Validation of educational technology on tuberculosis for adolescents

Validação de tecnologia educacional sobre tuberculose para adolescentes

Validación de tecnología educativa sobre tuberculosis para adolescentes

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Abstract

Objective: To validate an educational technology for health education on tuberculosis among adolescent students.

Methods: Methodological study of 49 adolescents from public schools in Belém (PA) aged between 13 and 18 years comprising three steps: technology assessment; analysis of attributes to measure the degree of representativeness and clarity; and review according to adolescents' understanding. A wordsearch was presented to adolescents, who were asked to follow the reading guidelines, locate the highlighted words and answer the questions using the indicated locations. A Likert-type questionnaire was applied to describe the agreement among adolescents in relation to the attributes: objective, organization, writing style, appearance and relevance of the technology, considering the Content Validity Index with a cutoff point of 0.90. The textual corpus was processed in the *R Interface pour les Analyzes Multidimensionnelles de Textes et de Questionnaires*, 0.7 alpha 2. A word cloud graphic resource was used. Numerical data were summarized by the Statistic Package for the Social Sciences, version 22.0.

Results: The attributes were satisfactorily evaluated, with an indication of full agreement ranging between 72.8% in writing style and 84.7% in the relevance of technology. The content validity indices obtained were above 0.90, and the texts generated three clouds corresponding to the definition of tuberculosis, disease transmissibility and clinical manifestation.

Conclusion: The wordsearch proved to be valid for use with adolescents as a tool in educational actions on tuberculosis, and can contribute to self-care and multiplication of knowledge in their social network.

Resumo

Objetivo: Validar tecnologia educacional para educação em saúde sobre tuberculose entre estudantes adolescentes.

Métodos: Estudo metodológico com 49 adolescentes entre 13 e 18 anos, de escolas públicas de Belém (PA), em três etapas: apreciação da tecnologia; análise dos atributos para medir o grau de representatividade e clareza e revisão segundo a compreensão dos adolescentes. Trata-se de um caça palavras, apresentado aos adolescentes, sendo solicitado que seguissem as orientações de leitura, localizassem as palavras em destaque e respondessem as perguntas utilizando os locais indicados. Foi aplicado questionário tipo Likert, para descrever a concordância entre os adolescentes em relação aos atributos: objetivo, organização, estilo da escrita, aparência e relevância da tecnologia, considerando Índice de Validade de Conteúdo com ponto de corte 0,90. O *corpus* textual foi processado no *Interface de R pour les Analyses Multidimensionnelles de Textes et de Questionnaires*, 0.7 alpha 2. Utilizou-se recurso gráfico da nuvem de palavras. Os dados numéricos foram sumarizados pelo *Statistic Package for Social Sciences*, versão 22.0

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Conflicts of interest: none to declare.

Resultados: Os atributos foram avaliados satisfatoriamente, com indicativo de concordância plena variando entre 72,8% no estilo da escrita e 84,7% na relevância da tecnologia. Os índices de validade de conteúdo obtidos foram superiores a 0,90, e os textos geraram três nuvens correspondentes à definição de tuberculose, à transmissibilidade da doença e à manifestação clínica.

Conclusão: O jogo caça palavras mostrou-se válido para utilização como ferramenta em ações educativas sobre tuberculose junto a adolescentes, podendo contribuir para o autocuidado e a multiplicação do conhecimento em sua rede social.

Resumen

Objetivo: Validar tecnología educativa para la educación en salud sobre tuberculosis entre estudiantes adolescentes.

Métodos: Estudio metodológico con 49 adolescentes entre 13 y 18 años, de escuelas públicas de Belém (Pará), en tres etapas: apreciación de la tecnología; análisis de los atributos para medir el grado de representatividad y de claridad y revisión según la comprensión de los adolescentes. Se trata de una sopa de letras, presentada a los adolescentes, se les solicita que sigan las orientaciones de lectura, localicen las palabras en destaque y respondan a las preguntas utilizando los lugares indicados. Se aplicó cuestionario según Escala Likert, para describir el nivel de acuerdo o de desacuerdo entre los adolescentes en relación con los atributos: objetivo, organización, estilo de escritura, apariencia y relevancia de la tecnología, considerando el Índice de Validez de Contenido con punto de corte 0,90. El *corpus* textual fue procesado en el *Interface de R pour les Analyses Multidimensionnelles de Textes et de Questionnaires*, 0.7 alpha 2. Se utilizó el recurso gráfico de la nube de palabras. Se resumieron los datos numéricos por el *Statistic Package for Social Sciences*, versión 22.0

Resultados: Los atributos fueron evaluados de forma satisfactoria, con indicación de nivel de acuerdo o desacuerdo pleno que varió entre 72,8 % en el estilo de la escritura y de 84,7 % en la relevancia de la tecnología. Los índices de validez de contenido obtenidos fueron superiores a 0,90 y los textos generaron tres nubes correspondientes a la definición de tuberculosis, a la transmisibilidad de la enfermedad y a la manifestación clínica.

Conclusión: El juego sopa de letras se mostró válido para uso como herramienta en acciones educativas sobre tuberculosis con adolescentes, que puede contribuir para el autocuidado y para la multiplicación del conocimiento en su red social.

Introduction

The problem of tuberculosis in the social environment has driven the search for better targeted strategies in public policies and health actions to control the disease worldwide.[1,2] In Brazil, the high rates of illness combined with the unsatisfactory performance of actions to fight tuberculosis expressed in operational indicators for disease monitoring have been decisive for the country's position in the priority group for implementation of control measures.[3]

The state of Pará and its capital Belém have contributed strongly to maintain this situation with a high incidence rate and poor results in the outcome of cases. In 2019, incidence rates in Brazil and Belém were 54.7/100 thousand inhabitants and 90.7/100 thousand inhabitants, respectively. In 2018, the cure of new cases was 68.0% in Brazil and 75.8% in Belém. Treatment abandonment rates in the country and in the capital of Pará were 13.8% and 10.1%, respectively.[4]

This epidemiological scenario presupposes the need to disseminate accurate information about the disease and its treatment in society. Adolescents were identified as an important group to spread information that can contribute to prevention, early diagnosis and appropriate treatment of cases, especially among people from their social network.

An educational technology with essential information for adolescents can help to identify cases in their environment, clarify doubts and dismantle possible disease-related myths. This portion of the population is still little inserted in this context of control actions, and once empowered by knowledge, they should contribute to disseminate essential information regarding the diagnosis, treatment and cure of cases in the family and in other social groups to which they belong.[5] Thus, it may be possible to achieve improvements in epidemiological indicators and disease monitoring essentially in the capital of Pará.

In this sense, educational technologies are identified as tools that can disseminate information about the disease and favor reflections, but should result from people's daily experiences in order to respond to their purpose when used with this audience. They must also undergo a validation study to reach content reliability and the purpose of their development.[6]

Validation allows the accurate examination of the technology and the possibility to measure the feasibility of its use. Through validation, it is possible to make the necessary adjustments in the specific construct of each detail and in the entire content. Validating the content of the technology provides an opportunity for a thorough analysis to assess if it

can produce the expected effects in the transmission of accurate information.[7] Only validation with adolescents provides an opportunity to identify the complete understanding of the technology by this target audience.

Studies[8,9] have been developed essentially in the health area to qualify content validation processes, contemplate the specificities of population groups and appreciate the local culture. Thus, validating the technology proposed here in the form of a wordsearch is an important step for its future implementation with adolescents in the school environment and other spaces that provide health education.

The aim of this study was to validate an educational technology for health education on tuberculosis among adolescent students.

Methods

This is a methodological,[10] descriptive study for the semantic validation of an educational technology that was developed in three steps. The first consisted in the appreciation of educational technology by adolescents, the target audience for which it is intended; in the second step, the analysis of pre-established attributes was performed to measure the degree of representativeness and clarity of the instrument; and in the third, the technology was reviewed according to adolescents' understanding.

This study presents the details of the validation performed with the target audience. It was developed with 49 adolescents aged between 13 and 18 years, which corresponds to 40% of the total invited to participate in the study. They come from two public schools in the city of Belém located in a peripheral neighborhood with high incidence of tuberculosis. Students regularly enrolled, currently attending the school and present at the time of data collection were included. There was little interest from some adolescents, and six children under 18 years of age did not obtain authorization from the guardian or did not bring the informed consent form signed. Exclusion criteria were not established.

The educational technology was built in the form of a wordsearch comprising a brief text of nine lines arranged in the middle of the page informing about the definition of the disease, its transmission and the signs and symptoms possibly presented by the person with suspicion/diagnosis of tuberculosis. Beside this text, there is a rectangular board with letters arranged apparently randomly, which form words and expressions camouflaged in the middle of the various letters. These words and expressions are highlighted in the text and should be located by the adolescents. It also displays 15 circle shaped colored pictures of approximately 2cm diameter illustrating the words and expressions to be located on the letter board. The pictures were inserted with the aim to reinforce important aspects related to tuberculosis, based on visual communication.

At the bottom of the page, there are three colored tables to record the answers to the respective questions presented therein. The first table concerns the definition of the disease and the question is: "What is tuberculosis?". The second table corresponds to its transmissibility, with the question: "How does it pass from one person to another?". The third table concerns signs and symptoms, with the question: "What can be observed in a person with tuberculosis?".

Data were collected in February 2019. To this end, based on prior contact with the school principals and pedagogical coordinators, the logistics of fieldwork was structured, as well as the training of the research team, which included eight members of the Group of Studies of Diseases in Traditional Populations of the Amazon linked to the National Council for Scientific and Technological Development, under leadership of the main researcher of this study.

For data collection, the researcher initially presented the printed technology and provided guidance on the activity to be developed. Adolescents individually read the informative text and began searching for words on the board. Afterwards, they proceeded to answer the questions listed in the colored tables at the bottom of the page.

Once this step was completed, a questionnaire with Likert-type answer options was applied indi-

vidually to describe the agreement between adolescents regarding the following attributes: organization, writing style, appearance and relevance of the educational technology. The judgment of each item was made by evaluation of the assertions, which corresponded to totally disagree, partially disagree, partially agree and totally agree.

Numerical data were summarized using the Statistic Package for the Social Sciences, version 22.0. The Content Validity Index was calculated to measure the proportion of agreement between responses grouped by block and in the entire scale, adopting a cutoff point equal to 0.90.[8] The following blocks were evaluated: objective, organization, style, appearance and motivation.

The scores were obtained from the sum of values corresponding to items marked as "3" and "4" and divided by the total number of responses in each block. The overall Content Validity Index was the result of the sum of items considered relevant by the adolescents divided by the total number of responses.[8]

In addition, a description of the empirical material was made from the adolescents' responses given to the open questions contained in the educational technology. The answers were transcribed, organized into a textual corpus and processed using the *Interface de R pour les Analyzes Multidimensionnelles de Textes et de Questionnaires* (IRaMuTeQ), version 0.7 alpha 2.[11] The graphic resource of the word cloud was used, which allowed the expression of the organization of data based on lexical frequencies. Three clouds corresponding to questions related to the definition of tuberculosis, disease transmissibility and clinical manifestation were produced.

During the development of the technology, a step before the one that is the object of this article, the technology was evaluated by health and education experts by means of the DELPHI technique.

In compliance with Resolution 466/2012 of the National Health Council, the study was approved by the Research Ethics Committee under opinion number 2.870.707 (CAAE: 95979618.6.0000.5170), and authorized by the Department of Education of the Municipality of Belém. Informed consent forms were signed by adolescents aged 18 years and over and by parents/guardians if they were under 18 years of age, and these subsequently signed the Assent Term expressing their desire to participate in the study. The data collection instruments were coded according to the sequential order of interviews.

Results

The mean age of adolescents who validated the educational technology was 14 years, median of 13 with a standard deviation of 1.5 years. Most were female, corresponding to 57.1% of the total participants. Regarding the attributes assessed by adolescents, with regard to "objectives", 19.4% partially agreed that the educational technology had educational potential, and 75.5% totally agreed, which are considered extremely relevant scores (Table 1).

For the "organization" attribute, which evaluated the general presentation of the educational technology, the coherence of parts and guidelines for everyday use, most attributed a higher value: 23.3% partially agreed and 68.6% totally agreed (Table 1).

In the evaluation of the "writing style", corresponding to linguistic characteristics as facilitators for a better understanding of the message contained in the educational technology, 21.8% partially agreed with the presented style, and 72.8% totally agreed. As for "appearance", which assessed the significance and feasibility of using the educational technology, 15.8% partially agreed with the appearance of the technology, and 76.6% totally agreed (Table 1).

In the assessment of "relevance", to measure the possibility of the educational technology exerting impact on the daily lives of adolescents and arousing interest in new information, 11.8% partially agreed with the relevance of the technology and 84.7% totally agreed (Table 1).

The Content Validity Index results ranged between 0.92 and 0.95 for objective, organization, writing style and appearance of the educational technology, and was 0.96 for relevance. The Overall Index reached 0.94. In this sense, both the Content Validity Index of the scale and the attributes eval-

Table 1. Attributes evaluated and calculation of the Content Validity Index according to adolescents

Attributes	CVI	Overall CVI
Objective (evaluated the purpose and what is intended to achieve with the use of ET)	0.95	
Organization (evaluated the way to present the guidelines for using the ET, general organization, structure, consistency and formatting)	0.92	
Writing style (evaluated linguistics, text comprehension and writing style of the ET)	0.95	0.94
Appearance (evaluated the degree of significance and feasibility for the use of each part of the ET)	0.92	
Relevance (evaluated the ability of the ET to exert impact and arouse interest in adolescents)	0.96	

CVI - Content Validity Index; ET - Educational Technology

uated were above 0.9, indicating the feasibility of using the educational technology.

The graphic organization of the words from the adolescents' records allowed the identification of the highest frequencies in the corpus (Figure 1).

Figure 1A corresponds to adolescents' answers regarding the definition of tuberculosis; the words "mycobacterium-tuberculosis", "disease" and "tuberculosis" had the highest frequencies, corresponding to 44, 43 and 41 times, respectively. Figure 1B expresses the answers regarding the forms of disease transmission, and the highest frequencies were the words "saliva" (41 times), "sick" (39 times) and "mouth" (37 times). Figure 1C refers to the responses corresponding to the signs and symptoms present in a person with tuberculosis. In this cloud, the words with the highest frequency were "phlegm" (39 times), "loss" (38 times), "weight" (38 times) and "fever" (36 times).

The clouds showed a reduced number of words and a strong similarity in the statements of adolescents, with a slight variation in figure 1C that had greater diversity in the answers. In the three clouds, the words were positioned randomly in such a way that the most frequent ones appeared larger than the others, thereby demonstrating their prominence in the corpus of analysis.

Discussion

The educational technology proposed to be used in health education on tuberculosis with adolescent students has been semantically validated by the target audience for which it is intended. Content Validity Index values above 0.9 associated with the meaning attributed to the words expressed by the adolescents conferred viability for its use. The importance of the target-audience participation in the validation process of the educational technology is noteworthy, as these are the recipients of the information to be transmitted by the instrument.[7,12]

According to adolescents, the composition of the technology was considered satisfactory and could stimulate knowledge acquisition, empowering them for preventive practices and reaching the status of health education. This potential is seen in the objectivity and clarity of the messages conveyed, associated with a playful format that is attractive to the target audience and produces quality communication.[13]

Note that for health education, especially among students, it is necessary to build a space for reflection-action, essential for the incorporation of new knowledge conducive to behavior transformation and, consequently, to the dissemination of information.[14,15] This is an individual process mediated by personal autonomy that requires a protagonist role, favoring the adolescents' adoption of new behaviors and their global education.[16,17]

The validated wordsearch is distinguished by presenting a short, easy-to-understand text with

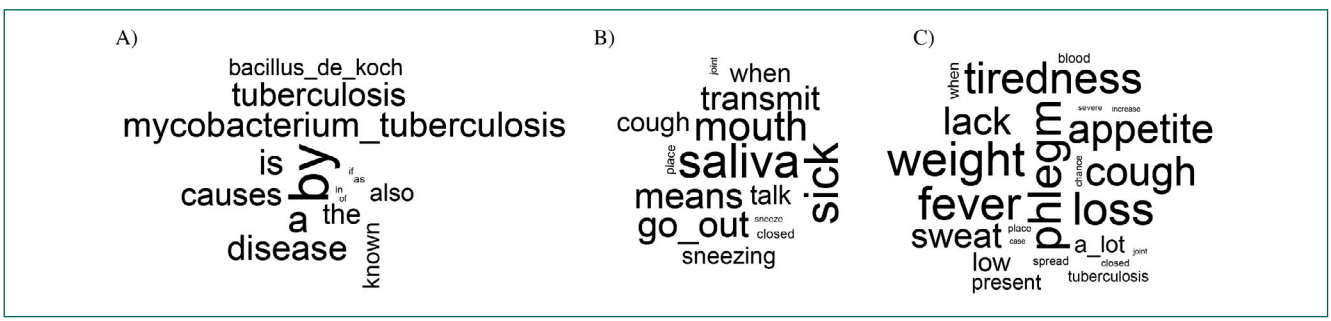

Figure 1. Word clouds related to adolescents' knowledge of tuberculosis

significant illustrations relating to the words in the game, in addition to direct questions about tuberculosis that stimulate reflective thinking. All this is achieved by the ludic transfer of information, which can enhance the understanding and fixation of the message to be conveyed. The adolescents' acquisition of knowledge through the messages contained in educational materials is an admittedly favorable strategy for their self-care, in addition to the possibility of its extension to their social network.[17]

The validation performed in this study reached high levels identified in the analysis attributes, with Content Validity Index ranging between 0.92 and 0.96, in addition to the overall index of 0.94. The use of statistical indices for the validation of educational technologies has shown satisfactory results, as in a study with adolescents who validated a playful game about leprosy, in which the global Content Validity Index was 0.97,[18] and an educational booklet for the prevention of falls with an overall Content Validity Index of 1.0 reached by the judges, and of 0.98 by the target audience.[19]

By strengthening the statistical measurement performed with the education technology, the recognition of the etiological agent, means of transmission and clinical condition of tuberculosis were identified in the main meanings of words present in the adolescents' statements. Thus, it is understood that the technology in this format can help adolescents to identify the disease and adopt possible prevention practices, considering the perception of the transmission process.

It is a fact that knowledge about tuberculosis can help in coping with it, as adolescents recognize the symptoms and this may favor decision-making for self-care and care of their families. Health education actions supported by informative material are essential to help in the dissemination of information and offer adolescents the opportunities to know and face the disease.[20,21] Such actions should enhance the construction and reconstruction of knowledge and value experiences and the existing knowledge with support of the educational technology in order to strengthen more accessible and interactive learning spaces.[22,23]

The handling of educational technology by adolescents at the time of validation made it possible to recognize its potential for health education, as they showed to be motivated and completed all the filling steps. When adolescents were asked to write about the disease, they reproduced the content of the text contained therein, showing interest in the conveyed message. Nevertheless, educators both in health and in schools should explore the material to encourage the (re)construction and deepening of knowledge. The acquisition of knowledge after the educational activity confirms that health education is an important means of training social actors to deal with the illness, and the school should be an environment for socializing information and raising awareness of students.[24,25]

A study conducted in 40 countries in Europe highlighted the importance of addressing tuberculosis in the school environment and an association between education and incidence of the disease was identified. Moreover, local epidemiological indicators or of the country should be valued and addressed in the process of educational training. Education is an important determinant of health, as it directly and indirectly interferes with lifestyle, dietary pattern, healthy habits and access to services and health.[26]

Thus, using educational technology to equip adolescent students with tuberculosis knowledge can be a strategy for improving epidemiological and disease monitoring indicators, thereby contributing to achieve the goals established by the National Plan for the End of Tuberculosis as a Health Problem.[27]

The results of this study can contribute to the practice of health and education professionals as a support for educational actions, especially with adolescents with a similar profile to that of participants. They can be multipliers of knowledge and disseminate correct information about tuberculosis. The results may also support further studies with a view to better control the disease in the social environment.

A possible limitation of the study concerns its development in two schools, given the reduced possibilities of greater diversity of student opinions. Furthermore, future studies can investigate

adolescents' health literacy, aiming to measure the knowledge about the information conveyed in the educational technology in order to ensure its potential for identifying suspected cases of tuberculosis, adopting preventive measures, appropriate diagnostics and forms of treatment.

Conclusion

The wordsearch proved to be valid for use with adolescents as a tool in educational health actions on tuberculosis. It can contribute to self-care and the multiplication of knowledge in their social network. The semantic validation confirmed its potential to facilitate the possible replication of knowledge acquired from health education, and the instrument can be used in schools and other spaces. Its playful format arouses adolescents' interest and greater interaction with the content, configuring itself as an opportunity to disseminate correct information about the disease.

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Collaborations

Nogueira, LMV contributed to the project design, data collection and interpretation, article writing, relevant critical review of the intellectual content and final approval of the version to be published. Rodrigues, ILA contributed to the study design, relevant critical review of the intellectual content and approval of the final version to be published. Santos, CB contributed with project design, critical review and approval of the final version. Silva, MAI contributed with the relevant critical review of intellectual content. Pinheiro, AKC contributed to the article writing and approval of the final version to be published. Vasconcelos, EMR contributed with the critical review. Nascimento, LC contributed to the project design, article writing, relevant critical review of the intellectual content and approval of the final version.

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