






Development and Validation of an Educational Comic Book for Guidance on the Safe Use of Fluoride Toothpaste by Children

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ABSTRACT

Objective: To describe the elaboration and content validation of a comic book for guidance on the safe use of fluoride toothpaste by children. **Material and Methods:** Study on the development of educational technology carried out in four phases: 1 – literature review and script; 2 – elaboration of the material (illustrations, layout and design), 3 – validation (Content Validity Index = CVI and Flesch Readability Index = FI), 4 – pilot test to legitimize the material with the target population. Thirty-one individuals participated in the validation, being 07 expert judges and 24 representatives of the lay population, responsible for the daily care of preschool and school-age children. **Results:** In the validation, CVI= 0.97 (97%), indicating high agreement of the judges' answers; and FI = 92%, which corresponds to “very easy to understand” reading. In the pilot test carried out with the lay population, the 3 assessment blocks had CVI=1.0 (100%). **Conclusion:** The comic book proved to be valid regarding appearance and content and can be used for health education activities for adults on the use of fluoride toothpaste for oral hygiene in children.

Keywords: Health Education; Graphic Novel; Fluorides; Dentifrices.

Introduction

The wide use of fluoride was a fundamental factor for the decline in dental caries reported worldwide and resulted in concern about the increase in the prevalence of dental fluorosis [1-6]. Dental fluorosis - an alteration in the mineralization of teeth in formation due to the presence of fluoride - is related to the chronic ingestion of this element, which severity is dose dependent. Clinically acceptable dental fluorosis (very mild and mild) is characterized by small white and opaque striations on the tooth surface, with hypomineralized subsurface enamel coated by a mineralized surface being histologically observed. However, this alteration does not make the affected tooth neither more nor less susceptible to caries, and its greatest relevance is in the aesthetic aspect when it occurs in permanent maxillary incisors [2], which, due to the known period of mineralization [3], are at risk of fluorosis when fluoride ingestion occurs between 15 and 30 months of age.

In this context, it is important to highlight the need to promote educational actions on the safe use of toothpaste by children, aiming at maximum benefit in caries control and minimizing the risks of dental fluorosis. Comic books have been used for a long time in public education, being very useful to quickly and directly communicate unknown and important information to the reader [7]. As an educational technology, comics demonstrate aspects of popular culture that the individual is inserted, ensuring this approach to the reader, who perceives himself within the story as a co-participant in the plot. This fact, linked to the scientific approach to narrated themes, allows the exchange of experiences with the reader and, thus, the internalization of the knowledge transmitted by these narratives [8].

Based on the above, the purpose of this study was to describe the elaboration and content validation of a comic book for guidance on the safe use of fluoride toothpaste by children.

Material and Methods

Ethical Clearance

This study was conducted in accordance with precepts determined by Resolution No. 466 of 2012. The project was approved by the Research Ethics Committee under CAAE number 32602720.8.0000.5374.

Participants and Study Development

Study participants were divided into two groups: judges and target population representatives. The development of this educational technology had four phases: 1 - literature review and script; 2 - preparation of the material (illustrations, layout, design, and text), 3 - validation by judges (Content Validity Index = CVI and Flesch Readability Index = FI), 4 - pilot test for validation of the material with the target population (Content Validity Index = CVI and Flesch Readability Index = FI).

Study Phases

Phase 1 - Literature review: aspects related to dental fluorosis were considered, aiming at the safe use of toothpaste at an age at risk for its development. Scientific evidence on the importance of the use of fluoride toothpastes in children [9], on the concern about fluorosis resulting from the use of toothpastes in the phase at which teeth are being mineralized [10] and on the care recommended for their safe use was analyzed [11,12]. From this, a script was created, which narrates the story of three characters who, together, investigate the effects of fluoride on the human organism, addressing the effects of its absence/presence and teaching about its correct use, as well as the consequences of its inadequate use.

Phase 2 – Based on the script, illustrations and characters were created, in addition to the formatting, configuration and layout of pages. Adobe Photoshop® and Adobe InDesign® software were used for the elaboration, layout and editing of the educational technology, and with the help of an experienced graphic designer, we sought to comply with criteria related to content, structure/organization, language, layout and design, cultural sensitivity and adaptation to the context for which the comic book is intended, seeking to use respectful terms, words that allow the group to understand the problem addressed, and seeking to clarify the expected individual and family roles in the routine of care presented in the material [13]. This material constitutes version 1 of the comic book, in which the internal area of the cover contains the presentation of the “*Aprender brincando sobre saúde / Learning playfully about health*” project and the intention to use educational technology with the target population; the body of the comic book contained the comic itself and, finally, the last session was for playful games focused on the topic addressed.

Phase 3 - Validation: the appearance and content validation process were carried out by invited professionals who were intentionally selected through the analysis of their *Lattes Curriculum*. Seven expert judges with a Ph.D. degree and scientific production in the area of Cariology, Public Health or Pediatric Dentistry were chosen for their expertise with regard to the development of prevention and/or health promotion actions aimed at children for at least 10 years; or for having published scientific papers on the use of toothpastes by children, dental fluorosis, dental caries and/or experience in the construction and validation of educational materials. Each judge received a printed copy of version 1 of the comic book, in addition to a questionnaire containing 6 questions that allowed confirming their profile. After careful and critical reading of the material, judges were invited to fill a sociodemographic questionnaire and an evaluation instrument adapted from Rosa et al. [14], organized into three blocks that contained statements related to the material's content to be evaluated by participants. The first block had items referring to the purpose of the material, the second referred to its structure and presentation, while the third contained statements about the scientific relevance of the educational technology. In each of these blocks, the judges should mark their answers in the form of a Likert Scale containing four classifications, namely: Totally Adequate (TA), Adequate (A), Partially Adequate (PA) and Inadequate (I), considering the valuation that best represents their opinion. In addition, a space was made available for the judge to justify the answer given and insert suggestions, which were considered in the final version.

To validate the readability of the text, the indexes Content Validity Index (CVI) and Flesch Readability Index (FI) were calculated. CVI values range from 0 to 1 and are calculated by the sum of adequate answers (TA and A), divided by the sum of answers multiplied by 100. The percentage obtained at the end of the calculation denotes the agreement of experts on certain aspects of an instrument and its items. FI assesses the degree of readability of texts on a scale from zero to one hundred so that the higher the index value, the greater the ease of reading the evaluated text and, consequently, the lower the level of education required for reading and comprehension, with standard text being scored between 60 and 70; reasonably easy between 70 and 80; easy between 80 and 90; and between 90 and 100, a text is considered very easy to read [15]. To calculate the FI, texts that make up the material were selected and evaluated by the text analysis program of Microsoft Office Word (Microsoft Corp., Redmond, WA, USA).

Regarding CVI, the agreement index from 0.80 (80%) is considered as a validity parameter [15] and the minimum acceptable FI value was established at 70%, allowing to classify the reading as reasonably easy/easy / very easy to understand [16]. Therefore, a text considered standard by the FI is the one with percentages between 60 and 70% and in case of FI lower than the established parameter, the text would be rewritten [15].

Phase 4 – Pilot test: after adapting the comic book to the suggestions and perceptions of judges, a pilot test was carried out with version 2 of the material. For this, at the reception of the institution's pediatric dentistry clinic, 24 adults representing the target population were invited to participate: lay individuals responsible for the daily care of preschool and school-age children for personal and/or or professional reasons. Like the judges, they filled out a sociodemographic questionnaire, received a printed copy of the comic book (version 2) and later filled out an evaluation instrument in the form of a Likert scale. It consisted of 3 blocks (Content; Layout; Characters), containing four classifications, namely: Totally Adequate (TA), Adequate (A), Partially Adequate (PA) and Inadequate (I). In addition, in this phase, indexes referring to version 2 of the material were calculated (Content Validity Index = CVI and Flesch Readability Index = FI).

The educational comic book produced and validated in this study is entitled “*Dentitos: o flúor e a saúde bucal*”. It was registered with the Brazilian Book Chamber (CBL) under ISBN:978-65-86718-11-9. The final material is available for free download at <https://bit.ly/3v9cGdZ> and this final version has cover, back cover and 16 pages, with a standard formatting size of 20.5 cm in height and 14.5 cm in width. In the final version of the educational material, at the suggestion of judges, a new section located on the back cover was added, which includes a summary of the main information on oral health care for children.

Data Analysis

For each comic book version, an exploratory analysis of statistics generated by Microsoft Office Word was performed, including the number of pages, words, characters, paragraphs, and lines. In view of suggestions given by judges, these calculations considered the constituent parts of each version: 1: presentation and body of the comic book and 2: presentation, body of the comic book and summary, typed with single spacing.

After data tabulation, the Content Validity Index (CVI) and the Flesch Readability Index (FI) were calculated, which assesses the degree of readability of the text, in which the complete material and the constituent parts of each one of the versions were considered.

Results

It should be highlighted that 11 expert judges were invited to participate in the study, and only seven answered the necessary assessment instruments, among which the majority were female (85.7%), over 40 years old (85.7%) and with more than 10 years of professional experience (100%). All of them have completed their Ph.D. and have published scientific works in the area and/or developed prevention and health promotion actions aimed at children for at least 10 years and/or construction and validation of educational materials. The 24 representatives of the target population had an average of 39 (± 8) years of age and were mostly female (87.5%), with complete high school (41.7%) followed by incomplete higher education (25%) and incomplete high school (16.7%). They were responsible for children aged 2-11 years (6 ± 3 years) and were at the reception of the clinic waiting for their children in pediatric dental care.

Some comments from expert judges during the validation process were recorded:

J2: The technical work is very good, with relevant information, I just think that some information is overlapped; maybe the sequence needs to be reorganized (there are few). I also think that the material is a little extensive and some illustrations have too much information. J3: I would like to congratulate you for your work and praise its importance for the population. Educating and preventing is the key to oral health! I really enjoyed the text and illustrations. As a suggestion, and because it is a comic book, in some parts, I would make shorter and more objective texts, especially in the initial part. I believe this would make some pages less polluted and draw more attention from the target population to the most important parts. I think it's important to illustrations about the concentration and amount of toothpaste...

and maybe insert something about teaching the child to spit out the paste as he/she grows older and keeping the toothpaste out their reach. J6: There are moments in the comic book when the sentences are too long. I believe that this would hinder the understanding of the subject and make the reading uninteresting, but information is very pertinent. J7: I would close the comic book as I do in my lectures: a) Caries is not caused by lack of fluoride, but by the high frequency of exposure to sugars in the diet. b) The benefit of brushing teeth with fluoride paste is undeniable. c) There is a risk of fluorosis. So, until children are unable to take care of themselves, it is a responsibility of parents or caregivers to educate children about: a) Discipline consumption of sugary products. b) Brush teeth. c) Use a small amount of fluoride paste having at least 1000 ppm F, as a powerful ally!"

Table 1 presents the exploratory analysis of statistics generated by Microsoft Office Word, considering the text typed with single spacing, which composed versions 1 and 2 of the educational material, divided into Presentation, body of the comic book (comic book itself) and Summary (closing of the material, included only in the second version at the suggestion of one of the judges). In general, there is an effort to make the texts more streamlined in version 2, as unanimously suggested by all expert judges.

Table 1. Descriptive statistics of the constituent parts of each version.

Constituent Parts	Presentation	Body of The Comic Book		Summary (Version 02)
		Version 1	Version 2	
Pages	1	3	2	1
Words	116	862	763	92
Characters without Space	605	3923	3444	471
Characters with Space	718	4773	4203	560
Paragraphs	4	42	42	6
Lines	11	74	68	10

This same content division was used to calculate FI referring to the material from phases 3 and 4 of the study and, as can be observed in Table 2, in both versions, the established limit value was reached, and for the final version of the comic book, the calculated value represents a reading classified as easy to understand. Although the introduction of the material did not reach the classification "easy to understand", judges did not suggest changes in this part and, as it was understood that the purpose of the comic book would not be harmed, it was decided to keep it without adjustments.

Table 2. Analysis of the Flesch Readability Index (FI) and readability classification.

Variables	Flesch Readability Index (FI)	Readability
Introduction	68.4	Text quite difficult to understand (60-70)
Body of the comic book (Version 1)	92.0	Text very easy to understand (90-100)
Body of the comic book (Version 2)	92.2	Text very easy to understand (90-100)
Summary (Version 2)	74.6	Text a little difficult to understand (70-80)
Total (Version 2)	88.09	Text easy to understand (80-90)

Table 3 presents the evaluation of judges and the exploratory analysis of CVI considering evaluation blocks and version 1 of the comic book, observing that both in relation to block 1 (Objectives) and to block 3 (relevance), the agreement of the judges' answers was excellent and CVI was equal to 1.00 (100%). In block 2 (structure and presentation), although within the minimum value established for CVI, the agreement value was lower, 0.94 (94%), and suggestions for changes were especially focused on this block, involving the reduction of the amount of text in some of the dialogs and the reordering of some illustrations. At the suggestion of one of the judges, a summary was also inserted at the end of the comic book so that there was a closing of the most important information in the addressed context.

Table 3. Content validity distribution of blocks and exploratory analysis by question of the instrument, from the point of view of expert judges.

Content Validity Distribution	I§	Judges' Evaluations			CVI
		PA‡	A+	TA*	
BLOCK 1 - OBJECTIVES					
Is the information consistent with the day-to-day needs of the target population?	0	0	2	5	1.00
Is the information/content important for the target population's quality of life and/or work?	0	0	2	5	1.00
Does it invite and/or instigate behavior and attitude change?	0	0	0	7	1.00
Can it circulate in the scientific environment of the area?	0	0	3	4	1.00
Does it meet the objectives of institutions that serve/work with the target population?	0	0	0	7	1.00
Partial Total			7 (20%)	28 (80%)	1.00
Block 2 - Structure and presentation					
Is the comic book appropriate for the target audience? Are messages clearly and objectively presented?	0	0	3	4	1.00
Is the information presented scientifically correct?	0	1	4	2	0.85
Is the material appropriate to the sociocultural level of the target population?	0	0	0	7	1.00
Is there a logical sequence of proposed content?	0	0	7		1.00
Is the information well-structured?	0	1	2	4	0.85
Is the information well-structured in concordance and spelling?	0	1	3	3	0.85
Does the writing style match the level of knowledge of the target population?	0	0		7	1.00
Is the comic book appropriate for the target audience? Are messages clearly and objectively presented?	0	0	6	1	1.00
Partial Total		3 (5.4%)	25 (44.6%)	28 (50%)	0.94
BLOCK 3 - RELEVANCE					
Do the themes present key aspects that should be reinforced?	0	0	0	7	1.00
Does technology (comic book) allow learning generalization and transfer?	0	0	0	7	1.00
Does technology (comic book) propose knowledge construction?	0	0	1	6	1.00
Does the technology (comic book) address the subjects necessary for the knowledge of the target audience?	0	0	0	7	1.00
Is the technology (comic book) to be used by any professional with the target audience?	0	0	4	3	1.00
Partial Total			5	35	1.00
General CVI		3 (2.3%)	37 (28.2%)	91 (69.5%)	0.97

*Totally adequate; †Adequate; ‡Partially adequate; §Inadequate; ¶Content Validity Index.

After the suggested adjustments, evaluation by the lay population was carried out, in which the options “totally adequate” and “adequate” represented most answers in the three evaluation blocks, leading to CVI equal to 1.00 (100%) in the three assessments blocks, which indicates agreement between answers among participants (Table 4).

Table 4. Answers from the lay population regarding the validation of the comic book (version 2), according to content, design and characters.

Assessment Blocks	I§	PA‡	A+	TA*	CVI¶
Content					
Is the information/content coherent?	0	0	6	18	1.00
Is the information/content presented in a clear and understandable way?	0	0	5	19	1.00
Is the way in which the content of the comic book is presented inviting to those who read it?	0	0	4	20	1.00
Does it meet the purpose of providing guidance on the safe use of fluoride toothpaste for children?	0	0	3	21	1.00
Is there a logical sequence of content?	0	0	5	19	1.00

Does the content repeat in the comic book?	0	0	9	15	1.00
TOTAL OF THE BLOCK	0	0	32 (22.2%)	112 (77.8%)	1.00
Design					
Is the comic book adequate and does it help to understand the content?	0	0	5	19	1.00
Are the images that compose the comic book suitable for the content being worked on?	0	0	5	19	1.00
Is the scenario appropriate?	0	0	6	18	1.00
Are the illustrations used adequate to the work content?	0	1	5	18	0.96
Are the colors and the design of images adequate?	0	0	7	17	1.00
Is the comic book adequate and does it help to understand the content?	0	0	7	17	1.00
TOTAL OF THE BLOCK	0	1 (0.4%)	60 (22.7%)	203 (76.9%)	1.00
Characters					
Do characters speak clearly?	0	0	4	20	1.00
Is the way they present themselves adequate?	0	0	3	21	1.00
Are the statements adequate and reflect reality?	0	0	6	18	1.00
TOTAL OF THE BLOCK	0	0	13 (18.1%)	59 (81.9%)	1.00
Overall Total	0	1 (0.3%)	73 (21.7%)	262 (78.0%)	0.997

*Totally adequate; †Adequate; ‡Partially adequate; §Inadequate; ¶Content Validity Index.

Discussion

The validation of an educational technology is of great importance for it to be scientifically reliable, as well as effective and adequate to be used in the context for which it is intended, enabling modifying the reality of the target population [14,17]. The choice of the theme for the educational comic book arose from the need to educate parents/guardians to place a small amount of toothpaste on the children's toothbrush, considering data of high fluoride intake reported in the literature [4,18]. Therefore, the script was prepared after the literature review, seeking to emphasize the importance of using fluoride toothpaste safely, highlighting its role in health promotion, and aspects that adults should be aware of were included in the comic book script so that it can be safely used by children [11,12,19].

The benefits of fluoride toothpastes are firmly established and there is strong evidence for their indication in the daily routine of oral hygiene, acting in the prevention and control of dental caries [20]. In this way, the fundamental aspects for its safe and effective use by children were highlighted in the script that guided the creation of the comic book, including the minimum and maximum concentrations contained in conventional toothpastes, as well as the amounts to be used and the care involved.

In Brazil, it is not mandatory that toothpastes contain fluoride, but if they do, it is the duty of the manufacturer to ensure that formulations are suitable to have an anti-caries effect, ensuring that the fluoride is in a chemically soluble form, reducing demineralization and activating dental remineralization. The International Dental Federation (FDI) established that the fluoride concentration in toothpastes must be between 1000 and 1500 ppm, with a minimum amount of 800 ppm of fluoride ion available to all people [19], which recommendation is adopted in the last technical note that was designed to guide managers and oral health professionals on the theme in Brazil [21].

In this context, the indication of toothpaste should be made taking this concentration into account from the eruption of the first deciduous tooth [19,22], which occurs approximately in the first six months of life. At this age and during early childhood, it is common for children to ingest large amounts of toothpaste used in brushing due to motor difficulties in controlling swallowing, causing them not to be able to expel all the saliva with the toothpaste [18,23], resulting in swallowing rates from 30% to 63.2% of the product during brushing [24]. Given that this period of life coincides with the phase in which the dental crowns of the permanent maxillary anterior teeth are being mineralized [3], the concern with the prevention of dental fluorosis should

permeate the dental hygiene routine since the amount of toothpaste placed on the toothbrush and the brushing frequency are directly related to the fluoride dose submitted by brushing [18].

An adult should be responsible for placing toothpaste on the toothbrush [25], allowing control of the adequate amount of fluoride to be used and for children under 3 years of age, the recommended amount is equivalent to the size of a rice grain (approximately 0.14 g of toothpaste). When the child turns 3 years of age and is better able to expectorate consistently, an amount of toothpaste equivalent to the size of a pea (approximately 0.3 g of toothpaste) should be used.

The critical evaluation of judges was important to guarantee the scientific validity of the material, highlighted by the observations made in the evaluation form and by the result obtained in general and block CVI. Based on this critical evaluation, it was also possible to improve the readability of the comic book content with the repositioning of illustrations and reduction of texts in dialogues, allowing the most important information to be resumed objectively at the end of the material, version 2. The participation of representatives of the target population allowed the acceptance, understanding and reliability of educational technologies to be expanded [15,26] and, in the present study, version 2 obtained FI value higher than the minimum established, demonstrating that its reading was classified as easy to understand by the lay population; in addition, the agreement rate was higher than the established minimum of 80%, with CVI equal to 0.99 (99%), characterizing high agreement rate for the lay population [15]. Data regarding the degree of readability and the language used in the comic book demonstrate that it is valid for application to the target population.

Alternative resources, such as comic books, are humorous and accessible to different literacy levels and, especially, have proven to be effective in engaging students, facilitating their learning and improving understanding, in addition to enabling the prompt understanding of complex contents [27,28]. They are also viable for gaining subjective knowledge compared to other health education communication efforts [29].






Among study limitations, as also verified in other studies on the validation of educational technologies, it is possible that the personal and training characteristics of judges and the lay public have somehow impacted the findings since, in view of the methodology adopted, face-to-face access to participants was essential. In this context, future studies should be carried out in different scenarios and use strategies to evaluate the acquisition of knowledge through the material developed; in addition, studies should seek to evaluate the impact of its use as educational material in oral health care routines for children.

The final version of the material has improvements resulting from criticisms and suggestions made by expert judges and the participating lay population, which complemented and qualified the educational technology presented in this study. However, up to the present moment, educational technology has proved to be effective and well accepted by the target population and especially valid for its purpose.

Conclusion

The comic book proved to be valid in terms of appearance and content and can be used for health education activities for adults on the use of fluoride toothpaste for oral hygiene in children.

Authors' Contributions

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EAR	 https://orcid.org/0000-0002-8121-7353	Investigation and Writing - Original Draft.
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All authors declare that they contributed to critical review of intellectual content and approval of the final version to be published.		

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Conflict of Interest

The authors declare no conflicts of interest.

Data Availability

The data used to support the findings of this study can be made available upon request to the corresponding author.

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