Construction and validity of educational technology for adolescents on cardiac resuscitation

Construção e validação de tecnologia educacional para adolescentes sobre reanimação cardíaca

Elaboración y validación de tecnología educativa para adolescentes sobre reanimación cardíaca

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Abstract

Objective: To construct and validate a comic book for adolescents about cardiac resuscitation.

Methods: This is a methodological study with a quantitative approach carried out in three phases: 1) integrative review; 2) identification of learning needs (through a cross-sectional survey with 84 adolescents); and 3) construction and validity of storyboard made under considerations of the Theory of Meaningful Learning. The story obeyed the six steps of comic artist Mccloud, and was validated by 23 judges who judged the comic book using the Educational Content Validation Instrument in Health. The Content Validity Index and the binomial test were used to verify whether the proportion of agreement was statistically equal to or greater than 80%.

Results: The integrative review justified the need to construct educational technologies on Basic Life Support. The 84 adolescents indicated the need to learn about the first three links of care in a cardiac arrest. The technology brought, in the narrative of character Dara, instructions to apply Basic Life Support only with the hands in victims of cardiac arrest. In validity, 17 (seventeen) of the 18 (eighteen) items assessed received the maximum score, and the overall assessment of the technology obtained a value of 0.99.

Conclusion: The judges considered the comic book type educational technology valid for teaching cardiopulmonary resuscitation.

Resumo

Objetivo: Construir e validar uma história em quadrinhos para adolescentes sobre reanimação cardíaca.

Métodos: Estudo metodológico de abordagem quantitativa realizado em três fases: 1) revisão integrativa, 2) identificação das necessidades de aprendizagem (mediante inquérito transversal com 84 adolescentes) e 3) construção e validação de *storyboard* feito sob considerações da Teoria da Aprendizagem Significativa. A história obedeceu aos seis passos do quadrinista Mccloud, e foi validada por 23 juízes que julgaram os quadrinhos pelo Instrumento de Validação de Conteúdo Educacional em Saúde. Utilizou-se o Índice de Validade de Conteúdo e o Teste Binomial para verificar se a proporção de concordância foi, estatisticamente, igual ou superior a 80%.

Resultados: A revisão integrativa justificou ser necessária a construção de tecnologias educacionais sobre Suporte Básico de Vida. Os 84 adolescentes apontaram necessidade de aprendizagem sobre os três primeiros elos de atendimento a uma parada cardíaca. A tecnologia trouxe, na narrativa da personagem Dara, instruções para aplicar Suporte Básico de Vida somente com as mãos em vítimas de Parada Cardíaca. Na validação, 17 (dezessete) dos 18 (dezoito) itens avaliados receberam nota máxima, a avaliação global da tecnologia obteve o valor 0,99.

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Conflicts of interest: nothing to declare.

Conclusão: Os juízes consideraram válida a tecnologia educacional do tipo história em quadrinhos para ensinar reanimação cardiopulmonar.

Resumen

Objetivo: Elaborar y validar una historieta para adolescentes sobre reanimación cardíaca.

Métodos: Estudio metodológico de enfoque cuantitativo realizado en tres fases: 1) revisión integradora, 2) identificación de las necesidades de aprendizaje (mediante investigación transversal con 84 adolescentes) y 3) elaboración y validación del *storyboard* realizado de acuerdo con reflexiones sobre la teoría del aprendizaje significativo. La historia siguió los seis pasos del autor de historietas Mccloud y fue validada por 23 jueces, que evaluaron la historieta mediante el Instrumento de Validación de Contenido Educativo en Salud. Se utilizó el Índice de Validez de Contenido y la prueba binominal para verificar si la proporción de concordancia era estadísticamente igual o superior a 80 %.

Resultados: La revisión integradora justificó la necesidad de elaborar tecnologías educativas sobre soporte vital básico. Los 84 adolescentes señalaron la necesidad de aprender sobre los tres primeros eslabones en la atención a un paro cardíaco. La tecnología proporciona, mediante la narrativa del personaje Dara, instrucciones para aplicar el soporte vital básico solo con las manos en víctimas de paro cardíaco. En la validación, 17 (diecisiete) de los 18 (dieciocho) ítems evaluados recibieron nota máxima, la evaluación global de la tecnología obtuvo el valor de 0,99.

Conclusión: Los jueces consideraron válida la tecnología educativa tipo historieta para enseñar reanimación cardiopulmonar.

Introduction

Cardiopulmonary resuscitation (CPR) performed by lay people increases survival after out-of-hospital cardiac arrest (OHCA). However, the overall prevalence of bystander resuscitation training and attitude is low.[1,2] To expand the CPR offer, international and national guidelines recommend that adolescents aged 12 years and older be trained to perform high-quality CPR.[3,4]

Lack of knowledge and skill about Basic Life Support (BLS) are obstacles to performing CPR.[5] However, this can be overcome by promoting BLS learning in the school setting.[6] It turns out that in Brazil, unlike other countries, teaching this subject is not mandatory.[7] Training in the basics of first aid is only compulsory for teachers and employees of public and private schools.[8]

BLS includes recognizing cardiac arrest, calling the emergency service, performing CPR, and using an automated external defibrillator (AED).[3] Among the educational technologies capable of facilitating teaching BLS, the video mentioned in the largest number of publications.[9] However, a randomized controlled trial (RCT) showed that elementary school students who studied cardiac resuscitation using still images achieved significantly higher percentages of chest compressions with correct hand placement than those who learned with video educational technology.[10] Furthermore, when considering the audience's different needs and interests that demand training, the America Heart Association (AHA) suggests the increase of technologies.[1]

Thus, comic books, as an educational technology that uses texts and static images in its narrative, and as an object of historical interest for adolescents, could help them learn BLS. In Brazil and in other countries, comic books have been used for health education.[11,12] However, until the writing of this research, validated studies with methodological rigor capable of assessing whether or not comic book is valid as an educational technology to teach resuscitation were identified.

It is believed that, due to its low cost, easy reproduction and mass dissemination, comic book may arouse the interest of adolescents in BLS, increase CPR supply and the survival of OHCA victims. Therefore, the creation of this tool intends to contribute to evidence-based practice (EBP) and to empower the lay population on cardiovascular emergencies. Thus, this study aimed to construct and validate a comic book for adolescents about cardiac resuscitation.

Methods

The methodological study of comic book construction and validity was carried out in three phases: in the first moment, an integrative literature review was carried out; then, the learning needs were identified; finally, work was done on storyboard construction, resorting to judges with experience in CPR for validity purposes. A storyboard is a set of sequential drawings used as a guide to tell a story.

The integrative review was carried out between July and October 2019, and written according

to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines.[13] The identification of learning needs, through a cross-sectional survey, was carried out between November and December 2019. Comic book storyboard/validity construction took place between January and May 2020.

To establish the research question, the acronym PICo was used: P (population) – adolescents, I (phenomenon of interest) – educational technologies and Co (context) – CPR. Thus, we sought to answer the following question: what evidence is available in the literature on educational technologies related to CPR developed for adolescents' education?

For this purpose, the Medical Literature and Retrieval System onLine (MEDLINE/PubMed®) via National Library of Medicine, Latin American and Caribbean Literature in Health Sciences (LILACS) via VHL, Cumulative Index to Nursing & Allied Health Literature (CINAHL), Web of Science via Core Collection (Clarivate Analytics) and Scopus databases were used. For the search, words present in Descriptors in Health Sciences (DeCS) and in Medical Subject Headings (MeSH) and CINAHL titles were selected (Chart 1).

In order to identify the target audience's learning needs, a situational diagnosis was carried out with students from a federal technical school in northeastern Brazil. The institution was chosen because it is a reference in free technical and vocational education, in addition to bringing together students from more than 25 municipalities. During the data collection period, there were 228 adolescents regularly enrolled. After applying the inclusion criteria (being an adolescent aged between 10 and 19 years) and exclusion (having professional training in the health area and/or being expected to evade or drop out of the course during the data collection phase), 84 participants were selected.

The students included filled out a form that was divided into 02 parts. The first had seven questions about the sociodemographic profile. The second contained 23 questions about the first 03 links in the OHCA survival chain.[14] In items of the 1st link of care, students mentioned the need to learn about recognizing and activating the emergency medical service. In the 2nd, they pointed out what they needed to know about immediate high-quality CPR. In the 3rd link, they pointed out the gaps in learning about rapid defibrillation. For each question, there was a four-point Likert-type scale: not important, reasonably important, very important, and extremely important. Participants should choose one and mark it. Form application took place in the school auditorium, and the response time ranged from 15 to 20 minutes.

In the third phase, storyboard construction and validity were carried out. The comic book was made up of researchers with experience in BLS and educational health technologies. Moreover, the team had the help of a private designer company in the graphic art elaboration. The storyboard was created considering the learning needs pointed out by adolescents. For each identified demand, educational objectives were drawn up based on Bloom's Taxonomy. The educational content on CPR, in turn, was based on recommendations extracted from the Brazilian Society of Cardiology and the AHA.[3,4] Figure 1 presents the process of creating a comic book.

Chart 1. Controlled and uncontrolled descriptors used in the search strategy

Acronym	Controlled descriptors/ DeCS/MeSH Terms		Uncontrolled descriptors/entry terms
P	Adolescent	OR	Adolescence OR Adolescents OR "Adolescents, Female" OR "Adolescents, Male" OR Teenagers OR Teens OR Youth
AND			
I	Technology OR "Educational Technology"	OR	"Technology, Educational" OR "Educational Technologies" OR "Technologies, Educational" OR "Instructional Technology" OR "Technology, Instructional" OR "Instructional Technologies" OR "Technologies, Instructional".
AND			
Co	Resuscitation OR "Cardiopulmonary Resuscitation" OR "Advanced Cardiac Life Support"	OR	"Resuscitation, Cardiopulmonary" OR CPR OR "Cardio-Pulmonary Resuscitation" OR "CardioPulmonary Resuscitation" OR "Resuscitation, Cardio-Pulmonary"; "Code Blue" OR "Mouth-to-Mouth Resuscitation" OR "Mouth to Mouth Resuscitation" OR "Mouth-to-Mouth Resuscitations" OR "Resuscitation, Mouth-to-Mouth" OR "Resuscitations, Mouth-to-Mouth" OR "Basic Cardiac Life Support" OR "Life Support, Basic Cardiac"

DeCS – Descriptors in Health Sciences; MeSH - Medical Subject Headings

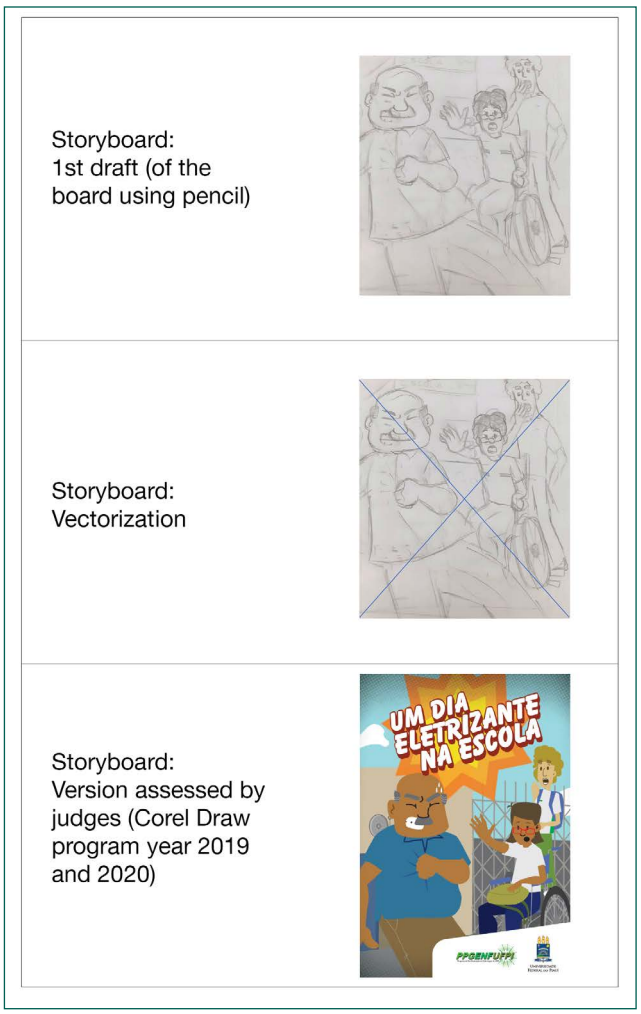

Figure 1. Cardiac resuscitation comic book construction process

Storyboard content validity occurred remotely, via email/google docs. To establish the number of judges, a sample calculation was performed based on the formula for a finite population n=(Z1-α/2.S)2/e. In this formula, Z1-α/2 (confidence level) was set at 95%, (S) of 0.17 for standard deviation, and a (e) sampling error of 0.07, totaling 23 judges.[15] Judges were recruited through a Brazilian researchers curriculum platform (https://lattes.cnpq.br/), using the subject term "BLS". A total of 73 (seventy-three) judges were identified in BLS. The first 23 who had a PhD in nursing, with academic and clinical experience and who participated in a research group involving CPR were included. Those who answered the data collection instrument incompletely and/or did not return it within the stipulated time of 30 days were excluded.

The judges had the levels of expertise classified according to the criteria stipulated by Benner, Tanner and Chesla, namely: novice (1.0 point), beginner (2.0 points), competent (3.0 points), proficient (4.0 points) and expert (5.0 points),[15,16] as can be seen in Table 1.

Table 1. Classification of judges' level of expertise

Score	Practical experience	Participation in research group	Academic experience		
			Scientific knowledge (Z)		
	Job tenure* (X)	Research group time* (Y)	Degree (Z_1)	Degree work (Z_2)	Scientific production in Basic Life Support (Z_3)
0	-	-	Graduate	No	No
1	1-4	1-4	Specialist	Yes	Yes
2	5-9	5-9	Master's degree	-	-
3	10-14	10-14	PhD	-	-
4	15-19	15-19	-	-	-
5	20-24	20-24	-	-	-

*years; level of expertise = Sum of scores obtained in columns X, Y and Z divided by 3
Source: Adapted from Leite SS, Áfio AC, Carvalho LV, Silva JM, Almeida PC, Pagliuca LM. Construction and validation of an Educational Content Validation Instrument in Health. Rev Bras Enferm. 2018;71(Suppl 4):1635–41.[17]

To validate the comic book, the judges received by email guidelines on how to carry out comic book storyboard validity, two copies of the Informed Consent Form (ICF), a sociodemographic and professional characterization form and the Educational Content Validation Instrument in Health (ECVIH).[17] The latter has 18 items and 3 domains (objective, structure/presentation and relevance) that assess, respectively, purposes, goals or objectives; organization, structure, strategy, coherence and sufficiency; significance, impact, motivation and interest. It is noteworthy that, for each domain, there was a space available for the evaluators to record suggestions, rectifications/ratifications or any other information they deemed necessary. The ECVIH uses a Likert-type scale with scores ranging from zero to two (0 - disagree, 1 - partially agree and 2 - totally agree).[17] It is noted that judges' forms with considerations and notes on comic book will be available to readers on demand. Sociodemographic and professional data were coded in Microsoft Office Excel 365 spreadsheets. Data were double-entered and inspected for error correction, in addition to being exported and analyzed using the Statistical Package for the Social Sciences (SPSS), version 20.0. A de-

scriptive data analysis was carried out with verification of absolute and relative frequency, median and interquartile range (due to data non-compliance with normality). For this purpose, R, version 3.1.1, was used.

The Content Validity Index (CVI) was calculated by applying the Item-level Content Validity Index (I-CVI). The I-CVI was calculated for each of the 18 items, and dealt with the proportion of judges who agreed with a given item. For the overall comic book assessment, the Scale-level Content Validity Index, Average Calculation Method (S-CVI/AVE) was calculated, which represented the average value of I-CVI.[18] The comic book and its respective evaluative items were considered valid when the proportion of experts' agreement was equal to or greater than 80% in the binomial test, with a significance level of 5%.[18]

In this study, two theoretical-methodological references were used. The first, Ausubel's Theory of Meaningful Learning, identified learners' cognitive structure, and made educational technology meaningful to readers. By completing the adapted CPR form, students provided information about the need for BLS learning. Thus, observing the form data, potentially significant instructional material was developed, structured and not arbitrary to learners' interest.[19] The second theoretician consulted was comic artist Mccloud, who points out the six steps for storyboard production: objective and educational content definition; format notation; choice of language; structure; ability; comic surface.[20]

The research was approved by the Research Ethics Committee (REC) of the *Universidade Federal do Piauí* (UFPI), and followed the principles of Resolution 466/12 of the Brazilian National Health Council, under Opinion 3,697,960 (*Certificado de Apresentação para Apreciação Ética* - Certificate of Presentation for Ethical Consideration 24422419.6.0000.5214).

Results

During the literature review, four modalities of technologies developed for teaching CPR to the adolescent public were identified: web/online courses, applications, virtual reality and video as the most used technology. Among the highlighted gaps, we mention the use of non-validated technologies, the fragile theoretical basis, the low number of research in the Latin American continent and the few publications in non-medical areas. In the cross-sectional survey, of the 84 (100.0%) adolescents who participated in the situational diagnosis, 56 (66.7%) were female, with a mean age of 16.3 (±1.07), a minimum of 14 and maximum of 19 years. Regarding the learning needs about the 1st link of care to a OHCA, 79 (93.9%) needed to know about "responsiveness check" of OHCA victims, 76 (90.3%) "when to call for help" and 72 (85.6%) "how to ask for help". About the learning needs related to the 2nd link of care to a OHCA (immediate and quality CPR), 67 (79.7%) of adolescents needed to know about "what force should be applied to perform cardiac massage", and 64 (76.1%) lacked information about "how many compressions should be performed per minute". In turn, regarding the 3rd link, 81 (96.4%) of adolescents needed to know "what to do right after shocking the victim".

The comic book was titled "An Electrifying Day at School", with 20 pages, 64 strips and 10 characters. Main character is Dara, a black, paraplegic adolescent and daughter of a nurse from the Mobile Emergency Care Service (SAMU-192). Despite having in-depth knowledge of BLS, acquired in conversations with her father, she did not imagine how she would be able to help anyone, due to her physical limitations. In this sense, the comic takes place when Dara witnesses the school doorman, John, showing signs and symptoms of acute myocardial infarction (AMI) followed by OHCA. She guides her friends and teachers to deliver hands-only BLS using non-technical skills (NTS) and her deep theoretical knowledge. The speeches, comic book and plot focused on the actions that must be developed by lay people in the first three links of the service chain. Figure 2 shows some clippings from the comic book.

Twenty-three (100.0%) judges validated the comic book content. The mean age was 41.5 (±8.02) years and the mean job tenure related to

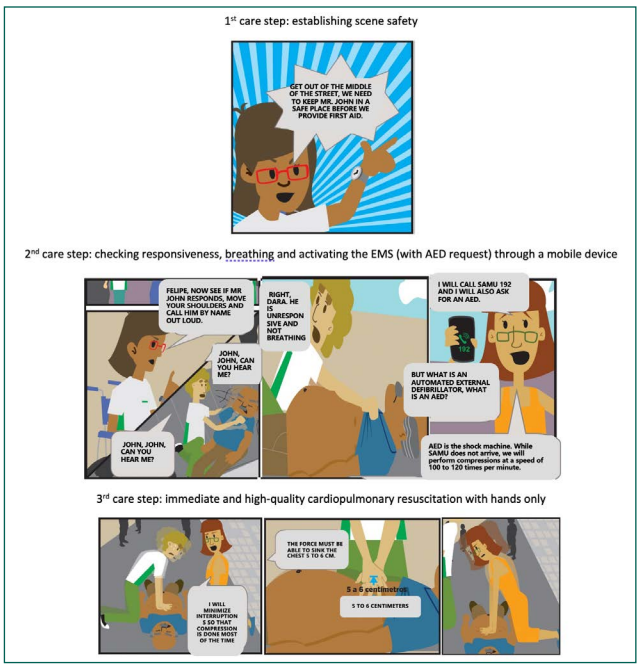

Figure 2. Comic book images with steps to assist a OHCA with hands only

BLS was 11.57 years. There was at least one judge from each region of Brazil, with prevalence for the southeast 9 (39.1%) and the northeast 7 (30.4%). All were doctors, and 8 (34.8%) developed a thesis related to BLS. The average of publications involving this theme in the last 5 years was 2 (±2.86) articles. Fifteen judges (65.2%) were advanced beginner, 4 (17.4%), novice, and 4 (17.4%), competent. The items were validated in agreement greater than 95% among the judges. The one that received less approval referred to material adequacy to the teaching-learning process. Even so, this item had an I-CVI of 0.95. All others were assessed with a maximum score for I-CVI agreement = 1. The SCVI/AVE (for overall technology assessment) obtained a value of 0.99 (Table 2).

Table 2. Judges' agreement on the Educational Content Validation Instrument in Health (n = 23)

Variables	Adequate n(%)	Partially adequate n(%)	I-CVI*	p-value**
OBJECTIVES: purposes, goals or objectives				
1. Includes proposed theme	17(73.9)	6(26.1)	1	1
2. Suitable for the teaching-learning process	22(95.7)	1(4.3)	0.95	0.994
3. Clarifies doubts about the topic addressed	17(73.9)	6(26.1)	1	1
4. Provides reflection on the topic	23(100)		1	1
5. Encourages behavior change	18(78.3)	5(21.7)	1	1
STRUCTURE AND PRESENTATION: organization, structure, strategy, coherence and sufficiency				
6. Appropriate language for the target audience	18(78.3)	5(21.7)	1	1
7. Appropriate language for educational material	17(73.9)	6(26.1)	1	1
8. Interactive language, allowing active involvement in the educational process	2 (91.3)	2(8.7)	1	1
9. Correct information	17(73.9)	6(26.1)	1	1
10. Objective information	20(87)	3(13)	1	1
11. Clarifying information	19(82.6)	4(17.4)	1	1
12. Necessary information	16(69.6)	7(30.4)	1	1
13. Logical sequence of ideas	20(87)	3(13)	1	1
14. Current topic	22(95.7)	1(4.3)	1	1
15. Appropriate text size	21(91.3)	2(8.7)	1	1
RELEVANCE: significance, impact, motivation and interest				
16. Encourages learning	23(100)		1	1
17. Contributes to knowledge in the area	23(100)		1	1
18. Arouses interest in the topic	23(100)		1	1

I-CVI* - Item-level Content Validity Index; p-value** - Binomial test

Discussion

The comic presented guidelines on how to provide BLS for adults in OHCA. To achieve this objective, the strategy was to insert as the main character (Dara) a person with disabilities (PwD) who would act as a regulator. Thus, through NTS, such as situational awareness, leadership, decision-making and communication, she guided which BLS measures should be taken. Studies corroborate that the demonstration of NTS in OHCA scenarios, although essential, is not always addressed.[21,22]

Throughout the plot, the comic book contemplated the first three links in OHCA survival chain of the AHA, which teach lay people to perform CPR only with their hands. A study points out that the application of simplified protocols, which dispense with pulse checks and rescue ventilation, makes lay people more likely to help cardiac arrest victims.[21] Still in this sense, the authors point out that interventions in prisons have a positive impact on the survival of victims. [23,24]

The educational content of the 1st link brought instructions on how to maintain a safe setting to perform CPR. Publications by the Brazilian Society of Cardiology, AHA and the European Society of Resuscitation reinforce the need for scene safety.[4,23,24] However, when con-

sidering that OHCA situations are accompanied by intense emotion, and that the team's experience, values and skills (uncommon characteristics in adolescents) can interfere with decision-making. In this sense, it is possible that safety can be forgotten, and, acting on impulse, inattention to the scene can turn the rescuer into a second victim.[25]

The correct way to identify a cardiorespiratory arrest, when to trigger it and what to ask the EMS were also taught in the comic book. It is worth noting that the way to identify and treat a OHCA varies depending on the rescuer's education level, age and equipment available for care. For laypeople, studies agree that it is not necessary to check the central pulse: responsiveness should be checked by touching the victim's shoulder, calling him out loud. In the event of more than one rescuer at the scene, another person must be delegated to ask for the AED and activate the Emergency Medical Service (EMS).[4,23,24]

The comic book contemplated the correct way to perform resuscitation and how to request the AED (2nd and 3rd link of care to OHCA). Researchers from Hungary identified that adolescents not exposed to educational processes have low knowledge about activating the EMS, immediate CPR and AED use.[26] In this perspective, scientists from Ghana and Brazil also identified that not all respondents trigger the EMS in cases of OHCA, and that 64.7% do not know the amount of compressions that should be done.[25,27]

In the educational content validity, 17 of the 18 items assessed had a maximum I-CVI. As for the objectives, purposes, goals or purposes, there was agreement that comic book contemplated the proposed theme (I-CVI = 1), was suitable for the teaching-learning process (I-CVI = 0.95), clarified doubts, provided reflection on the subject and encouraged behavior change (I-CVI = 1). These data are slightly higher than those found in a study that built and validated an educational video on CPR, a fact that suggests that comic books are a potential educational tool for CPR. However, unlike the video, its effectiveness has not yet been assessed.[9]

Aspects related to adequate, appropriate and interactive language, as well as factors related to the relevance of information and theme, logical sequence of ideas and text size, were validated by the 23 judges with the highest score. A study carried out in Canada pointed out that language barriers in health care lead to a lack of communication between professionals and the lay public, reducing the quality of health care delivery and patient safety.[28]

The judges considered the comic relevant, meaningful and motivating. There was maximum agreement that the narrative encourages learning, contributes to knowledge in the area and arouses interest in the subject. These conclusions reinforce the European and American Resuscitation Councils' hypothesis that non-vertical studies, which consider the opinion of the target audience and adopt educational theories for the technology basis and construction, can optimize the interest and motivation to perform CPR.[3,23]

Among the limitations of this study, mention is made of the fact that the effectiveness of the comic book was not assessed and the fact that the cross-sectional survey was carried out with students from only one school. Even with the educational content validated by judges with expertise in BLS, further studies are needed to identify the real impacts on theoretical, practical and motivational knowledge on the part of comic book readers.

Conclusion

The comic book was considered valid, according to judges in CPR, regarding the educational content on BLS.

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Collaborations

Luz PK, Galindo Neto NM, Machado RS, Marques MCMP, Santos AMR, and Andrade EMLR contributed to the study design, data analysis and interpretation, article writing, relevant critical review of the intellectual content, and approval of the final version to be published.

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