incident occur?	Does this item represent the concept of the action taken during actual cardiac arrest event?	Are the item is clarity in term of wording?	Are the item relevant to the concepts of the actual cardiac arrest event?	

Figure 1. Scale for content and face validity.

5. Methodology

Two validity tests, content and face validity, are employed to validate the Smart-CPR training module, as indicated by Roy et al. (2023). The validation process initiates with content validity, which refers to the research instrument's ability to encompass and represent all items intended to measure the construct of interest (Straub and Gefen, 2004). It is recommended that this phase be conducted by relevant experts (Allen et al., 2023). The conventional method of assessing content validity involves expert evaluation of each item and rating its applicability to the specific item

(Yaghmaie, 2003).

The subsequent step involved conducting a face validation test to assess the clarity and usability of an instrument comprising a module workflow and questionnaire, intended for non-experts or the target population. The objective was to determine if the module content and workflows are clear, easily comprehensible, and relevant to respondents' perspectives (Allen et al., 2023). Additionally, this test aimed to evaluate whether the content and workflows accurately measure their intended constructs and are practical for healthcare professionals to develop and maintain CPR competency.

5.1. Adoption of the ADDIE instructional model design in developing the Smart-CPR training module

The ADDIE instructional model guides the creation of technology-based CPR training in a structured way. It involves five phases: analysis, design, development, implementation, and evaluation. First, the analysis phase looks at who needs the training and what they need to learn. Then, in the design phase, the training program is planned, including what content to cover and how to make it engaging, like using videos or simulations. Next, in the development phase, the actual training materials are made, like digital modules or mobile apps. After that, the training is put into action in the implementation phase, using online platforms or virtual classrooms. Finally, the effectiveness of the training is assessed in the evaluation phase, using data to see how well learners are doing and what can be improved. In this study, data collection takes place during the design phase. Following the theoretical development of the module, validation is necessary before its transfer into a digital environment. **Figure 2** illustrates where the validation phase takes place in the ADDIE instructional model design.

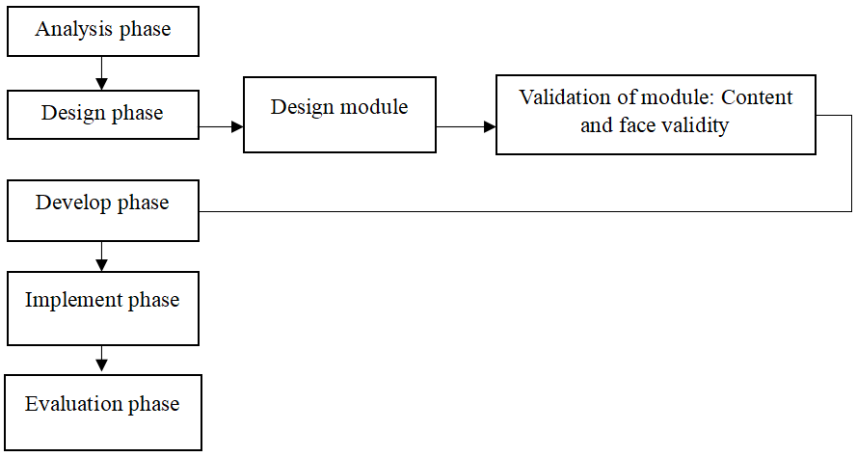

Figure 2. Validation of Smart-CPR training module.

5.2. Data collection

5.2.1. Assessment of content validity

Content validity was assessed with the participation of ten experts, including emergency physicians, senior medical officers with at least five years of experience in emergency room (ER), and senior emergency department nurses with advanced

diplomas in emergency care (Desai and Patel, 2020; Shafie et al., 2020; Yusoff, 2019). These experts were selected based on specific criteria, such as being certified CPR trainers from local or international authorities, possessing a minimum of five years of experience in the emergency department, and holding strong academic qualifications (medical officers: PhD/MPh, national specialist register; senior nurses: bachelor's in nursing, diploma in nursing, and advanced diploma in emergency care). They were informed via email and provided with a copy of the Smart-CPR training module to rate each item's content validity on a scale of four, focusing on consistency, representativeness, clarity, and relevance. The experts were encouraged to offer feedback for module improvement, submitting their responses via email or WhatsApp and participating in virtual interviews for comprehensive data collection. This evaluation process occurred in stages, with the first draft evaluated by Experts #1 and #2, leading to revisions, rephrasing, discarding, and additions as necessary. The revised module was then assessed by Experts #3 and #4, continuing until consensus was reached among all experts. Experts received the Smart-CPR training module one week before review to enhance response rate and efficiency, with follow-ups conducted via WhatsApp after three days of initial contact. **Table 1** represents the demographic distribution of the experts' panel involved.

Table 1. Background of experts' panel.

No.	Academic and specialisation	Designation
#1	Master of Emergency Medicine (Mmed), UKM	Emergency physician
#2	Master of Emergency Medicine (Mmed), UM	Emergency physician
#3	Master of Emergency Medicine (Mmed)	Emergency physician
#4	Master of Emergency Medicine (Mmed)	Emergency physician
#5	Doctor of Medicine, UMS	Senior medical officer, ED
#6	Doctor of Medicine, UMS	Senior medical officer, ED
#7	Bachelor of Nursing, Advanced Emergency Care (ADEC)	Nursing officer
#8	Bachelor of Nursing, Advanced Emergency Care (ADEC)	Nursing officer
#9	Diploma In Nursing, Advanced Emergency Care (ADEC)	Senior nurse
#10	Diploma In Nursing, Advanced Emergency Care (ADEC)	Senior nurse

5.2.2. Assessment of face validity

In the face validity phase, each item within the Smart-CPR training module and questionnaires underwent review and assessment by ten randomly selected nurses from a teaching hospital in north Borneo, who represented the target population among healthcare professionals (Allen et al., 2023). The selection of participants was based on the criteria as healthcare provider. Detailed information regarding these nurses is provided in **Table 2**. Notification of their participation was conveyed through email and WhatsApp, and informed consent was obtained prior to the face validation process. The complete set of Smart-CPR training module and questionnaire were then provided to the nurses for their review. Face validity assessments were conducted in face-to-face sessions, allowing nurses to directly address any queries to the researcher regarding the Smart-CPR training module and questionnaires. Subsequently, the researcher provided brief explanations for each module item to ensure better

understanding among participants. It is noteworthy that these ten nurses were excluded from the implementation phase of the study.

Table 2. Detail of nurses involve in face validity.

Nurse	Qualification	Total experience (years)	Clinical placement (department)
#1	Degree	9	Medical
#2	Degree	5	Surgical
#3	Diploma	3	Ophthalmology
#4	Diploma	3	Emergency
#5	Diploma	3	Primary care centre
#6	Degree	5	Operation theatre
#7	Diploma	12	Orthopedic
#8	Diploma	7	Emergency
#9	Diploma	5	Infection control
#10	Diploma	5	Medical

6. Data analysis

For content validity approach, data obtained from experts were assessed using the content validity ratio (CVR), which ranges from 1 to −1. A score closer to 1 indicates greater consensus among the expert panel regarding an item's importance in the instrument. The CVR is calculated using the formula CVR = ($Ne - N/2$)/($N/2$), where Ne is the number of expert panelists indicating "important" and N is the total number of expert panelists. The numeric value of CVR is determined using Lawshe's (1975) table. In this study, with 10 expert panelists, a CVR above 0.62 was considered acceptable (Ayre and Scally, 2014). To assess the validity of the entire module and questionnaires, the content validity index (CVI) was computed. The CVI represents the average CVR score for all Smart-CPR training module and questionnaire items. Like CVR, values closer to 1 indicate higher content validity. To calculate the CVI for all items, the average of all 44 CVR scores was determined.

Table 3. Formula to calculate the I-FVI, S-FVI/Ave and S-FVI/UA (Ozair et al., 2017).

The CVI indices	Formula
I-FVI (Item-level face validity index)	I-FVI = (agreed item)/(number of rater)
S-FVI/Ave (scale-level face validity index based on average method)	S-FVI/Ave = (sum of I-FVI scores)/(number of item)
S-FVI/UA (scale-level face validity index based on universal agreement method)	S-FVI/UA = (sum of UA scores)/(number of item)

To assess the face validity result, we used two indices: the item face validity index (I-FVI) and the scale face validity index (S-FVI). The S-FVI will be presented as both S-FVI/Ave, which is the average of I-FVI scores, and S-FVI/UA, the average of universal agreement (UA). To calculate these indices, we assign a score of 1 for 'consistency', 'representativeness', 'clarity', and 'relevance' when rated as 3 or 4, and a score of 0 when rated as 1 or 2. The formulas for calculating I-FVI, S-FVI/Ave, and

S-FVI/UA are presented in **Table 3** by Ozair et al. (2017). An FVI value of at least 0.83 is considered acceptable (Yusoff, 2019).

7. Result

The demographic profile of the professional experts ($N = 10$) reveals an equal distribution of female (5, 50%) and male experts (5, 50%). These experts are affiliated with Universiti Malaysia Sabah and a teaching hospital in northern Borneo, holding positions such as emergency physician (4, 40%), senior medical officer (2, 20%), nursing officer (2, 20%), and senior nurse (2, 20%). They are pursuing qualifications including master of emergency medicine, doctor of medicine, and advanced diploma in emergency care.

To evaluate the content validity of both the Smart-CPR training module and questionnaire, Lawshe's content validity ratio (CVR) and content validity index (CVI) were employed (Lawshe, 1975). The CVR scores for 'consistency', 'representativeness', 'clarity', and 'relevance' aspects of both the Smart-CPR training module and questionnaire ranged from 0.80 to 0.99, indicating strong content validity (Gilbert and Prion, 2016). The CVI values for 'consistency' of the Smart-CPR training module and questionnaire were 0.99 and 0.96, respectively. Similarly, for 'representativeness', the CVI values were 0.99 for the module and 0.97 for the questionnaire. 'Clarity' scored 0.99 for the module and 0.96 for the questionnaire, while 'relevance' achieved a score of 0.99 for both the module and the questionnaire. It is recommended that CVI values be above 0.70, with a suggested desirable threshold of greater than 0.80 (Davis, 1992; Gilbert and Prion, 2016; Tilden et al., 1990). **Table 4** displays the content validity ratio (CVR) and content validity index (CVI) for the Smart-CPR training module and questionnaire. The detailed results of the content validity ratio (CVR) and content validity index (CVI) are presented in **Table A1**.

Table 4. The result of the content validity ratio (CVR) and content validity index (CVI) for the Smart-CPR training module and questionnaire.

Item	*N*	Consistency		Representative		Clarity		Relevancy	
CRSTP module	4	CVR (Mean)	CVI	CVR (Mean)	CVI	CVR (Mean)	CVI	CVR (Mean)	CVI
		0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
CRSTP questionnaires	40	0.98	0.96	0.98	0.97	0.97	0.96	0.99	0.99

Following the completion of content validity assessment, the Smart-CPR training, comprising four modules and forty questionnaires, underwent further analysis for face validity. Ten nurses participated in this process, all of whom were female. Their work experience ranged from three to twelve years across various wards and departments. The majority of nurses held diplomas as their highest educational qualification ($N = 7$, 70%), with the remaining possessing degrees ($N = 3$, 30%). Remarkably, all 44 items surpassed the minimum threshold of 0.83, indicating strong face validity. A summary of the analyzed items is presented in **Table 5**. The comprehensive results of the face validity index (FVI) are shown in **Table A2**.

Table 5. The summary result of Face validity value of Smart-CPR training module and questionnaire.

Items	Means of raters in agreement	Proportion of consistency, representative, clarity, and relevancy	
CRSTP module	10	1	1
CRSTP questionnaires	10	1	1
Average proportion of item judged for consistency, representative, clarity, and relevancy across 10 raters			1

8. Discussion

A favorable outcome in both content and face validity assessments for validating a CPR training module earmarks it as a robust and reliable educational tool, particularly when slated for digitization. Content validity ensures that the module comprehensively covers essential CPR knowledge and skills, aligning with established guidelines and best practices. This aspect is crucial for ensuring that learners receive a thorough and accurate understanding of CPR procedures. On the other hand, achieving face validity signifies that the module appears credible and relevant to learners, thereby enhancing their engagement and motivation to participate in the digitalized training. Together, a positive content and face validity result instills confidence among educators, healthcare professionals, and learners regarding the module's effectiveness in imparting CPR knowledge and skills in a digital environment, ultimately contributing to improved healthcare practices and outcomes.

The review conducted by professional experts indicated that no item required substantive revision, except for minor grammar improvements. Some items were rephrased to enhance clarity and ensure ease of understanding, utilizing layman language. All items garnered positive content validity ratio (CVR) values ranging from 0.8 to 0.99. This suggests that the items were well conceptualized and operationalized based on adopted theories and guidelines. However, minor modifications in grammar were necessary for questions 15, 22, and 35 to enhance clarity. Notably, the strength of CVR was evident in this study, facilitating clear differentiation of opinions among the expert panel. The professional experts recommended subjecting all 44 items to a pilot study. The research findings indicate that the scale possesses good content validity, demonstrating significant potential as a valuable instrument for aiding users in developing and retaining CPR cognitive knowledge and psychomotor skills. The researcher plans to further investigate the scale's validity evidence, including face validity.

The aim of this face validity index was to assess comprehension in terms of consistency, representativeness, clarity, and relevancy from the perspective of the target population, potentially including laypersons. The FVI yielded high levels of face validity across all four domains, indicating a robust response process. Remarkably, all items within the Smart-CPR training module and questionnaires received favorable scores for S-FVI/Ave, surpassing the cut-off value of 0.83 and 0.9 or higher (Shi et al., 2012). Qualitative feedback from respondents primarily focused on sentence clarity. Consequently, researchers rephrased sentences to enhance layperson understanding. Overall, respondents found the items acceptable, underscoring the effectiveness of the face validity assessment.

9. Conclusion

The validation of the technology-based CPR training module is of paramount importance in ensuring its efficacy and reliability. Through meticulous validation procedures, which include a thorough examination of the module's content and instructional design, adherence to established guidelines and best practices in CPR education is confirmed. This validation process instills confidence among educators and healthcare professionals regarding the module's ability to effectively impart crucial CPR knowledge and skills to learners, thereby enhancing their competence and readiness to respond to cardiac emergencies. Ultimately, this rigorous validation significantly improves the quality and effectiveness of CPR training, thereby leading to better patient outcomes and potentially saving lives.

A potential limitation in conducting face and content validity research lies in the subjectivity inherent in the assessment process. While face validity primarily concerns the extent to which a measure appears, on the surface, to be measuring the construct of interest, and content validity pertains to the comprehensiveness and relevance of the items included in the measure, these judgments can be influenced by individual biases, perspectives, and experiences of the assessors. Consequently, there is a risk that the results obtained may not accurately reflect the true validity of the instrument, as interpretations of what constitutes face validity or relevant content may vary among different evaluators. Moreover, the reliance on qualitative judgments without rigorous quantification methods may introduce inconsistency and ambiguity into the assessment process, potentially compromising the reliability and generalizability of the findings. Thus, while face and content validity are valuable aspects of measurement validation, the subjectivity involved underscores the importance of employing rigorous methodologies and multiple evaluators to enhance the credibility and robustness of the research outcomes.

The development of the Smart-CPR training module and accompanying questionnaires underwent iterative and thorough procedures to ensure compliance with both face and content validity standards. The 44 items demonstrated appropriate levels of content and face validity, meeting predefined criteria. These evaluations underscored the effectiveness of theoretically enhancing and sustaining CPR competency among healthcare providers, with potential extensions of benefits to the broader community. The rigorous development process aimed to ensure that the training module and questionnaires accurately captured essential aspects of CPR knowledge and skills, thus contributing to enhanced healthcare practices and outcomes.

Author contributions: Conceptualization, NA and WW; methodology, NA; software, FK and SSSAR; validation, NA, HH and LJ; formal analysis, SSSAR; investigation, WW; resources, NA and WW; data curation, FK and SSSAR; writing—original draft preparation, NA and WW; writing—review and editing, NA, WW, and TS; visualization, FK and SSSAR; supervision, HH; project administration, WW; funding acquisition, WW, NA, FK, and TS. All authors have read and agreed to the published version of the manuscript.

Conflict of interest: The authors declare no conflict of interest.

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Appendix

Table A1. Content validity ratio (CVR) and content validity index (CVI) for CRSTP module and questionnaires.

Item	Consistency		Representative		Clarity		Relevancy	
	CVR	**CVI**	**CVR**	**CVI**	**CVR**	**CVI**	**CVR**	**CVI**
CRSTP Module		0.99		0.99		0.99		0.99
Item 1	0.99		0.99		0.99		0.99	
Item 2	0.99		0.99		0.99		0.99	
Item 3	0.99		0.99		0.99		0.99	
Item 4	0.99		0.99		0.99		0.99	
CRSTP Questionnaire		0.96		0.97		0.96		0.99
Item 5	0.99		0.8		0.8		0.99	
Item 6	0.99		0.99		0.99		0.99	
Item 7	0.99		0.99		0.99		0.99	
Item 8	0.99		0.99		0.99		0.99	
Item 9	0.99		0.99		0.99		0.99	
Item 10	0.99		0.99		0.99		0.99	
Item 11	0.99		0.80		0.99		0.99	
Item 12	0.99		0.99		0.99		0.99	
Item 13	0.99		0.99		0.99		0.99	
Item 14	0.99		0.99		0.99		0.99	
Item 15	0.99		0.99		0.99		0.99	
Item 16	0.99		0.99		0.99		0.99	
Item 17	0.99		0.99		0.80		0.99	
Item 18	0.8		0.99		0.99		0.99	
Item 19	0.99		0.99		0.99		0.99	
Item 20	0.99		0.99		0.99		0.99	
Item 21	0.99		0.99		0.99		0.99	
Item 22	0.99		0.99		0.99		0.99	
Item 23	0.99		0.99		0.99		0.99	
Item 24	0.99		0.99		0.99		0.99	
Item 25	0.99		0.99		0.80		0.99	
Item 26	0.99		0.99		0.99		0.99	
Item 27	0.60		0.99		0.99		0.99	
Item 28	0.99		0.99		0.99		0.99	
Item 29	0.99		0.99		0.99		0.99	
Item 30	0.99		0.99		0.99		0.99	
Item 31	0.99		0.99		0.80		0.99	
Item 32	0.99		0.99		0.99		0.99	
Item 33	0.99		0.99		0.99		0.99	
Item 34	0.99		0.99		0.99		0.99	
Item 35	0.99		0.99		0.99		0.99	
Item 36	0.99		0.99		0.99		0.99	

Table A1. (*Continued*).

Item	Consistency		Representative		Clarity		Relevancy	
	CVR	**CVI**	**CVR**	**CVI**	**CVR**	**CVI**	**CVR**	**CVI**
Item 37	0.99		0.99		0.99		0.99	
Item 38	0.99		0.99		0.99		0.99	
Item 39	0.99		0.99		0.99		0.99	
Item 40	0.99		0.99		0.99		0.99	
Item 41	0.99		0.99		0.99		0.99	
Item 42	0.99		0.99		0.99		0.99	
Item 43	0.80		0.80		0.80		0.80	
Item 44	0.99		0.99		0.99		0.99	

Table A2. The consistency, representative, clarity, and relevancy ratings of CRSTP by 10 raters.

Items	**N.1**	**N.2**	**N.3**	**N.4**	**N.5**	**N.6**	**N.7**	**N.8**	**N.9**	**N.10**	**Raters in agreement**	**I-FVI**	**UA**
CRST-P Module													
Item 1	1	1	1	1	1	1	1	1	1	1	10	1	1
Item 2	1	1	1	1	1	1	1	1	1	1	10	1	1
Item 3	1	1	1	1	1	1	1	1	1	1	10	1	1
Item 4	1	1	1	1	1	1	1	1	1	1	10	1	1
CRST-P Questionnaire													
Item 5	1	1	1	1	1	1	1	1	1	1	10	1	1
Item 6	1	1	1	1	1	1	1	1	1	1	10	1	1
Item 7	1	1	1	1	1	1	1	1	1	1	10	1	1
Item 8	1	1	1	1	1	1	1	1	1	1	10	1	1
Item 9	1	1	1	1	1	1	1	1	1	1	10	1	1
Item 10	1	1	1	1	1	1	1	1	1	1	10	1	1
Item 11	1	1	1	1	1	1	1	1	1	1	10	1	1
Item 12	1	1	1	1	1	1	1	1	1	1	10	1	1
Item 13	1	1	1	1	1	1	1	1	1	1	10	1	1
Item 14	1	1	1	1	1	1	1	1	1	1	10	1	1
Item 15	1	1	1	1	1	1	1	1	1	1	10	1	1
Item 16	1	1	1	1	1	1	1	1	1	1	10	1	1
Item 17	1	1	1	1	1	1	1	1	1	1	10	1	1
Item 18	1	1	1	1	1	1	1	1	1	1	10	1	1
Item 19	1	1	1	1	1	1	1	1	1	1	10	1	1
Item 20	1	1	1	1	1	1	1	1	1	1	10	1	1
Item 21	1	1	1	1	1	1	1	1	1	1	10	1	1
Item 22	1	1	1	1	1	1	1	1	1	1	10	1	1
Item 23	1	1	1	1	1	1	1	1	1	1	10	1	1
Item 24	1	1	1	1	1	1	1	1	1	1	10	1	1
Item 25	1	1	1	1	1	1	1	1	1	1	10	1	1
Item 26	1	1	1	1	1	1	1	1	1	1	10	1	1

Table A2. (*Continued*).

Items	N.1	N.2	N.3	N.4	N.5	N.6	N.7	N.8	N.9	N.10	Raters in agreement	I-FVI	UA
Item 27	1	1	1	1	1	1	1	1	1	1	10	1	1
Item 28	1	1	1	1	1	1	1	1	1	1	10	1	1
Item 29	1	1	1	1	1	1	1	1	1	1	10	1	1
Item 30	1	1	1	1	1	1	1	1	1	1	10	1	1
Item 31	1	1	1	1	1	1	1	1	1	1	10	1	1
Item 32	1	1	1	1	1	1	1	1	1	1	10	1	1
Item 33	1	1	1	1	1	1	1	1	1	1	10	1	1
Item 34	1	1	1	1	1	1	1	1	1	1	10	1	1
Item 35	1	1	1	1	1	1	1	1	1	1	10	1	1
Item 36	1	1	1	1	1	1	1	1	1	1	10	1	1
Item 37	1	1	1	1	1	1	1	1	1	1	10	1	1
Item 38	1	1	1	1	1	1	1	1	1	1	10	1	1
Item 39	1	1	1	1	1	1	1	1	1	1	10	1	1
Item 40	1	1	1	1	1	1	1	1	1	1	10	1	1
Item 41	1	1	1	1	1	1	1	1	1	1	10	1	1
Item 42	1	1	1	1	1	1	1	1	1	1	10	1	1
Item 43	1	1	1	1	1	1	1	1	1	1	10	1	1
Item 44	1	1	1	1	1	1	1	1	1	1	10	1	1
Proportion of consistency, representative, clarity, and relevancy	1	1	1	1	1	1	1	1	1	1	S-FVI/Ave	1	-
											S-FVI/Ua	-	1
Average proportion of item judged for consistency, representative, clarity, and relevancy across 10 raters											1		