

Development and validation of an educational game about drug abuse and the risk of suicide*

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Objective: to describe the development and validation of an educational game about drug abuse in association with risk of suicide. **Methodology:** a technological development study. The Contextualized Instructional Designer was used to operationalize the development stages, in addition to the Content Validation Index (CVI) for evaluation. **Results:** creation of the “*SerTão Bom*” game was designed, a quiz with 195 questions available offline for Android systems. Regarding content validation, an overall CVI of 0.78 was obtained under the general characteristics; with CVI values of 0.87 in organization and 0.90 in writing style. Regarding the technical aspects, the game was validated with CVI values of 0.86 in the usability item, 0.88 in efficiency and 1.00 in functionality.

Conclusion: through the development and validation of the educational game, the importance of technologies in order to promote education in the field of mental health from a playful and accessible perspective is understood.

Descriptors: Mobile Applications; Health Education; Mental Health; Drugs; Suicide.

* Paper extracted from master's thesis “Construção e validação de um jogo interativo sobre uso abusivo e problemático de drogas e o risco de suicídio”, presented to Universidade Federal do Ceará, Sobral, Ceará. Supported by Fundação Cearense de Apoio ao Desenvolvimento Científico e Tecnológico (FUNCAP), Grant # 2.739.560, Brazil.

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How to cite this article

Viana LS, Oliveira EN, Vasconcelos MIO, Fernandes CAR, Dutra MCX, Almeida PC. Development and validation of an educational game about drug abuse and the risk of suicide. SMAD, Rev Eletrônica Saúde Mental Álcool Drog. 2023 Apr.-June;19(2):16-25 [cited ____-____-____]. Available from: _____. <https://doi.org/10.11606/issn.1806-6976.smad.2023.188483>

Desenvolvimento e validação de um jogo educativo sobre uso abusivo de drogas e o risco de suicídio

Objetivo: descrever o desenvolvimento e a validação de um jogo educativo sobre uso abusivo de drogas em associação ao risco de suicídio. **Metodologia:** estudo de desenvolvimento tecnológico. Utilizou-se o *Designer Instrucional Contextualizado* para operacionalização das etapas de desenvolvimento além do Índice de Validação do Conteúdo (IVC) para avaliação. **Resultados:** desenhou-se a construção do jogo "SerTão Bom", um *quiz* com 195 perguntas, disponível *off-line* para sistema *Android*. Em relação à validação do conteúdo, obteve-se um IVC geral de 0,78 no âmbito das características gerais; IVC de 0,87 na organização e estilo da escrita com IVC de 0,90. Sobre os aspectos técnicos, o jogo foi validado com IVC de 0,86 no item usabilidade; 0,88 na eficiência e funcionalidade com IVC de 1,00. **Conclusão:** mediante desenvolvimento e validação do jogo educativo, compreende-se a importância de tecnologias com o intuito de promover a educação no âmbito da saúde mental sob uma perspectiva lúdica e acessível.

Descritores: Aplicativos Móveis; Educação em Saúde; Saúde Mental; Drogas; Suicídio.

Desarrollo y validación de un juego educativo sobre abuso de drogas y riesgo de suicidio

Objetivo: describir el desarrollo y la validación de un juego educativo sobre abuso de drogas en asociación con riesgo de suicidio. **Metodología:** estudio de desarrollo tecnológico. El Diseñador Instruccional Contextualizado se utilizó para operacionalizar las etapas de desarrollo, además del Índice de Validez de Contenido (IVC) para la evaluación. **Resultados:** se diseñó la creación del juego "SerTão Bom", un cuestionario con 195 preguntas disponible sin conexión para sistemas *Android*. En cuanto a la validación de contenido, se obtuvo un IVC global de 0,78 bajo las características generales; con valores de IVC de 0,87 en organización y 0,90 en estilo de redacción. En cuanto a los aspectos técnicos, el juego fue validado con valores de IVC de 0,86 en el ítem usabilidad, 0,88 en eficiencia y 1,00 en funcionalidad. **Conclusión:** a través del desarrollo y la validación del juego educativo se comprende la importancia de las aplicaciones con el objetivo de promover la educación en el campo de la salud mental desde una perspectiva lúdica y accesible.

Descriptorios: Aplicaciones Móviles; Educación en Salud; Salud Mental; Drogas; Suicidio.

Introduction

Abusive consumption of psychoactive substances involves a complex context that exerts a significant impact on society. Such associated elements, which represent a contributing factor for suicide attempts, become a severe public health problem. Thus, there is a need to promote quality of life for individuals affected by this condition, especially with regard to mental health, which is weakened⁽¹⁾.

Associated with these issues, the role of technologies for health promotion and disease prevention is emphasized, even in the mental health context, characterized as Digital Information and Communication Technologies (DICTs)⁽²⁾. Therefore, they stand out as a health-promoting resource, fundamental for the promotion of healthy behaviors, through skills for health care in coping with the health-disease process, as they allow sharing information in real time⁽³⁾.

Linked to this context is the phenomenon of mobile technologies, related to the use of smartphones and tablets, among others, linked to mobile applications, called apps. In turn, apps are characterized as a set of strategies/elements structured to perform countless specific tasks and activities⁽⁴⁾.

In association with the use of apps, the elaboration of interactive/educational games also emerges as a technological tool that facilitates the learning process. In this way, through playful methodologies, users end up getting more involved in the activities proposed and, thus, acquire knowledge and information in a more agile way. Given the above, the game can awaken skills, attitudes and behaviors, making their actions more intense and spontaneous. In addition, the gamification process allows users to become protagonists in their own teaching-learning process⁽⁵⁾.

It is understood that studies related to the elaboration and validation of games have been produced in various health scenarios, although scarcely in relation to mental health. Therefore, an educational game in the form of a quiz is exemplified, developed to investigate the general population's knowledge about oral health and hygiene in adults⁽⁶⁾. It also portrays the development of a smartphone game to raise awareness about the Human Papilloma Virus (HPV) as a risk factor for cervical cancer⁽⁷⁾.

From this perspective, advancement of the DICTs involves the population in general, in all social sectors, enabling access to information, knowledge and interactivity, among other benefits, being excellent tools for health promotion and care⁽⁸⁾.

Currently, there is also a discussion about the relevance of using apps in game format, which can have specific purposes such as promoting engagement,

involvement and knowledge acquisition in individuals, including those related to suicide prevention and to abuse of psychoactive substances⁽⁹⁾.

Thus, this study aimed at describing the development and validation of an educational game about drug abuse and harm reduction strategies, in association with the risk of suicide.

Methodology

Type of study

This is a technological development study for the elaboration of a mobile app for the general population⁽¹⁰⁾.

It is noted that this project is part of a broader research study entitled "Mental health and risk of suicide in drug users", a Productivity Grant in Research, Stimulation to Internalization and Technological Innovation (*Bolsa de Produtividade em Pesquisa, Estímulo à Interiorização e à Inovação Tecnológica*, BPI) project, funded by the Ceará Fund to Support Scientific and Technological Development (*Fundo Cearense de Apoio ao Desenvolvimento Científico e Tecnológico*, FUNCAP), Ceará. The proposal of the second phase of this study was to develop and validate an educational game about drug use and harm reduction strategies, in association with the risk of suicide.

Development

The study was carried out from September 2019 to May 2020 at the State University of Vale do Acaraú (*Universidade Estadual Vale do Acaraú*, UVA), Health Sciences Center (*Centro de Ciências da Saúde*, CCS) campus, and at the Federal University of Ceará (*Universidade Federal do Ceará*, UFC), Mucambinho campus, with their respective courses in Nursing and Computer Engineering, with support from the UVA Study and Research Group in Mental Health (*Grupo de Estudos e Pesquisa em Saúde Mental*, GESAM).

The game development stage essentially involved ten GESAM members, five of whom are Scientific Initiation (*Iniciação Científica*, IC) scholarship holders, two are game developers (Computer Engineering and Computer Science students at UFC and UVA, respectively), two are professors in charge of monitoring development of the app and one is an MSc student in Family Health at UFC.

The first stage of the research involved development of the game, which took place through five workshops and systematic meetings that involved planning and organization of the creation stages, such as the elaboration of the questions that would be used in the quiz.

The game was developed based on the assumptions set forth in the ADDIE model (acronym for Analyze, Design, Develop, Implement and Evaluate)⁽¹¹⁾, also known as Contextualized Instructional Designer (CID), for the creation and validation of educational games.

The proposal in the first meeting was to present the idea of creating an app in the form of an educational game. To such end, it was necessary to prepare the Game Design Document (GDD). According to the creator of the ADDIE model⁽¹¹⁾, this document has the function of organizing the main ideas for building the game, especially when there is not a well-defined project. Thus, the main elements required to develop the game were systematized through a workshop with Nursing students from UVA. Subsequently, some more specific aspects of the game and the way it would be structured were discussed, initiating elaboration of a prototype.

Validation by specialists

Content validation was divided into two moments: validation of the questions by experts on the themes addressed in the game (drugs, harm reduction and suicide) and evaluation of the final product of the quiz. In addition, validation of the technical aspects was performed by the specialists in Informatics.

Expert judges were selected for this stage. Pasquali's framework⁽¹²⁾ was used for such purpose, which recommends a total from 6 to 20 evaluators, preferably an odd number. The selection criteria for the judges were having a thesis, dissertation or specialization, participating in study groups, authoring papers, being a professor, and having practical experience in the area of interest⁽¹³⁾. The searches were conducted by means of the Lattes Platform, selecting the specialists that obtained scores equal to or higher than five points.

The judges selected were invited to participate in this study by means of a letter sent by email. The specialists that responded positively were sent the access link to the Free and Informed Consent Form (FICF), the material with the questions referring to the specific theme of each specialist and the evaluation form. A free website to assess the questions developed by the GESAM was created during the first validation stage. In the last stage, a form was made available via *Google Forms* for the content and Informatics specialists, using an instrument adapted to meet the specificities of this study⁽¹¹⁾.

Data analysis

The data were compiled and analyzed in Excel 2010. To analyze the content and technical aspects of the interactive game, the Content Validity

Index (CVI) was used, in order to quantify the agreement level between the specialists⁽¹⁴⁾. For the first content validation stage, which consisted in evaluating the questions, calculation of the overall CVI was used, with the sum of all the CVIs by items and dividing by the total number of items in the instrument. A minimum agreement index of 0.8 was used for full agreement among the evaluators and between 0.7 and 0.79 for the questions that would be adequate, but with adjustments proposed by the specialists; CVI values below 0.7 would result in exclusion of the question analyzed⁽¹⁴⁾. The CVI varies from -1 to 1 and the item is considered valid when there is agreement between the judges (equal to or greater than 0.80, with a CVI equal to 1 indicating full agreement)⁽¹⁴⁾.

The second content validation stage was conducted through the assessment according to the form in *Google Forms*. The following aspects were considered: general characteristics of the game, its organization and the writing style. The instrument offered the following answer options: 01- Totally inadequate; 02- Moderately inadequate; 03- Moderately adequate; 04- Totally adequate; and 05- Not applicable⁽¹⁴⁾.

The frequency of the items that received scores 3 and 4 by the content experts was calculated, with validation of those that reached an overall CVI equal to or greater than 0.8. Adaptations were made according to the suggestions for those below this value⁽¹⁴⁾.

In order to assess the technical aspects, all 3 (three) specialists in Informatics also developed a form in *Google Forms*. In this way, the following aspects were considered: functionality, usability and efficiency. The instrument offered the following answer options: 01- Totally inadequate; 02- Moderately inadequate; 03- Moderately adequate; 04- Totally adequate; 05- Not applicable, given the adapted instrument⁽¹³⁾.

Technical evaluation of the game was performed by calculating the simple frequency of the items that received scores 3 and 4 by the judges. The number of items that obtained these scores from the experts was considered, acknowledging as valid those that reached overall CVI values equal to or greater than 0.8. For the items that obtained CVIs below this value, adaptations were made according to the evaluators' suggestions.

Ethical aspects

The study followed the principles set forth in Resolution No. 466/12 of the National Health Council (*Conselho Nacional de Saúde, CNS*) on research studies involving human beings, incorporating the principles of autonomy, beneficence, non-maleficence and justice⁽¹⁵⁾. The study was approved by the UVA Research Ethics Committee, under opinion No. 2,739,560.

Results

For better systematization, the results were divided into two subtopics about the development stages of the educational game and the process for validating the content and technical aspects of the game.

Development of the educational game

The first stage of the ADDIE model comprises the analysis phase, known in the technology field as the stage for surveying requirements. Through a workshop held with Nursing students from UVA, it was defined that it would be a quiz addressing drug use, harm reduction and risk of suicide and directed to the community in general.

During this phase, the literature was thoughtfully analyzed by means of an integrative review conducted in the following databases: LILACS, BDNF, MEDLINE, SCOPUS and Web of Science, using "mobile apps" and "health education" as descriptors. Full articles, written in English and Portuguese and published in the last ten years were included, excluding documents that were not articles, did not answer the guiding question, duplicates and those in the pilot test phase. Thus, for final analysis, a total of 12 articles were retrieved portraying how creation and validation of educational games take place in the health education scope⁽¹⁶⁾.

In the second stage, the instructional design of the game was defined based on the GDD, in which all documentation and planning were carried out. This stage is characterized as decisive for success of the project, considering that it is from the diverse information that the game product is directed. As first steps, the layout was created and the elements and tools that would make up the game were defined, characterizing its beta version⁽¹¹⁾.

The name "*SerTão Bom*" was defined for the game, as its content refers to the Northeast region, with the use of the word *sertão* which, at the same time, has a connotative function together with the words "*tão*" and "*bom*" in Portuguese ("so" and "good"), referring to a person knowledgeable about a given subject matter. Thus, the name chosen contemplates the desired objective in creation of the app (Figure 1).



Figure 1 – Logo of the "*SerTão Bom*" game. Sobral, CE, Brazil, 2021

The game in the form of a quiz consists of questionnaires with questions and answers, aiming to assess the player's knowledge on a given subject matter⁽¹⁴⁾.

The "*SerTão Bom*" game is available offline for *Android* systems and was developed by means of the *Unity* program in 2D format. Its objective is to raise awareness in the general community about risk of suicide among drug users, as well as it contributes reflections related to the harm reduction strategy.

The game scenario is the *sertão*. Its purpose is to honor and exalt northeastern regionalism, as the game was developed in this region, as well as to bring with it some typical elements such as warm colors, plants and the geography of the landscape. It starts with a brief explanation about its objective and welcoming of the new user. All the illustrations were created in *Corel Draw*.

The main menu includes commands with the "*Iniciar*" ("Start") (it starts the game), "*Opções*" ("Options") (game settings) and "*Sobre*" ("About") (diverse information about the game) options. When starting the game, there is a roulette wheel with three main categories: Drugs, Suicide and Harm Reduction, with questions related to each of them. Thus, it was defined that the pattern of multiple-choice questions would be followed with items A, B, C and D answered within 30 seconds (Figure 2). The categories are chosen at random through the roulette, where the player decides when to start and when to stop.

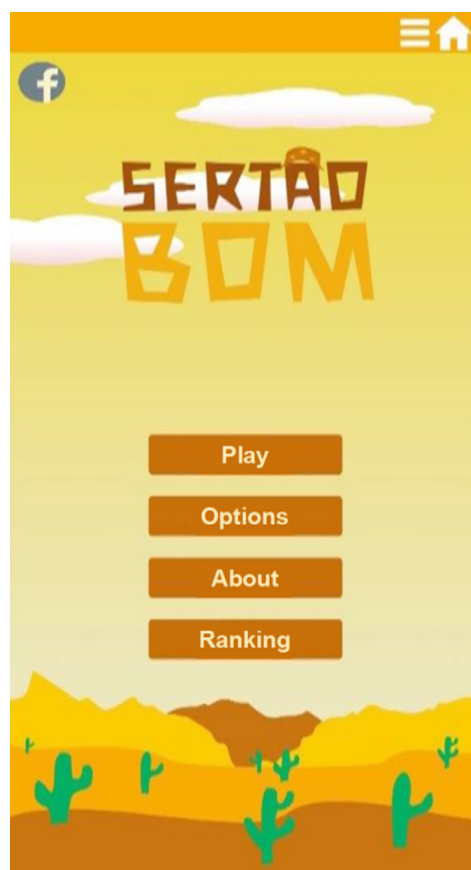


Figure 2 – Initial scene of the "*SerTão Bom*" game. Sobral, CE, Brazil, 2021

In case of any difficulty, the player can resort to three aids, namely: remove two incorrect items (50%), add 30 seconds or skip the question. To such end, each aid costs some coins, which are awarded for each round when the player answers some question correctly.

When clicking on “Opções”, the player can restart the game and access a brief tutorial. The “Sobre” button offers general explanations about what the “SerTão Bom” game is, in addition to the credits with the names of the collaborators involved in creating the app.

In the third stage, development, materialization of the design produced in the previous phase took place through the definition of the programming language and the multimedia to be used⁽¹¹⁾. It was in this stage that the questions that would comprise the quiz were defined in workshops with the GESAM.

The subsequent meetings involved improvement of the prototype, such as the creation or improvement of new tools, choosing the details that would comprise the sound of the keys and the roulette and development of the credits page, among others.

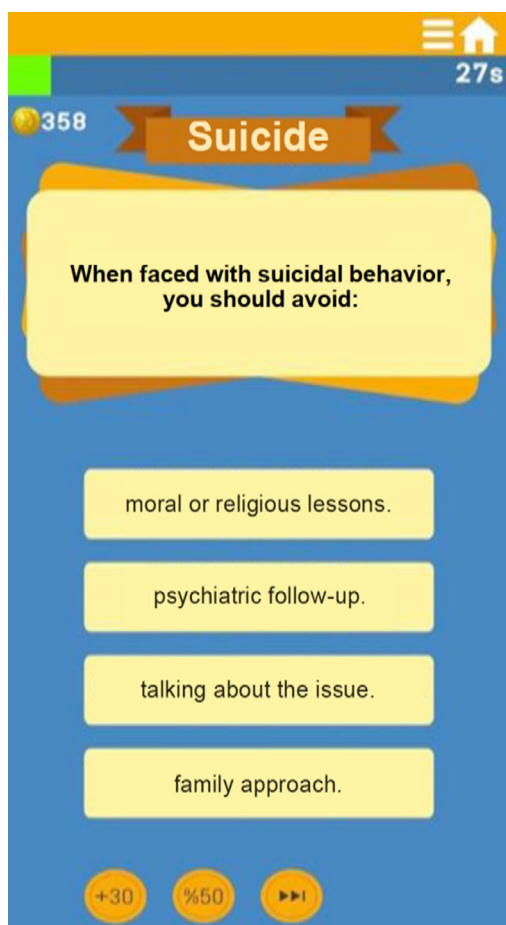


Figure 3 - Scenes of the “SerTão Bom” game questions. Sobral, CE, Brazil, 2021

In the implementation phase, the tools and technological resources that were used were configured, as well as a virtual environment was

created for downloading the app and installing it via the *Play Store*⁽¹¹⁾. Such being the case, the game was already fully operational, in its beta version.

Validation of the educational game

The content validation phase was divided into two stages: validation of the questions by experts in the themes covered in the game (drugs, harm reduction and suicide) and technical evaluation of the quiz product.

The participants were 15 mental health specialists with specific knowledge about drugs, harm reduction strategies and/or suicide, five experts for each thematic category and three specialists with specific knowledge about Computer Science/Informatics.

Regarding the validation, the harm reduction (65.52%) and suicide (44.11%) topics were assessed as totally adequate. The drugs category (56.12%) was assessed as partially adequate (Table 1). It is noted that a good number of questions from the category on drugs needed adaptations, as well as it was the one from which it was necessary to exclude the highest number of questions. Consequently, 2 questions were added according to the suggestions made by the specialists. Regarding the questions from the “harm reduction” and “suicide” categories, a significant percentage presented full agreement among the specialists, with no need for adjustments. However, it is noted that 21 questions related to the theme of suicide were also developed.

Table 1 – Overall Content Validity Index (CVI) of the Drugs, Harm Reduction and Suicide categories. Sobral, CE, Brazil, 2021

Category	Totally adequate (≥0.80)	Partially Adequate (0.70-0.79)	Inadequate (< 0.70)
Drugs	25 (25.51%)	52 (56.12%)	17 (18.37%)
Harm Reduction	38 (65.52%)	10 (14.24%)	10 (14.24%)
Suicide	30 (44.11%)	17 (25.01%)	11 (16.18%)

After the analysis and the changes suggested, a total of 195 questions was reached: 79 in the Drugs category, 68 in Suicide and 48 in Harm Reduction. The questions include historical aspects, general concepts, care strategies and support network, as well as curiosities related to the topics.

In relation to the technical evaluation of the “SerTão Bom” game, the items from the functionality question received positive assessments from the specialists. Interactivity, learning through concepts and their applications, applicability and items about help/support attained the maximum possible in the evaluation (CVI=1.0) (Table 2). Consequently, in relation to the item that assesses if the game is easy to use, it was reported that its interface and playability proved to be very good.

Table 2 – Assessment of the items from the Usability question of the “*SerTão Bom*” game. Sobral, CE, Ceará, 2021

Items (Usability)	Item CVI
The interactive game is easy to use.	1.00
It is easy to learn the concepts used and their applications.	1.00
It allows controlling the activities it presents, and it is easy to apply.	1.00
It allows users to easily apply the concepts worked on.	1.00
It provides clear help.	1.00
It provides comprehensive help.	0.66
It provides help quickly without tiring.	1.00
The game is appealing and motivating for its target users.	0.66
The layout components are standardized, and they preserve their characteristics in all screens of the game.	0.66
The elements (colors, images and fonts) are aligned and suitable for the game's proposal.	0.66
Total	0.86

The items about providing comprehensive help (CVI=0.66), appeal (CVI=0.66), layout standardization (CVI=0.66) and elements suitable for the game's proposal (CVI=0.66) were evaluated as fair. In relation to these items, the experts in Informatics indicated some suggestions/considerations, which were taken into account for the final version of the game.

The items that received the most suggestions for improvement were those that evaluated whether the game provides comprehensive help, its appeal for the users, standardization of the layout components and the elements (colors, images and fonts). Regarding the tools, it was suggested to give more visibility to the roulette and to implement adaptations in the first screens of the game. In relation to the fonts used in the game, standardization of the items was reported.

Other suggestions were related to some questions that were too wordy. Consequently, it was sought to shorten the longest questions in order to standardize and adapt the fonts used. It is therefore considered that length of the questions exerted a direct influence on the time proposed for the answers, 30' in this case. Therefore the suggestions already pointed out were accepted, thus shortening the questions/answers, seeking not to exert any influence on the quality of the content presented.

It is observed that the overall assessment of the “*SerTão Bom*” game achieved the validation threshold (CVI=0.86), receiving positive evaluations from the experts (Table 2). In this way, the specialists indicated that the game constitutes an essential tool to promote education in mental health, from a light, appealing, accessible and interactive perspective.

Discussion

It is noted that the use of gamification in the health area is on the rise and that its greater employability is

aimed at promoting healthy lifestyle habits and within the health education scope⁽²⁾.

In addition, it is understood that gamification in this area is directly related to mobile devices, eased by the mobility culture. Such practicality is associated with full-time access to mobile devices, given that they can be used from one environment to another, at any moment, and that they offer fast processing and low cost to the user, which makes them practical for their application⁽¹⁷⁾.

From this perspective, it is understood that games, linked to several other technological factors/resources, provide opportunities for leisure and fun activities in different contexts, with specific purposes such as to promote engagement, involvement and knowledge acquisition in individuals regarding their health care⁽¹⁷⁾.

Therefore, inclusion of the achievement element (such as trophies, medals and coins) as rewards granted based on the participant's actions is important for the feeling of recognition during gamification, which enhances engagement⁽¹⁸⁾.

In the “*SerTão Bom*” game, reward was granted through coins. When the players answer some question correctly, they earn coins, which are lost when they give an incorrect answer or when they ask for help. Another important aspect is the increasing complexity as the player advances in the game. The ranking proposal was also accepted, in order to foster competition between the players

Therefore, it is important to point out that, in order to have an effective learning process during the development of an educational game, it is initially necessary for its content to be relevant to the proposal, in addition to being updated, reliable, diversified and presenting detailed information on the theme⁽¹⁹⁾.

In the “*SerTão Bom*” development context, ordinances and scientific and official booklets were sought as materials in order to guarantee safety in relation to the contents to which players would have access through the quiz. Even so, a number of studies indicate that many apps still adopt practices that do not employ adequate health education strategies, using diverse information that lack scientific basis, putting players/users at risk⁽²⁰⁾.

Regarding the validation process by the specialists in content and Informatics, it is understood that they were indispensable for the game to emerge as a good quality material and suitable for the general population. It is pointed out that the judges' experience contributes to a reliable evaluation of the material developed, as it is scientific and practical knowledge for the community in general and that will add benefits to the health education process⁽²¹⁾.

Thus, when choosing the specialists in content and technical aspects, professionals who had expertise in theory and practice were privileged. Regarding the “*SerTão Bom*” game, for example, technical specialists who worked directly in the development of games were chosen, more specifically targeted at apps or who taught academic subjects related to the theme.

It is argued that it is essential that the material undergoes constant updates, considering the appropriate language for the moment, the writing styles and presentation of the contents⁽¹⁰⁾. It is worth noting that, at this stage of validation with specialists, it is natural to correct and/or add diverse information, mainly related to the content, all contributing to the quiz administration process⁽²⁰⁾.

From this perspective, in the first stage of analysis of the questions, there was a round of adaptations in the questions that had CVI values between 0.7 and 0.79 for each thematic category, which were of fundamental importance to adapt questions related to writing and to language adequacy, so that it becomes more accessible and understandable to the community in general.

In the second stage of content evaluation, which involved evaluation of the final version of the game, it was observed that the items that had the lowest agreement levels among the content specialists were related to the general characteristics of the game.

Therefore, the experts’ considerations referring to the structure/presentation contributed to this process, and all the modifications suggested were accepted, such as giving greater emphasis to the “T” in the name of the game, standardization in relation to the fonts and writing, correction of some references used, adding the “exit the game” option and adding the possibility for the players to challenge themselves online, as well as increasing the time for the answers.

As for the technical aspects, it is noted that evaluation of the technology by the specialists is based exactly on this testing process to identify problems that may represent difficulties in development of the game. It is believed that the option of evaluating the functionality, usability and efficiency criteria together with Information Technology specialists provided an analysis of technical aspects relevant to learning, which can ease playability and, thus, favor learning⁽¹⁰⁾.

In this aspect, it is pointed out that there was full agreement in relation to functionality, which was not the case among the criteria related to usability and efficiency, with adaptations in these items, mainly related to the length of the questions and to the proposed time to answer them. It is noted that it is natural to find some disagreement among the evaluators, based on their individual perspectives and professional experiences⁽¹⁰⁾.

In turn, the game presents some limitations related to the system. Thus, only users with *Android* systems can access it. This limitation was also identified in the validation process, in which some experts did not complete the second stage because they only had smartphones with iPhone systems, precluding analysis of the process as a whole.

Conclusion

By carrying out the research, it was possible to develop and validate an educational game about drug abuse and a harm reduction strategy, in association with risk of suicide. It can be understood that the field of mental health, with an emphasis on drug abuse and a harm reduction strategy in articulation with risk of suicide, constituted a major challenge due to the complexity of the themes, so that a playful material would be produced and validated, of good quality and accessible.

Therefore, it is understood that the study was able to achieve its objective, as it fostered creation of the educational game, with due validation of the contents and technical aspects, reaching satisfactory agreement by the specialists in almost all items.

It is noted that the interaction of different knowledge areas (health and technology) was fundamental for the realization of a good quality app, based on scientific and adequate knowledge. In this sense, the next stage of the game consists in its validation by the general population, considering possible improvements and adaptations.

It is also noted that, despite the expansion of gamification in the health area, the studies related to mental health are still scarce, with the need for more materials to be prepared, in order to enable knowledge on the theme, as well as to facilitate the creation and validation of other games from this perspective.

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All authors approved the final version of the text.

Conflict of interest: the authors have declared that there is no conflict of interest.


Received: Jul 14th 2021

Accepted: Feb 25th 2022

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