Donate Life! Validation of a board game about knowledge of organ and tissue donation and transplantation

Flavio Henrique Aragão Ferreira, Luisa Vivas Santos, Rickelmy Anisio Lima Pessoa, Marina Marzano de Araújo, Wasantha Jayawardene, Rickelmy Anisio Lima Pessoa

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Abstract

Background: Organ and tissue donation practices in Brazil is low compared to other countries, the primary cause is due to family refusal. Adolescents are considered important targets in educational campaigns because they are involved in an intense process of biopsychosocial and indirect family involvement. Educational technologies aim to harness technological potential to engage individuals in the empowerment process. Educational games with content and purpose, also known as serious games (SG), play a prominent role. Conceptually, they represent games that go beyond entertainment, aiming to promote health, contribute to the discussion of sensitive topics, educate, guide, and encourage healthy habits and behaviors. To achieve this, they must undergo content and predictive validation, aiming to ensure their effectiveness as a health education tool as part of the learning process of the target audience.

Objective: This study aimed to document the process of designing, developing and validating the gamification of an experimental board game about organ and tissue donation and transplantation targeting adolescents and adults.

Methods: This was a methodological study of content and appearance validation organized in four stages: situational analysis, board game prototype development, content validation, and production of the final game board version. The game prototype underwent a content validation process following criteria established by Pasquali. The Delphi technique was used, which involves evaluating a specific theme through expert judgment. Na academic panel of professionals were selected and divided into 3 groups: educational professionals with experience in playful-pedagogical activities, health professionals with experience in organ donation and transplantation and design and advertising professionals with experience in playful games. One on-line data collection form was created for each panel of judges, using a 4-point Likert-type agreement scale for each item. After two Delphi rounds, the Content Validation Index (CVI) was obtained.

Results: The final game version consists of a game board with 48 squares, six pawns, a six-sided die, a set of 20 green cards, 20 yellow cards, and 15 red cards containing easy, moderate and difficult level questions, respectively. Additionally, the game includes a manual of rules and instructions to be used by the teacher to guide participants before and during the game. Out of the 86 items evaluated by the judge panel during the first Delphi round, 80 scored above a 0.78 CVI, considered valid. In the second round, after excluding one item, validation was achieved for the remaining five items.

Conclusions: It is expected that the game board will contribute to the learning of participants about the aspects involving organ donation and transplantation, as well as the importance and encouragement to become an organ-donor contributing to improving the health of others. Efficacy studies are needed to study game play involving participants.

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Original Manuscript

Donate Life! Validation of a board game about knowledge of organ and tissue donation and transplantation.

Flávio Henrique Aragão Ferreira[1*]; Luisa Vivas Santos[1*]; Rickelmy Anisio Lima Pessoa[1*]; Marina Marzano de Araújo[1*]; Wasantha Jayawardene[2*], MD, PhD; Mark Anthony Beinner[1*], PhD.

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Abstract

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Organ and tissue donation practices in Brazil is low compared to other countries, the primary cause is due to family refusal. Adolescents are considered important targets in educational campaigns because they are involved in an intense process of biopsychosocial and indirect family involvement. Educational technologies aim to harness technological potential to engage individuals in the empowerment process. Educational games with content and purpose, also known as serious games (SG), play a prominent role. Conceptually, they represent games that go beyond entertainment, aiming to promote health, contribute to the discussion of sensitive topics, educate, guide, and encourage healthy habits and behaviors. To achieve this, they must undergo content and predictive validation, aiming to ensure their effectiveness as a health education tool as part of the learning process of the target audience.

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This study aimed to document the process of designing, developing and validating the gamification of an experimental board game about organ and tissue donation and transplantation targeting adolescents and adults.

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Results

The final game version consists of a game board with 48 squares, six pawns, a six-sided die, a set of 20 green cards, 20 yellow cards, and 15 red cards containing easy, moderate and difficult level questions, respectively. Additionally, the game includes a manual of rules and instructions to be used by the teacher to guide participants before and during the game. Out of the 86 items evaluated by the judge panel during the first Delphi round, 80 scored above a 0.78 CVI, considered valid. In the second round, after excluding one item, validation was achieved for the remaining five items.

Conclusion

It is expected that the game board will contribute to the learning of participants about the aspects involving organ donation and transplantation, as well as the importance and encouragement to become an organ-donor contributing to improving the health of others. Efficacy studies are needed to study game play involving participants.

KEYWORDS

Game board; content validation; organ donation and transplant; adolescents; judge experts; Delphi

technique; Likert-scale; health education

Introduction

Organ and tissue transplantation is a form of treatment involving the replacement of compromised organs with healthy ones. These organs and tissues can be sourced from deceased or living donors [1]. Since the first successful organ transplant in 1954, significant advancements have occurred in this therapeutic field, leading to improvements in the quality of life for transplant recipients [2].

In 2001, presumed consent for organ donation was abolished in Brazil by Federal Law 10.211 [3], which mandated that organ and tissue retrieval for donation after death would only occur with authorization from the spouse or a legal adult family member up to a second degree relative, irrespective of the donor's expressed wishes in life [4].

Organ scarcity presents a challenging process. In Brazil, the primary reason for non-donation of organs from deceased individuals is family refusal. A significant portion of this refusal is due to lack of understanding regarding the concept of brain death [5]. Additionally, healthcare professionals' lack of preparedness in approaching families during such delicate moments, along with uncertainty regarding the deceased's wish to be a donor, are also significant and considerable factors [6].

Public health education is extremely necessary for individuals to be aware of their participatory rights in health programs [7]. The school environment plays a crucial role in the personal and social development of individuals and can serve to bridge the gap in educating students about health, potentially reaching their respective family and community environments [8].

Adolescents deserve special attention regarding health education, as they are undergoing an intense process of biopsychosocial development. The lessons they receive in school and society influence their personal and social development [9]. The participation of this age group in educational activities fosters autonomy, essential experiences and knowledge for the development of active citizenship [10].

Educational technologies can be instruments for disease prevention and health promotion, as they

contribute to clarifying doubts, transmitting knowledge, stimulating behavioral changes, and encouraging decision-making. Serious Games (SG) - educational games - are examples of educational technologies, as they not only entertain but also stimulate learning and behavioral changes using playful, validated instruments [11].

Playful instruments allow participants to engage all their senses, enabling them to relate the content and meaning of the activity to the reality to which they belong, so that they can subsequently seek to change their surroundings as change agents [12].

Thus, a board game aimed at educating school-age adolescents about organ donation and transplantation could potentially be a serious game. For this to occur, it must undergo a content and appearance validation process involving a panel of expert judges. The goal of validation is to ensure the authenticity of the game's appearance, as well as the accuracy, transparency, and relevance of its content. By analyzing the evaluation by experts in the field, the aim is to assess whether the game's content effectively addresses the criteria necessary for measuring what is intended to be investigated and improved [13]. In this scenario, the validation process highlights the reliability of the game and the feasibility of this technique for use in educational practices [14].

The objective of the present study was to assess the reliability of a board game about organ and tissue donation, designed for school-age adolescents, by conducting a content validation study with the participation of experts from the fields of education, health, design and advertising.

Methods

Game Development Process

A descriptive quantitative methodological validation study was conducted, employing the GREET tool (Guideline for Reporting Evidence-Based Practice Educational Interventions and Teaching; [15], which was adapted to the specific phases of this study. The validation focused on an educational instrument presented in the form of a board game centered around the main theme of organ and tissue donation for transplantation. The methodological sequence was organized into four stages: 1 -

situational analysis; 2 - development of the board game prototype; 3 - content validation; and 4 - production of the final version of the game. All sequences were carried out between March of 2022 to May of 2023, in the metropolitan region of Belo Horizonte, Minas Gerais, Brazil.

Stage 1: Situational Analysis

A literature review was conducted regarding the population's knowledge on organ donation, using the SciELO and Lilacs databases. Additionally, unpublished data from an educational activity on organ donation and transplantation in 2021 (personal communication by Mark Anthony Beinner, 10 November, 2023), although unpublished), involving 230 elementary and high school students aged 11 and 18 years old, from three public schools in the metropolitan region of Belo Horizonte, reported lower than expected knowledge among young school-aged individuals on the topic. A multiple-choice questionnaire was administered during this activity, addressing knowledge about organ and tissue donation and Brazilian legislation as well as attitudes and concepts.

Stage 2: Development of the Board Game Prototype

The board game was developed based on Vygotskyan concepts, with reference to the social interactionist theory. Vygotsky asserts that the child's language development implies thought development and occurs within the construction of a social world [16]. Social interactionism prioritizes the analysis of the reflections of the external world of an individuals' inner world, based on their interaction with reality. Thus, the social-cultural dimension of the individual is observed, emphasizing the historical, social and cultural context of each individual.

This proposal values group activities, starting from the conception that development occurs in interpersonal contexts, transitioning from social to individual, highlighting the importance of the individual in the environment in which they live and build their knowledge through social interaction. Therefore, based on the social-interactionist theory, teaching in schools should offer a proposal that encourages collaboration and exchange of views, based on the principle of using mediatory tools as aids in teaching, reasoning, making choices, and problem-solving [17].

The board game entitled "Donate Life: The board game about organ and tissue donation and transplantation", was designed for school-age adolescents, aged 13 years and older. The activity takes into account the capacity for reading and comprehension of written and oral languages, autonomy and social interaction.

Stage 3: Content Validation

Following the methodology established by Pasquali [18], the board game prototype underwent a content validation process. The Delphi technique [19] was employed, which involves evaluating a particular theme through judgment by a penal of experts in the field. The evaluating judges were selected after searching and reviewing their curriculum vitae on the National Council for Scientific and Technological Development (CNPQ) Curriculo Lattes platform which is open access.

Masters and doctoral degree holders were selected and divided into three categories of evaluating panel of judge experts, following the literature recommendations [20] according to the following criteria: 1) pedagogical professionals with experience in playful-pedagogical activities; 2) healthcare professionals with experience in organ donation and transplantation; and 3) professionals in design and advertising with experience in developing serious games.

The evaluators were contacted by email through an invitation letter containing a description of the study, an invitation to participate as evaluators, and finally, an Informed Consent Form. After consenting to participate in the study within the established deadline, the evaluators received Content Validity Index (CVI) forms.

For the validation of the board game, three data collection forms were developed, one for each group of judge experts. The forms were adapted from another study [14], using a 4-point Likert agreement scale for each item addressed, with: 1 = Totally Disagree, 2 = Partially Disagree, 3 = Partially Agree, and 4 = Totally Agree.

The results of each form were entered into a Microsoft Excel spreadsheet to obtain the CVI as well as the mean score and the standard deviation of the Likert scale responses. The CVI is a measure of

content validity that measures the level of agreement among experts on certain aspects of an instrument and its items. It allows for the evaluation of each item individually (Item-Content Validity Index; I-CVI), and subsequently, the overall instrument or scale-level score (Scale-Content Validity Index; S-CVI). For an item using a Likert scale with a score of one to four, the I-CVI score is calculated by summing the number of experts marked 3 or 4, divided by the total number of experts. Then, S-CVI was calculated by taking the sum of the I-CVIs divided by the total number of items. A consensus of at least 0.78 was considered valid for I-CVI, and 0.80 for S-CVI [21].

Additionally, the questionnaires included a first section containing instructions about the form and a second section included brief social demographic questions (demographic region of residence, age, gender, profession, highest educational level, and years of work experience).

Stage 4: Elaboration of the final version of the board game

The final version of the board game was developed according to the results from the panel of judge experts during the content validation stage, taking into account their analysis and suggestions.

Ethical Considerations

This study complied with the regulatory guidelines for research involving human subjects. It was approved by the Research Ethics Committee of the Federal University of Minas Gerais (UFMG) under protocol number 60869322.7.0000.5149. All images used in the board game (board game layout and cards) were sourced from Google Images and Shutterstock, which are freely available and royalty-free, thus ensuring compliance with copyright regulations.

Results

In the situational analysis stage (stage 1), following a literature search and a preliminary study in public schools, the following topics that resulted in lower population knowledge about organ-donor transplantation were identified: general information as to how to become an organ and tissue donor; the concept of brain death; and ethical and legal aspects of donor-organ transplants [22-25].

The development of the board game prototype (stage 2) was initiated after selecting the main topics

to be addressed, as well as defining the target audience age group. An educational board game was chosen as the intervention material. The game's central theme was organ and tissue donation for transplantation, and its design was assembled through a brainstorming session involving project members. Afterwards, form of gameplay, establishing game rules and types of board game material were defined.

During Stage 3, a total of 23 professional judge experts, consisting of seven from the education field, seven from the healthcare field, and nine from the design and advertising field participated in the board game evaluation process. The professionals were distributed across three regions of Brazil: one from the Midwest, 13 from the Southeast and nine from the South. Regarding the age group, from 18 to 29 years of age there was one judge (4.4%); 6 judges (26%) were aged 30 to 39 years; four judges (17.3%) were aged 40 to 49 years; seven judges (30.5%) were aged 50 to 59 years, and five judges (21.8%) were aged 60 years or over. There was a greater number of professionals over 40 years of age (61%) and the majority of the judge experts were women (78%). Twenty (87%) judge experts held a doctorate degree and three (13%) held a master's degree; 16 (70%) of them worked as educators and 15 (65%) as researchers. Forteen (61%) professionals indicated that they had over 20 years of professional experience in their chosen field.

The evaluation questionnaire, responded by the panel of educational judge experts included 36 items divided into six categories: board game rules booklet (7), board game cards (8), the physical portion of the board game (6), board game objective (5), board game relevance (5), and board game additional learning information (5). The results are presented in Table 1.

Table 1: Percentage of agreement, content validity index, mean score, and standard deviation of the items included in the educational board game and evaluated by a penal of educational professional judge experts during the first Delphi round. Belo Horizonte, Minas Gerais. Brazil, 2023.

	Percentage agreement		

Evaluated items	**Panel: Education**				
Likert Scale Score:	**1 or 2**	**3 or 4**	**I - CVI**	**Mean**	**± SD**
(A) Validation of the board game rules booklet:					
1. Are the age and number of participants consistent?		7	**1.00**	3.71	0.48
2. Is the game proposal clear and easy to understand?	2	5	**0.71***	3	1.41
3. Is the game development clear and easy to understand?	1	6	**0.86**	3.28	0.75
4. Do the game rules present important steps?		7	**1.00**	4	0
5. Are the rules of the game clear and objective?	1	6	**0.86**	3.57	0.78
6. Is the way the game starts clear and coherent?	1	6	**0.86**	3.71	0.75
7. Is the way the game ends clear and coherent?		7	**1.00**	3.85	0.37
(B) Validation of green, yellow and red cards:					
1. Is the number of cards adequate?		7	**1.00**	3.85	0.37
2. Are the card categories clear and objective?	1	6	**0.86**	3.42	1.13
3. Is the appearance of the cards suitable for teenagers?	1	6	**0.86**	3.57	0.78
4. Is the content of the letters clear and objective?		7	**1.00**	3.57	0.53
5. Are the questions easy for teenagers to understand?		7	**1.00**	3.57	0.53
6. Are the questions easy for teenagers to read?		7	**1.00**	4	0
7. Are the questions in line with the theme of the game?		7	**1,00**	4	0
8. Is the language of the letters appropriate and accessible to the recommended age group?	1	6	**0.86**	3.57	0.78
(C) Validation of the game board:					
1. Is the number of board game spaces adequate?		7	**1.00**	4	0
2. Are the game space categories clear and objective?		7	**1.00**	4	0
3. Are the game space categories coherent and appropriate?		7	**1.00**	4	0
4. Are the illustrations present in some board game spaces suitable for the target audience?		7	**1.00**	4	0
5. Do the red "challenge" board game spaces contribute to dynamicity and playability?	1	6	**0.86**	3.57	0.78
6. Do the extra game spaces (blue, gray and orange) contribute to the dynamics and playability?		7	**1.00**	4	0
(D) Validation of the game objective:					
1. Is the board game content relevant to teaching about		7	**1.00**	4	0

organ donation?					
2. Can the game help clarify doubts regarding the topic?		7	**1.00**	3.85	0.37
3. Can the game encourage reflection on the topic of organ donation?		7	**1.00**	4	0
4. Can the game influence the adoption of behaviors favorable to organ donation?	2	5	**0.71***	3	1.15
5. Can the game promote interaction between participants?		7	**1.00**	3.85	0.37
(E) Validation of the relevance of the board game:					
1. Can the board game experience contribute to adolescents learning about the topic?		7	**1.00**	4	0
2. Can the board game stimulate interest in the topic?	1	6	**0.86**	3.71	0.75
3. Is the board game efficient for learning about the topic, comparing it to other activities?	1	6	**0.86**	3.42	0.78
4. After the game, will the teenager be able to discuss what they have learned?	1	6	**0.86**	3.42	1.13
5. Is the board game suitable for use by any education and healthcare professional?		7	**1.00**	3.85	0.37
(F) Validation of the suggestions included in the rules booklet:					
1. Are the suggestions presented clear and objective?		7	**1.00**	4	0
2. Are the board game suggestions easy to understand?		7	**1.00**	4	0
3. Do the game's suggestions cover the reality of Brazilian public schools?		7	**1.00**	3.85	0.37
4. Is the creation of the posters clear and objective?		7	**1.00**	3.71	0.48
5. Is the discussion of cases clear and objective?		7	**1.00**	3.28	1.11
	S-CVI/mean		**0.94**		

Note: I-CVI: Item-Content Validity Index for individualized items; Mean score; S.D: Standard Deviation; *Score below the required minimum (0.78); S-CVI/mean: Mean Scale-Content Validity Index for all obtained indexes.

Of the 36 items evaluated by the panel of judge experts from the education field, 34 items obtained the minimum score required for validation. Additionally, some items received suggestions for improvements, such as reducing the amount of text, both on the cards and in the rules manual, removing technical terms, and using language more accessible to the targeted age group. However, two items obtained an I-IVC score less than 0.78, from the board game rules and objective categories. Both received suggestions for improvements.

The panel of judge experts suggested reducing the text and altering the writing style to be less repetitive in relation to the board game's proposal and objective. The text was reformulated to include more details about the board game's beginning and development. Suggestions were made by the panel regarding the complexity of the question of organ-donor transplantation in relation to the psychological and social factors. We reformulated the question as suggested, highlighting learning about the importance of the topic of donor-organ transplantation.

For the panel of judge experts comprising the healthcare field, the questionnaire contained 30 items divided into five categories: rules booklet (7), board game cards (8), board game (5), board game objective (5), and game relevance (5). The results are presented in Table 2.

Table 2: Percentage of agreement, content validation index, mean score, and standard deviation of the items in the educational board game evaluated by a penal of judge experts from the health field during the first Delphi round. Belo Horizonte, Minas Gerais. Brazil, 2023.

	Percentage of Agreement				
Evaluated items	**Panel: Health**				
Likert Scale Score:	**1 or 2**	**3 or 4**	**I - CVI**	**Mean**	**S.D**
(A) Validation of the game rules booklet:					
1. Are the age and number of participants consistent?	1	6	**0.86**	3.57	0.78
2. Is the game proposal clear and easy to understand?	1	6	**0.86**	3	1
3. Is board game development clear and easy to	2	5	**0.71***	3	1.15

understand?					
4. Do the game rules present important steps?	1	6	**0.86**	3.71	0.75
5. Are the rules of the game clear and objective?	1	6	**0.86**	3.14	1.06
6. Is the way the board game starts clear and coherent?		7	**1.00**	3.71	0.48
7. Is the way the board game ends clear and coherent?		7	**1.00**	3.57	0.53
(B) Validation of green, yellow and red cards:					
1. Are the card categories coherent and appropriate?		7	**1.00**	3.71	0.48
2. Is the appearance of the cards appropriate for the theme?		7	**1.00**	4	0
3. Is the content of the letters clear and objective?	1	6	**0.86**	3.28	0.75
4. Are the questions in line with the theme of the game?	2	5	**0.71***	3.42	0.97
5. Can the questions promote learning about the topic?		7	**1.00**	3.57	0.53
6. Are the cards well separated by difficulty level?		7	**1.00**	3.71	0.48
7. Does the content accurately address the topics?		7	**1.00**	3.57	0.53
8. Are the correct answers to the questions correct according to the evidence?		7	**1.00**	3.71	0.48
(C) Validation of the game board:					
1. Is the board game well illustrated?		7	**1.00**	3.85	0.37
2. Are the images appropriate for teenage school audiences?		7	**1.00**	3.85	0.37
3. Are the images in line with the game's theme?		7	**1.00**	3.85	0.37
4. Are the illustrations in some board game spaces suitable for teenagers?		7	**1.00**	3.85	0.37
5. Are the illustrations capable of catching the attention of teenagers?		7	**1.00**	3.85	0.37
(D) Validation of the board game objective:					
1. Is the board game content relevant to teaching about organ donation?		7	**1.00**	3.85	0.37
2. Is the information presented in the game coherent?	1	6	**0.86**	3.57	0.78
3. Can the game help clarify doubts regarding the topic?		7	**1.00**	3.57	0.53
4. Can the game encourage reflection on the topic of organ donation?		7	**1.00**	4	0
5. Can the game influence the adoption of behaviors		7	**1.00**	3.85	0.37

favorable to organ donation?					
(E) Validation of the relevance of the board game:					
1. Can the board game contribute to teenagers' understanding of the topic?		7	**1.00**	3.57	0.53
2. Can the board game stimulate interest on the topic?		7	**1.00**	3.85	0.37
3. After the game, will the teenager be able to discuss what they have learned?		7	**1.00**	3.57	0.53
4. Does the board game address relevant issues regarding organ donation?		7	**1.00**	3.85	0.37
5. Is the board game suitable for use by education and healthcare professionals?		7	**1.00**	3.85	0.37
	S - CVI/mean		**0.95**		
Note: I-CVI: Item-Content Validity Index for individualized items; Mean score; S.D: Standard Deviation; *Score below the required minimum (0,78); S-CVI/mean: Mean Scale-Content Validity Index for all obtained indexes.					

Of the 30 items evaluated by the panel of judge experts from the healthcare field, 28 items obtained the minimum score required for validation. Additionally, similar to the items in the educational field questionnaire, some validated items also received suggestions for improvements, such as reducing the difficulty level for questions and promoting greater interaction and cooperation among players. For this questionnaire, two items also obtained an I-CVI score below the minimum required score (0.78) for validation and they were submitted for editing, according to the suggestions provided by the panel.

During the board game development process, the text was reduced, focusing only on key information necessary for understanding. The board game's ending was also altered to promote greater interaction and cooperation among players. Under this scenario, upon reaching the end of the board game spaces, by traversing all the spaces, each player will have the opportunity to assist others in thinking through answers to the card questions. Regarding the game card questions, some information about

the answers to certain cards was corrected based on the most recent evidence presented by the panel. The word "Question" was removed from all cards since some cards present statements rather than questions. Additionally, some questions were completely reedited to address topics related to organ and tissue donation, such as blood donation, myths surrounding organ donation, and personal beliefs related to the topic.

The third panel of judge experts, composed of design and advertising professionals, responded to a questionnaire comprising 20 items divided into three categories: the game design (6), game card design (6), and game board design itself (8). The results are presented in Table 3.

Table 3: Percentage of agreement, content validation index, mean score and standard deviation of the items in the educational board game evaluated by a panel of judge experts from the design and advertising field during the first Delphi round. Belo Horizonte, Minas Gerais. Brazil, 2023.

	Percentage of Agreement				
Evaluated items	**Panel: Design**				
Likert Scale Score:	**1 or 2**	**3 or 4**	**I - CVI**	**Mean**	**S.D**
(A) Game design validation:					
1. Is the game design appealing to a teenage audience?	2	7	**0.78**	3.11	0.78
2. Are the images appropriate for teenage audiences?	2	7	**0.78**	3.33	0.86
3. Are the images in line with the board game’s theme?	1	8	**0.89**	3.67	0.7
4. Is the game's appearance attractive and appropriate?	2	7	**0.78**	2.89	0.6
5. Are the illustrations on the board game rules adequate?	2	7	**0.78**	3	1
6. Are the rules of the board game relevant to understanding the game?	2	7	**0.78**	3.22	0.83
(B) Validation of the design of the game cards:					
1. Is the appearance of the game cards appropriate?	1	8	**0.89**	3.56	0.72
2. Is the choice of the game card colors appropriate?		9	**1.00**	3.67	0.5
3. Are the game cards attractive and eye-catching?	1	8	**0.89**	3.44	1
4. Are the size of the title and content of the letters	1	8	**0.89**	3.56	0.72

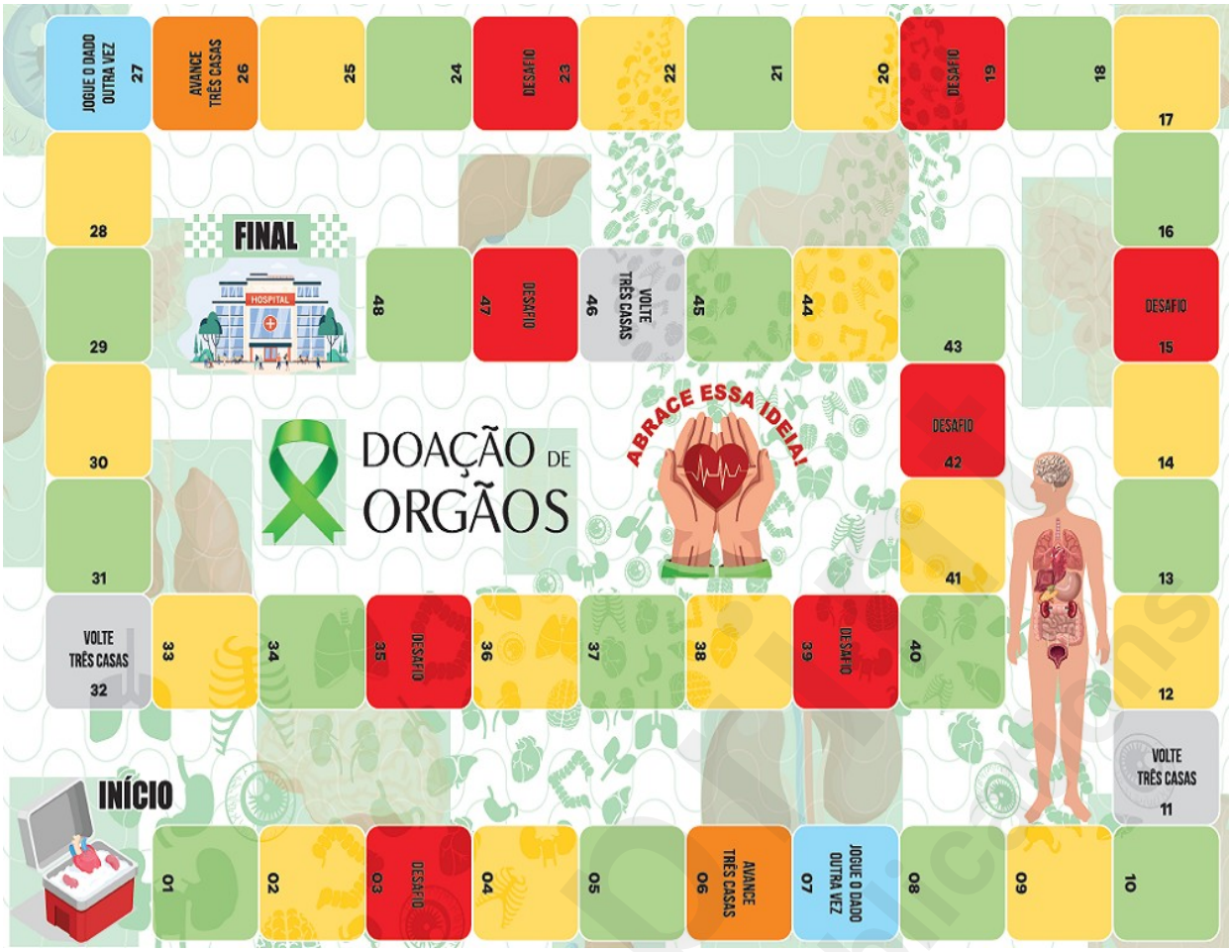
appropriate?					
5. Are the texts on the game cards easy to read?		9	**1.00**	3.89	0.33
6. Is the language of the letters appropriate and accessible to teenagers?	1	8	**0.89**	3.44	1
(C) Validation of game board design:					
1. Is the number of board game spaces adequate?	1	8	**0.89**	3.33	0.7
2. Is the board game space numbering clear and objective?	1	8	**0.89**	3.56	0.72
3. Are the beginning and end of the spaces well defined?	1	8	**0.89**	3.44	0.72
4. Is the trajectory of the board spaces well defined?		9	**1.00**	3.89	0.33
5. Are the board game space colors well distributed?		9	**1.00**	3.56	0.52
6. Are the illustrations in some spaces suitable for teenagers?	3	6	**0.67***	3	0.86
7. Is the board attractive and eye-catching?	2	7	**0.78**	3	0.7
8. Is the board game well illustrated?	3	6	**0.67***	2.89	0.78
	S-CVI/mean		**0.86**		

Note: I-CVI: Item-Content Validity Index for individualized items; Mean score; S.D: Standard Deviation; *Score below the required minimum (0.78); S-CVI/mean: Mean Scale-Content Validity Index for all obtained indexes.

Of the 20 items evaluated by the panel of judge experts in design and advertising, 18 of those received the minimum score required for validation, and several changes suggested by the panel were also made. The appearance of the cards was altered, with a greater emphasis on the answer options. The spaces on the board also received greater emphasis on numbering and inserted text. As in the findings presented in Tables 1 and 2, only 2 items in Table 3 received scores below the minimum required for validation, and adjustments were made accordingly.

As for the board game design, changes were made to some images deemed inappropriate for the age group, and greater emphasis was placed on the board game title and numbering of board game spaces (beginning to end). Figure 1 presents the final product of the board game.

Figure 1: Board game updated according to the suggestions by the panel of expert judges



After the changes from the first Delphi round were made, three new questionnaires were sent to the three groups of panel judge experts along with the modifications done by our research team. The questionnaires were reduced to two items for the panel of judge experts in education and health and one item for the panel of judge experts from design and advertising. The results of the second Delphi round are presented in Table 4.

Table 4: Percentage of agreement, content validation index, mean score and standard deviation of the items in the educational board game evaluated by the three panels of judge experts during the second Delphi round. Belo Horizonte, Minas Gerais. Brazil, 2023.

	Percentage of Agreement		
EVALUATED ITEMS	**2ª Round Delphi**		
	Panel experts: Education		

Likert Scale Score:	**1 or 2**	**3 or 4**	**I-CVI**	**Mean**	**S.D**
(A) Validation of the board game rules booklet:					
1. Is the game proposal clear and easy to understand?		5	**1.00**	3.8	0.44
(B) Validation of the board game objective:					
1. Can the game contribute to learning about the importance of the topic?		5	**1.00**	4	0
	Panel experts: Health				
Likert Scale Score:	**1 or 2**	**3 or 4**	**I-CVI**	**Mean**	**S.D**
(A) Validation of the game rules booklet:					
1. Is the game development clear and easy to understand?		6	**1.00**	4	0
(B) Validation of green, yellow and red cards:					
1. Are the questions in line with the theme of the game?		6	**1.00**	3.67	0.51
	Panel experts: Design				
Likert Scale Score:	**1 or 2**	**3 or 4**	**I-CVI**	**Mean**	**S.D**
(A) Validation of game board design:					
1. Is the game design appealing to a school-aged teen audience?	1	4	**0.80**	3.4	0.89

Note: I-CVI: Item-Content Validity Index for individual items; Mean score; S.D: Standard Deviation.

As in the first Delphi round, a deadline of 10 days was established for the second round for the panel of judge experts to evaluate the board game material once again, and to respond to the questionnaire. Of the 23 judge experts who received the second assessment, 16 responded by the specified deadline, with five experts from the education panel, six experts from health penal and five experts from design and advertising panel. The reviewed material by judges in education and health achieved a

maximum validation score. However, the item “Is the game design appealing to a school-aged teen audience?”, in Table 4 of the questionnaire, received an IVC of 0.80 by the judge experts from the design and advertising panel. This score was considered valid.

Discussion

The development of educational tools aimed at raising awareness and disseminating crucial information about organ donation and transplantation is of paramount importance [26]. One of these educational tools that has gained attention in recent years is board games. To the best of our knowledge, this was the first time a board game, designed as an educational intervention tool about organ and tissue donation and transplantation, was validated by a panel of expert judges.

These games offer an engaging and interactive way to educate people, especially young audiences, about a complex and vital topic such as organ donation [27]. Board games, often referred to as tabletop games, have a unique appeal due to their distinct approach compared to traditional teaching methods. Traditional teaching methods, such as lecture-based teaching, primarily focus on information transmission and promotion of memorization. In contrast, educational games present an alternative approach by immersing students in captivating scenarios that present challenging problems while offering multiple paths for them to navigate through these situations [28]. Consequently, games provide students with the opportunity to cultivate higher-level cognitive skills, including practical application and analytical thinking [29]. Additionally, games incorporate a feedback mechanism and can be carefully designed with various levels of difficulty to meet diverse learning needs [30].

However, the development of such games must be accompanied by rigorous validation processes to ensure their effectiveness and impact. Before assessing the board game on organ and tissue donation in schools, it was crucial to evaluate the content of this promising educational tool. Validation studies of educational games often emphasize the importance of user-centered design principles [31]. The analysis of evidence of content validity focused on clarity, practical relevance, and theoretical

relevance. In addition to evaluating indicators related to game content, this study also examined the overall visual presentation of the game. This includes considerations such as the use of colors, font legibility, and integration between text and images. These factors were examined to increase participant engagement during the game, with the aim of ensuring that visual elements complement the textual information on the cards [32].

Validation provides a basis for measuring the impact of the game. Researchers and educators can assess whether the game has achieved its educational and behavioral objectives through post-game evaluations, surveys, and follow-up studies. This data is invaluable for improving future iterations of the game [33]. The educational game on organ and tissue donation and transplantation was evaluated with excellent content validity index (CVI) scores by the panel of three groups of judge experts, obtaining CVI scores equal to or greater than 0.78 during the two rounds of Delphi evaluation. At the end of the second Delphi round, the CVI of two of the three panels of judge experts was equal to 1.00.

The use of a panel of expert judges and the two-round evaluation process demonstrate a dedication to validation and continuous improvement. This aligns perfectly with best practices observed in educational research, where iterative development and evaluation are imperative for improving instructional materials [34]. The invaluable feedback provided by the judges, along with their specific suggestions for improvements, played a fundamental role in optimizing the game. This underscores the vital importance of engaging potential users throughout the development process.

Validation studies conducted on educational games often highlight the importance of user feedback in fine-tuning game mechanics and content [35]. Studies using board games have found a reduction in depression in institutionalized elderly [36], improvement in cognitive capacity in Alzheimer's patients [37], promotion of healthy eating, smoking cessation, and safer sexual practices [38]. Specifically in the field of cardiology, a randomized clinical trial conducted in Thailand found that a board game was associated with increased knowledge and self-care behavior in heart failure patients

up to three months after the game session [39].

A limitation of the study was that the validation process of the board game did not involve the target population of teenagers. Further studies are needed to investigate the effectiveness and acceptance in a classroom environment with teenagers enrolled in public schools.

Conclusion

Population studies involving the population's knowledge regarding organ and tissue donation highlight the need for increased health education, especially among school-age youth. It is hoped that the present game will contribute to the learning of young people about the aspects involving the theme of organ and tissue donation and transplantation, as well as the importance and encouragement of exercising the citizenship of donating life, contributing to improving health in Brazil. Further studies are needed to evaluate the effectiveness of this educational tool in public school classrooms.

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Data Availability

All data supporting the study findings are within the manuscript. Additional details information and raw data are available from the corresponding author on reasonable request.

Authors' Contributions

MAB and WJ conceived the project. FHAF, LVS, RALP and MMA contributed to data collection. FHAF and MAB contributed to data analysis. MAB supervised the study. The manuscript was written mainly by FHAF, MAB and WJ with the approval of all authors. All authors read and approved the final version of manuscript for publication.

Conflicts of interest

None declared.

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Supplementary Files