

Evaluation of a digital game for sexual education for children and adolescents¹

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Abstract

Formal sexuality education is a fundamental right that helps promote healthy sexual behaviors and prevent childhood abuse. This study aimed to evaluate the game *Caça ao Tesouro: Educação Sexual* created to teach topics related to sexual education in a school context. Three teachers (Natural Sciences/Biology) participated online as judges, evaluating the game regarding the following aspects: language, precision, adequacy of themes and applicability to the school context. Teachers received an email containing the game and 7 questionnaires, one about professional experience and 6 that evaluated aspects of the game. The aspects were well evaluated by teachers who considered the game applicable to the school context. Adjustments were highlighted to be made in the design and updating terms, as well as in the language used in some instructions. The language will be adapted to the school context taking into account social issues raised by participants.

Keywords: educational technology; educational game; sex education; educational strategies; behavior analysis.

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Avaliação de um jogo digital para educação sexual de crianças e adolescentes

Resumo

A educação sexual formal é um direito fundamental que ajuda a promover comportamentos sexuais saudáveis e a prevenir abusos na infância. Esse estudo teve por objetivo avaliar o jogo Caça ao Tesouro: Educação Sexual criado para o ensino de temas relacionados à educação sexual em contexto escolar. Participaram de forma on-line 3 professores (Ciências da Natureza/Biologia) como juízes, avaliando o jogo quanto aos seguintes aspectos: linguagem, precisão, adequação dos temas e aplicabilidade ao contexto escolar. Os professores receberam um e-mail contendo o jogo e 7 questionários, um sobre experiência profissional e 6 que avaliavam os aspectos do jogo. Os aspectos foram bem avaliados pelos professores que consideraram o jogo aplicável ao contexto escolar. Foram apontados ajustes a serem realizados no design e atualização termos, assim como na linguagem utilizada em algumas instruções. A linguagem será adaptada ao contexto escolar levando em consideração questões sociais envolvidas levantadas pelos participantes.

Palavras-chave: tecnologia do ensino; jogo educativo; educação sexual; estratégia educacional; análise do comportamento.



Evaluación de un juego digital para la educación sexual de niños y adolescentes

Resumen

La educación sexual formal es un derecho fundamental que ayuda a promover conductas sexuales saludables y prevenir el abuso infantil. Este estudio tuvo como objetivo evaluar el juego Caça ao Tesouro: Educação Sexual creado para enseñar temas relacionados a la educación sexual en el contexto escolar. Tres profesores (Ciencias Naturales/Biología) participaron online como jueces, evaluando el juego en los siguientes aspectos: lenguaje, precisión, adecuación de los temas y aplicabilidad al contexto escolar. Los profesores recibieron un correo electrónico que contenía el juego y 7 cuestionarios, uno sobre experiencia profesional y 6 que evaluaban aspectos del juego. Los aspectos fueron bien evaluados por los profesores que consideraron el juego aplicable al contexto escolar. Se destacaron ajustes a realizar en los términos de diseño y actualización, así como en el lenguaje utilizado en algunas instrucciones. El lenguaje se adaptará al contexto escolar teniendo en cuenta las cuestiones sociales planteadas por los participantes.

Palabras clave: tecnología de enseñanza; juego educativo; educación sexual; estrategias educativas; análisis de comportamiento.



Introduction

According to the Ministry of Health (Brasil, 1999), children and adolescents have the right to be informed about body care and the changes that occur during the stages of human development. The Statute of the Child and Adolescent (Brasil, 1990) emphasizes that access to formal sexual education is a fundamental right that must be guaranteed by the Brazilian State. Sexual education increases the probability of behaviors such as safe sex (condom use), healthcare practices such as adequate hygiene, and protective conducts against child sexual abuse. Educational games have been considered potential tools for teaching different behaviors, including those related to sexuality. However, for them to fulfill their instructional function, it is important that, before being used, these games are evaluated by those who will utilize them, such as parents, children or adolescents, and teachers.

Sexual education, according to Figueiró (2009, p. 37), refers to “any teaching-learning action regarding human sexuality, whether at the level of basic information knowledge or at the level of knowledge and/or discussions and reflections on values, norms, feelings, emotions, and attitudes related to sexual life.” Sexual education contributes to ensuring that children and adolescents have sufficient knowledge to act consciously when the issue involves sexual behavior, reducing the likelihood of becoming victims of sexual violence (Pereira; Pena; Guimarães, 2024; Rogê, 2017). It provides this audience with the conditions to learn how to discriminate what constitutes violence, identify possible signs of risk, and how to seek help (Beloti, 2022; Pereira; Pena; Guimarães, 2024).

Furthermore, it is emphasized that the absence of formal sexual education (an intentional and planned process) does not mean that children and adolescents will not learn informally about themes involving sexuality. Informal sexual education occurs daily. Events containing expressions of sexuality are present in the lives of children and adolescents. They inevitably witness situations



such as kissing, hugging, dating, affection, pregnancy, childbirth, etc. When witnessing these situations is accompanied by looks, comments, gestures, and/or silence from adults, relationships between these events can be established. Values, ideas, and rules end up being learned through the establishment of these relations, which can bring suffering to these individuals in adulthood (Figueiró, 2020). Planning for formal sexual education allows for the formation of individuals with a repertoire based on high-quality scientific knowledge and a healthier relationship with the theme (Brum, 2011; Silva et al., 2023).

Until 2018, formal Sexual Education in Brazil was conducted based on the “National Curricular Parameters” or PCNs² (Brasil, 1997). The PCNs are a set of documents that provide guidelines on how and what to teach in Brazilian schools, respecting the student’s age and maturity. According to the PCNs, sexual education should be included as one of the cross-cutting themes in Elementary School. The establishment of these parameters allowed many education professionals to have clarity regarding the role of schools in teaching sexuality (Figueiró, 2009).

In 2018, the PCNs were replaced by the National Common Curricular Base (BNCC), which began to be used as a guideline for teaching various areas of knowledge, from Early Childhood Education to High School (Brasil, 2018). The BNCC has a smaller number of teaching objectives linked to Sexual Education compared to the PCNs, limiting it to a topic to be addressed during Science classes. This limitation may reduce opportunities for discussion when compared to the possibilities presented in the PCNs. According to Sartori (2022), following the conservative wave that had been taking over the Brazilian public debate, sexual education, sexual orientation, and gender-related issues were removed from the school curriculum. According to the author, the BNCC focused on the biological dimension of sexuality, covering Sexually Transmitted Infections (STIs) with the objective of reducing public health problems, without offering the learner the social and affective dimensions involving sexuality.



In the classroom, this reduction in the approach to behavioral aspects in favor of purely biological aspects can lead to a deficiency in the adolescent's behavioral repertoire for dealing with issues permeating sexuality, such as relationships, self-control regarding the choice to practice safe sex, and the avoidance of abuse (Bowen et al., 2014). Although biological aspects are important, dealing with these issues requires teaching children and adolescents to think critically about the problems and situations that will inevitably be part of their daily lives (Figueiró, 2009).

Recognizing that a large portion of people will become sexually active during adolescence (Brum, 2011) and that Sexual Education can be an effective tool for abuse prevention (Beloti, 2022), instructing on human sexuality and problematizing situations involving the theme can make children and adolescents more capable of making better decisions. One way to enable this learning safely and effectively is through educational games (Alencar et al., 2022; Borji-Navan; Maleki; Keramat, 2024). Educational games are tools that allow for the planning of teaching contingencies and do so using fun activities to keep the learner engaged in the task while learning (Bosquetti et al., 2024; Gris; de Souza, 2016). Games allow for active learning since players must behave in response to the proposed activity. According to Skinner (1968/2003), for learning to occur, the teacher (or whoever is teaching) must arrange the teaching contingencies appropriately, increasing the probability of the behavior occurring and, consequently, being followed by reinforcing consequences.

Regarding the use of electronic or digital games, an increase in interest is observed across different age groups. The 2021 Brazil Game Research (Sioux Group; Go Gamers, 2024) interviewed 12,498 people from all Brazilian states and revealed that 72% of the interviewed public uses digital games regardless of the platform (mobile, computer, or video game), with these games being one of the main forms of entertainment for those interviewed. The recreational use of digital games highlights their motivational potential. Due to this potential to engage users, educational games enable the teaching and improvement of



behaviors through fun interaction, keeping the player under the control of the teaching activity for a longer period. This motivational aspect and the planning of educational contingencies make educational games tools with great potential and effectiveness for teaching today (Alencar et al., 2022; Borji-Navan; Maleki; Keramat, 2024; Bosquetti et al., 2024).

The development of educational games presupposes steps that, if properly taken, increase the probability that the game fulfills its teaching function and keeps the player engaged in the proposed tasks. These steps include: (a) the development of terminal and intermediate target behaviors to be achieved with the game (Botomé, 1981; Santos et al., 2009), (b) the establishment of the activities necessary for the proposed objectives to be achieved (Souza et al., 2023), (c) the establishment of the formal elements of the game—technology, mechanics, narrative, and aesthetics (Schell, 2008; Salen; Zimmerman, 2004; Zimmerman, 2003), and (d) the development of a prototype to be evaluated by players (Ortolan et al., 2018; Perkoski; Souza, 2015) so that changes can be implemented if necessary. The evaluation process of a technology such as a game can also undergo a stage that includes analysis and judgment of the technology by specialists.

Expert analysis (judges), as the name suggests, involves presenting the technology (e.g., a game) to experienced individuals who will judge whether the content addressed is scientifically correct and whether it is suitable for the intended target population—content validity. Judges can also evaluate the clarity and conciseness of the information presented, and the appropriateness of the language used for the target audience, among other factors. Evaluation by judges has been employed for the validation of different types of technology, such as manuals (Costa et al., 2013) and checklists (Cavalcante; Jorge, 2022), among others. Using this type of procedure brings academic knowledge and behavioral science closer to the community, allowing this knowledge to have social relevance. Through the collaboration of judges (Natural Science and/or Biology teachers), this study aimed to evaluate whether the content addressed



by the game *Caça ao Tesouro: Educação Sexual* (Mazza; Souza, 2020) is correct from the perspective of scientific literature, whether teachers would use the game in a school context, and whether the language employed is clear, concise, and appropriate for the target population. This evaluation aims to refine the game so that, if appropriate, it may be used in schools to assist in teaching sexuality themes.

Method

The evaluation of the game was conducted by Natural Science and/or Biology teachers (judges), as they are the professionals most familiar with the sexual education content present in the curricula of both private and public elementary and secondary schools. The teachers declared their agreement to participate in the research by signing the Informed Consent Form. The research project was reviewed and approved by the Research Ethics Committee (Opinion Number: 5.219.219).

Participants

Initially, 10 Natural Science and/or Biology teachers were invited to participate via social media, but only 8 expressed interest. Of the 8 who showed interest, only 3 teachers completed all stages of the evaluation. All teachers signed the Informed Consent Form, sent via Google Forms, possessed access to a computer and the internet, and currently teach or have previously taught sexual education content in schools.

Instruments and Materials

The Game

Caça ao Tesouro: Educação Sexual (Mazza; Souza, 2020) is a 2.5D adventure game with environmental elements that provide depth through a top-down view (aerial perspective) and real-life simulation elements. The game's narrative revolves around a treasure hunt organized by the main character's school. The



game features a total of six main missions and two alternative missions—i.e., groups of in-game tasks that must be completed to progress, obtain tokens, and access new areas of the map. Each mission contains tasks to be performed for the player to advance. The game was divided into six sections to enable testing of each part of the user experience. These sections contain groupings of game missions with their respective teaching objectives. The descriptions of the contents of these sections are provided in Chart 1.

Chart 1 – The six sections of the game, tasks required to progress (missions), and their respective instructional objectives.

Game Sections and Themes	Game Missions	Instructional Objective(s)
Tutorial and Section 1 (Puberty)	<p>Tutorial Mission: Move the character across the game map, interact with events, objects, and other characters, and obtain information about the location of the next task.</p> <p>Mission 1: Find the mission location (University Room 2), interact with NPCs (Non-Playable Characters), read their instructions, and answer the presented questions. After completion, interact with characters to obtain information about the next section.</p>	Describe the action of hormones on body changes during adolescence; describe the female puberty process; identify secondary female characteristics that appear during puberty (e.g., breast growth, acne, changes in body odor, hair growth in the armpits and pubic area, first menstruation, widening of the hips); describe the male puberty process; identify secondary male characteristics that appear during puberty (e.g., increased height and muscle mass gain, changes in body odor, hair growth in the armpits and around the penis, deepening of the voice, acne).
Section 2 (Internal and External Female Sexual/Reproductive Organs)	Find the mission location (University Room 3), interact with NPCs, read their instructions, and answer the presented questions. After completion, interact with characters to obtain information about the next mission.	Identify internal and external female genitalia; describe the menstrual cycle; identify the duration (in days) of the cycle; identify how ovulation occurs; describe premenstrual syndrome (PMS); describe how menstruation occurs; name female gametes.
Section 3 (Internal and External Male Sexual/Reproductive Organs)	Find the mission location (University Room 1), interact with NPCs, read their instructions, and answer the presented questions. After completion, interact with characters to obtain information about the next mission.	Describe the functions of male body parts, especially sexual organs; identify internal and external male genitalia; name male gametes; describe the production of sperm and semen.



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<p>Section 4 (Conception, Sexual Intercourse, and Shopping Mission)</p>	<p>Find the mission location (Rural Area in the north of the city map), interact with NPCs, follow the narrative, assist NPCs by carrying items and caring for a female pony in labor, and read the provided instructions. After the dialogue, interact with characters to find the next location (Health Clinic). Find an NPC blocking the path and fulfill the request: purchase items for the maternity ward and deliver them to the blocked site. Once the NPC leaves, enter the unlocked area.</p>	<p>Describe how pregnancy occurs; identify and report the necessity of sexual intercourse for pregnancy; describe sexual intercourse; describe fertilization. Identify the financial consequences and responsibilities involved in a pregnancy.</p>
<p>Section 5 (STIs and Unplanned Pregnancy Prevention; AIDS, Myths, and Treatments; Contraceptive Use)</p>	<p>Interact with NPCs in a discussion group about STIs at the Health Clinic, read instructions, and answer the questions. Obtain information about the next location (Examination Room). In the examination room, interact with the NPC and complete a mini-game on contraceptives. Obtain information about the next area (Southern Region).</p>	<p>Describe how common STIs are contracted (HIV, HPV, Herpes, Syphilis, Gonorrhea, Hepatitis); modes of transmission; identify symptoms and consequences of each STI; treatments for each STI. Describe which STIs have vaccines and the consequences of using them (HPV and Hepatitis B). Describe how to prevent early (unplanned) pregnancy; identify different types of contraceptive methods (female condom, male condom, oral contraceptives); explain how each method works; describe how to use each method.</p>

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<p>Section 6 (Protection against Coercive or Exploitative/ Abusive Sexual Relationships)</p>	<p>Explore the map region, interact with characters, and follow the narrative.</p>	<p>Recognize mutual consent as necessary for pleasure in a relationship; describe the meaning of the term “consent”; understand the consequences for oneself and others in a non-consensual relationship.</p> <p>Identify and express feelings and desires while respecting those of others; identify through the other’s speech if there is consent before initiating sexual relations; identify individuals to ask for help when identifying an abusive relationship or violence.</p> <p>Identify and describe the characteristics of a coercive or exploitative relationship (presence of physical, moral, sexual, financial, and psychological violence; prevention of expressing feelings, etc.); identify and describe types of violence.</p>
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Source: The authors.

The visual structure of the game is composed of five maps that refer to the cardinal points of a city: City Center, North, South, East, and West. Within each region, there are smaller environments: the City Center contains school, hospital, and residential complex environments; the North region features a farm environment; the West region includes a fair with different types of restaurants, food stalls, and the city market; the South region features a mansion, and the East region contains a university with various departments. To move between the different regions, the player must reach the edges of each area (signage is provided in all scenarios for this purpose), and a screen with an amplified map view will appear (Image 1), allowing the player to choose the desired region. Within each environment, other screens can be accessed regarding the interior rooms of each location, where NPCs provide the game missions to be completed.



Image 1 - Example of game screens: enlarged map view for locomotion between scenarios (A), player dialogue with an NPC (B)



Source: Caça ao Tesouro: Educação Sexual (Mazza; Souza, 2020)

Game Plot

The game begins with the player entering a name for the playable character (avatar) and selecting its appearance from pre-defined options. Following this selection, the main character is transported to their bedroom, as if waking from a dream. From this initial tutorial, the plot refers to a treasure hunt organized by the main character's school. By interacting with Non-Playable Characters (NPCs), the player receives cues to go to the school and begin the hunt.

The player is free to interact with any available character on the screen at any time. Generally, there are four categories of NPCs: those who provide information about game missions, those who indicate mission locations, those who serve as environmental storytelling elements (interactive parts of the scenario), and those who provide plot-related information. Among these interactions are those with the main character's best friend. This friend informs the protagonist that she has started dating a handsome but jealous young man. Throughout the game, this character discusses the relationship and its progression, which in fact depicts an abusive and controlling relationship.

After receiving the first mission, NPCs provide tips regarding the locations to be explored; for example, in the first mission, the player must interact with teachers at the school. They indicate that the player needs to travel to the west



side of the city. Upon arriving at the western sector, where the local university is located, NPCs provide instructions, show illustrations, and ask questions about puberty, human development characteristics, and male and female anatomy. It is also possible to interact with an optional part of the scenario where the main character must wash dolls, receiving instructions on how to perform proper intimate hygiene. The completion of activities in Sections 1, 2, and 3 (described in Chart 1) is followed by the awarding of one medal each. Acquiring three medals grants access to a new part of the city, the North region.

The northernmost part of the city consists of a rural setting where the player can interact with items and characters characteristic of this area, such as ponies, sheep, chickens, fruit trees, a cowgirl, and an elderly woman. The woman asks the player to assist in the birth of one of her ponies; after the birth, a new foal appears in the scenario. The woman then explains how foals are conceived on the farm and draws a parallel with human conception. As a token of gratitude for the help and attention, the player receives another medal, which clears the path to enter the health clinic located in the city center, just below the school.

Upon arriving at the health clinic, one of the internal doors is blocked by another character who asks the player to use recently received funds (R\$ 300.00) to fetch the following items from the market (East region): disposable diapers, a pacifier, a baby bottle, and wet wipes, among others. Upon returning with the items, the NPC delivers the following message: “Thank you very much! Did you know that these items you bought represent only a small fraction of what a newborn needs for just one month?”. Following this message, the player passes through a door into a hallway. Moving through the hallway and interacting with a nurse, the player is exposed to a minigame.

Image 2 presents the minigame screens. The minigame features a passage with stone paths and stairs that the avatar must traverse without falling into lava or touching the bats roaming the cave setting. If the avatar fails, it is transported back to the start of the minigame. In this section, the



player collects round items representing oral contraceptive pills from a blister pack. As the player collects the “pills,” messages explaining the correct way to take the medication are displayed on the screen. The player wins the minigame when the avatar reaches the end of the crossing with all pills collected.

Image 2 – Example of the initial screens of the minigame for teaching oral contraceptive use.



Source: Caça ao Tesouro: Educação Sexual (Mazza; Souza, 2020)

At the health clinic, there is a room where a discussion group about STIs (Sexually Transmitted Infections) is held. In this room, information is provided regarding STIs: modes of transmission, symptoms, identification, treatments, and prevention of the main infections (HPV, herpes, syphilis, HIV, gonorrhea, and chlamydia). Subsequently, questions on this topic are presented; if the player answers correctly, they receive another medal.

Upon completing this part of the game, the main character’s best friend asks for help to escape an abusive situation she is experiencing. She requests the player to go to her house to support her while she tells her parents what she is going through. In the scene with the friend’s parents, they behave very compassionately, explaining how to recognize and protect oneself from this



type of relationship. They ask the main character to accompany the friend to a psychologist. In the scene with the psychologist, further information is provided on what characterizes violent and abusive relationships, according to the Maria da Penha Law (Brasil, 2006).

After this passage, the player is instructed by the psychologist to return to the school and complete the final quiz to win the hunt. At the school, other NPCs are present alongside the player's avatar. The game awards a gold trophy to players who answer 90% of the questions correctly, a silver trophy for those who answer between 70% and 89% correctly, and a bronze trophy if the percentage of correct answers is below 70%.

Game Evaluation Form

The Google Forms platform was used to distribute the evaluation forms to the teachers. A total of six forms were sent, each containing seven “yes” or “no” questions, totaling 42 questions. The structure of the questions was similar across all forms, differing only in the specific game section being analyzed and its respective instructional objectives. The following aspects were evaluated through the form: clarity, conciseness, and sufficiency of information; compatibility of the content addressed by the game with school curricula; accuracy; suitability for the target audience; and applicability. If a teacher responded “no,” they were requested to provide a justification at the end of each form. The questions and the content evaluation categories are presented in Chart 2. Teachers were required to complete one form for each section of the game.



Chart 2 – Questions presented to teachers to evaluate each game section

Q1. Clarity	Is the language used in this section of the game clear and understandable (avoiding broad/undefined terms or ambiguous expressions)?
Q2. Conciseness	Is the language used in the text concise (without excessive information)?
Q3. Sufficiency of Information	Does this section present sufficient information to achieve the proposed instructional objectives? ⁵
Q4. Compatibility	Is the content compatible with the material presented in schools for children and adolescents aged 9 to 13? (Content compatibility)
Q5. Accuracy	Is the information presented regarding the theme “XXXX” correct from the perspective of scientific literature? (Scientific accuracy)
Q6. Target Audience Suitability	Is the terminology used to address the theme appropriate for the target population (children and adolescents aged 9 to 13)?
Q7. Applicability	Based solely on this section of the game, would you use it as a pedagogical tool within the Natural Sciences curriculum for teaching issues related to knowledge of XXXX?
Essay Question	If you answered “no” to any of the questions, please indicate the question number(s) below and describe what improvements could be implemented.

Source: The authors.

Setting

Data collection was conducted remotely. Each participant used their personal computer to access the game and complete the online forms.

Procedure

Initially, an email containing the game link and instructions on how to complete the forms was sent to the teachers. The text file attached to the email contained the following instructions:

“Hello, thank you very much for your participation. This file contains the steps to be followed to play the game and complete the questionnaires:

- 1 Access the Informed Consent Form at the following link and complete it: [link];
2. Use a computer to download and play the game;
3. Download the game via the link: [link];
4. Extract the game folder, open the ‘SexEducationGame’



folder, locate the 'game' application, and click it to start the game; 5. Play until the message 'Please save the game and complete Questionnaire 1 from the email sent by the researcher' appears. When this message appears, open the game menu ('Esc' key) and save your progress; 6. After saving the game, proceed to the first questionnaire. After completing the corresponding questionnaire, return to the game and continue from where you left off; 7. The links for the questionnaires are as follows: Questionnaire 1: [link], Questionnaire 2: [link], Questionnaire 3: [link], Questionnaire 4: [link], Questionnaire 5: [link], and Questionnaire 6: [link]."

The teachers were free to choose when to play and for how long. After finishing the first part of the game (e.g., Section 1), a message appeared on the screen asking the teacher to access Questionnaire 1, which was also sent via email by the researcher. After completing the questionnaire, the teacher was requested to return to the game from the point where they had stopped (e.g., Section 2), and so on. The three teachers also completed a questionnaire to collect information such as age, educational background, the age group of the students they teach (or have taught), and the type of educational institution where they work or have worked.

Data Analysis

The categories for content analysis were those related to the evaluated items (Clarity, Conciseness, Sufficiency of Information, Compatibility, Accuracy, Target Audience Suitability, and Applicability). To analyze the judges' approval, the percentage of approvals was calculated (Alexandre; Coluci, 2011) for each evaluated item across every section of the game. The suggestions for modifications provided by the teachers were analyzed qualitatively, aiming to understand the context in which the comments were made.

Results

The questionnaires yielded three main types of information: participant characteristics (Chart 3), evaluation of the game sections according to



the analysis categories (Chart 1), and participant suggestions for game improvements (Charts 4 and 5).

Chart 3 - Participant Data

	Gender	Age	Education/Background	Educational Institution (Current or Past)	Age group experience
P1	Female	27	Biologist, Master in Entomology	Public School	11 to 14 years old
P2	Male	40	Biologist, Master in Botany	Private School	14 to 17 years old
P3	Female	46	Biologist and Pedagogue, Master in Science Education	Public and Private School	15 to 17 years old

Source: The authors.

Table 1 presents the average percentage of “YES” responses for each of the items evaluated in each section of the game, as well as the overall average percentage for each analysis category (last column on the right) and evaluated Section (last row of the table).

Table 1 – Average percentage of “YES” responses for each of the analysis categories evaluated in each game section.

	Section 1	Section 2	Section 3	Section 4	Section 5	Section 6	Average % per A.C..
Q1. Clarity	100%	67%	100%	100%	100%	100%	94%
Q2. Conciseness	100%	100%	100%	67%	100%	100%	94%
Q3. Sufficiency of information	67%	100%	67%	67%	100%	67%	78%
Q4. Compatibility	100%	67%	67%	67%	100%	67%	78%
Q5. Accuracy	100%	67%	67%	67%	100%	100%	83%
Q6. Target Audience Suitability	100%	67%	100%	100%	100%	100%	94%
Q7. Applicability	100%	100%	100%	100%	100%	100%	100%
Average % per S.	95%	81%	86%	81%	100%	90%	

Source: The authors. Note: Section 1 - Puberty; Section 2 - Female internal and external sexual and reproductive organs; Section 3 - Male body, reproductive and sexual organs; Section 4 - Pregnancy, sexual intercourse, and baby-related purchases; Section 5 - Puberty, STIs, prevention methods, contraceptive use, AIDS, myths, and treatments; Section 6 - Protection against abusive relationships. A.C. = Analysis Category. S. = Section.



Although the average percentage of “YES” responses for each question regarding the game sections was high, Sections 2, 3, and 4 obtained the lowest average percentages for this type of response (81% for Sections 2 and 4, and 86% for Section 3 – see the last row of the table). Furthermore, the average percentage of the analysis categories demonstrates that, according to the teachers: the game possesses Applicability in the classroom (100%), is clear regarding the information provided (94%), and presents textual conciseness and suitability of terminology for the intended target audience (94% of “yes” responses for each category – see the last column on the right). Regarding the analysis categories for which negative responses were recorded, participants provided suggestions for game improvements, which are presented in Charts 4 and 5.

Chart 4 – Participants’ comments regarding Sections 1, 2, and 3 of the game.

	Section 1 – Puberty	Section 2 – Internal and External Female Sexual/Reproductive Organs	Section 3 – Internal and External Male Sexual/Reproductive Organs
P1		Compatibility: “The issue of female masturbation—I think it is interesting to talk about the subject, but not in such a descriptive way. I find it interesting to teach that girls should know and have autonomy over their own bodies and to emphasize what the clitoris is and its function, but not to teach how to use it. I think it deviates a bit from the focus and ends up looking like ‘teaching how to have sex.’”	Sufficiency of information: “I missed a general image like the one presented for female gametes and the identification of organs such as the prostate, for example. Also, the definition of terms like ejaculation.” Compatibility: “The same problem of excessive detail when speaking about masturbation.”
P2	Sufficiency of information: “Up to this point, I have not noticed anything related to hormonal changes and external sexual characteristics.”		

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<p>P3</p>		<p>Clarity: “There is confusion between the terms oocyte and ovum [egg], which are sometimes used as synonyms in the game. The ovum only forms after meiosis II, which only occurs if fertilization happens. So, defining the ovum as the oocyte that is in the uterine tube is not a good option. I would suggest using the term gamete or oocyte throughout.”</p> <p>Accuracy: “If I am not mistaken, the most current nomenclature is uterine tube (<i>tuba uterina</i>) and not Fallopian tube (<i>trompa</i>).”</p> <p>Target Audience Suitability: “As much as the game has excellent intentions, I felt that in the pregnancy section, there is an unnecessary judgment: ‘One should only become pregnant when there is emotional and financial maturity.’ This is the ideal plan, but not what actually happens in most Brazilian schools. Let us consider pregnancies resulting from rape—how would that be? How would those students feel reading what is written? Even those who became pregnant through consensual sex: I believe there is a statement there that could lead classmates to unnecessary and unwelcome judgment.”</p>	<p>Accuracy: “I found the information that the testicles are outside the man’s body strange. They are outside the abdominal cavity, but they are part of the male body. I think the phrasing could be revised to avoid imprecision. One question: couldn’t the term ‘hard’ applied to the penis be placed in quotation marks? Because scientific expressions are used in the game, and ‘hard’ seems like colloquial language to me.”</p>
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Source: The authors.



Chart 5 – Participants’ comments regarding Sections 4 and 6 of the game.

	Section 4 – Conception, Sexual Intercourse, and Shopping Mission	Section 6 – Protection against Coercive or Exploitative (Abusive) Sexual Relationships
P1	Compatibility: “I believe it again errs in being too detailed, for example, when discussing the back-and-forth movements.”	
P2		Compatibility: “The content presented, unfortunately, does not partially align with the BNCC [National Common Curricular Base] or with school dynamics (school management team).”
P3	<p>Sufficiency of information: “In the conversation with the ‘grandmother,’ whose theme is the birth of the foal, I saw nothing associated with ‘Describing possible consequences of an unplanned pregnancy.’ This means the game did not correctly guide me to reach this phase before asking me to complete the questionnaire. Thus, I was unable to evaluate this section.”</p> <p>Accuracy: “Regarding the section on hygiene: is the anus part of the genitalia? Because the guidelines mention bowel movements and cleaning the anal region, but the reference used is genitalia... To me, this sounds incorrect.”</p>	<p>Sufficiency of information: “I was directed to answer this questionnaire after a visit where I learn about sexual rights. Reading the questions, I realize I should have visited another part of the game, but I did not find it. If it was only that part about rights, I do not see the described objectives fulfilled. Note: I missed a citation regarding the source of the cited rights. Are they from the Constitution, from the UN?”</p> <p>General Comments: “Throughout the game, I noticed some typing and agreement errors. I suggest it undergoes grammatical correction by a specialist. I found it quite confusing to reach the end of this block. Information was difficult to find; I almost gave up inside the market. I also saw a confusion between left and right in the instruction given by the doctor to access a room within the hospital corridor.”</p>

Source: The authors.

Overall, P3 was the participant who provided the most suggestions. P3’s comments highlight the need for corrections related to game programming errors, typing errors, and the updating of terminology. The other participants also made comments, with P1 expressing concern regarding descriptions that more directly involved sex and masturbation, suggesting modifications in this regard. P2 commented that some contents addressed by the game are not part of the BNCC or the school reality, which may interfere with the use of the game in this context.



Discussion

This study aimed to evaluate the content addressed by the game *Caça ao Tesouro: Educação Sexual* (Mazza; Souza, 2020) from the perspective of scientific literature and the language employed (clarity, conciseness, and suitability for the target audience). Furthermore, it investigated, with the judges (Natural Science/Biology teachers), whether the game presents sufficient information to achieve the proposed instructional objectives and whether the content is compatible with that presented in schools for children and adolescents aged 9 to 13. Finally, the judges were asked if they would use the game as a pedagogical tool for teaching knowledge about sexuality. Adapting the game to the reality described by teachers in the classroom increases the likelihood of the pedagogical tool being useful and applicable to that context.

Regarding the language used in the game, according to the judges, it is clear, concise, and suitable for the target audience. Clear instructions are crucial when aiming to establish conditions for behavior learning. A clear text places the learner under the control of the same variables as the instructor (Botomé, 1997). The clearer the language, the lower the number of errors and confusions when contacting teaching contingencies. This makes behavioral change more likely and minimizes potential aversive stimuli that such confusion might cause. Regarding conciseness, the more concise a text is, the lower the response cost for emitting the behaviors described therein, which also increases the probability of the player/learner behaving according to the game's instructions (Ortolan et al., 2018). Finally, it is emphasized that the more suitable a game is for the target audience, the higher the probability that the teaching tool will be attractive, as such suitability considers the learner's initial repertoire, increasing the probability of their behavior being reinforced more frequently.

Despite the judges' positive evaluation of the game's language and suitability for the target audience, they indicated the need for grammatical corrections, terminology updates, and software programming fixes. The



creation of educational games involves planning steps aimed at optimizing the tool with each new version. Zimmerman (2003) proposes a cyclic model of iterative digital game design based on user behavior, consisting of the following stages: (a) design, which includes development and decision-making actions such as mechanics, plot, aesthetics, and, in the case of educational games, the definition of instructional objectives; (b) testing, consisting of playtest sessions with target audience members and qualified judges; and (c) analysis of the data obtained from testing, which indicates the corrections to be made and future decisions.

The more times the game undergoes this cycle, the more optimized and suitable for the target audience it becomes (Zimmerman, 2003). More recent models, such as that of Viudes-Carbonell et al. (2021), reinforce this approach of short design-test-evaluation-redesign cycles for serious games. Other contemporary studies extend these notions to gamified virtual learning environments (Vera-Mora et al., 2024).

Revisions to the game will be conducted according to the judges' suggestions. Adjustments to be made include: (a) reviewing terms such as ovum, oocyte, and uterine tube, considering the most recent literature on the subject; (b) revising the game's programming to make the information more precise; and (c) reviewing the section discussing unplanned pregnancy in pre-adolescence and adolescence. According to one of the judges, the wording suggests that only adults with emotional and financial maturity should become pregnant, even though unplanned pregnancy in pre-adolescence and adolescence, with or without consent, is a reality in the classroom. Regarding this last item, the text will be revised so that the instructions avoid any accusatory connotation that could blame the pre-adolescent or adolescent who has become pregnant. However, it is understood that this population requires repertoires that allow them to make more conscious decisions. Consequently, the items referring to the possible consequences of an unplanned pregnancy were maintained.



Regarding the game's suitability for the target audience, one participant questioned what she perceived as an excess of information on topics such as masturbation and sexual intercourse. According to this participant, the excessive detail could embarrass the teacher, as this topic is not addressed in schools with the level of detail presented in the game. Topics such as masturbation can be understood as an important part of the development and self-knowledge of children and adolescents (Figueiró, 2020).

For Figueiró (2020), human sexuality themes, such as masturbation, should be treated positively and naturally, highlighting the importance of privacy and consent to avoid the establishment of dysfunctional relationships with the subject, such as feelings of shame and guilt. However, a common complaint among teachers is that most teaching materials do not describe the behaviors educators should exhibit during instruction for this to occur naturally and positively (Figueiró, 2020). Tools such as games, based on specific Sexual Education literature, can provide models or serve as starting points for classroom discussions. Digital games like the one presented in this article provide a private virtual environment so that the learner can engage with the themes without embarrassment. According to Sartori (2022), the school context may not be as welcoming for certain topics, given that in recent years conservatism has taken root in various institutions, with schools being one of its primary focuses. This context must be considered for the reformulation of these descriptions in the next update of the teaching tool.

Furthermore, regarding the suitability of the themes for the target audience, one participant pointed out that the content in Section 6—concerning relationship violence, consent, and protection against sexual abuse—was not compatible with the BNCC. For the development of the game's content regarding this issue, it was decided to adopt the PCNs (Brasil, 1997) instead of the BNCC (Brasil, 2018). It is understood that the protection of life and health are fundamental rights of children and adolescents (ECA, Law No. 8,069, July 13, 1990) and that these rights supersede the BNCC. It is vital that this audience



be informed about their rights, how to protect themselves, and how to request help if they are suffering or at risk of suffering any type of violence. This type of information has been shown to assist in prevention and in help-seeking should violence occur (Pereira; Pena; Guimarães, 2024; Silva et al., 2023).

Design flaws, such as the lack of signage indicating where to obtain certain information and the lack of an initial indication of all themes covered, also led judges to raise questions regarding the sufficiency of information. Providing sufficient information without compromising conciseness is fundamental for effective teaching and learner engagement. It is expected that the forthcoming adjustments will improve the sufficiency of information.

All issues related to these flaws are being reviewed for the next version of the game. These data demonstrate the importance of the educational game testing process. The steps included in the testing and evaluation phases are fundamental to determining how reinforcing the game can be for the target audience, whether the chosen mechanics and aesthetics function and make sense for this population, and if the game is effective—that is, if it teaches what it proposes (Gris; de Souza, 2016).

Despite the observed conservative school context (Oliveira; Nóbrega, 2025; Sartori, 2022; Silva et al. 2023) and participants' criticisms regarding sensitive topics like masturbation and teenage pregnancy, all research participants evaluated the current version of the game as applicable in the school context as a pedagogical tool. This demonstrates a demand for this type of teaching tool. A fundamental aspect to consider when discussing the development of teaching tools is the relevance of the technology to the target context. According to Botomé (1981), teaching behaviors will only be effective if it is also pertinent to those individuals. A game developed for the school context benefits from having its applicability evaluated by teachers, who are the potential intermediaries of this technology with the target audience and are also capable of assessing its pertinence. Overall, it was found that, according to the participants' evaluation, the game is interesting for the school context



and possesses aspects (i.e., design and terminology) to be refined. Following these corrections, a new testing cycle should be conducted with more teachers, parents, and legal guardians.

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Notes

- ¹ Translation performed with the assistance of AI-GEMINI
- ² In the PCNs, Sexual Education is referred to as Sexual Orientation (Brasil, 1997); however, today the term has another connotation, referring to affective or sexual attraction—heterosexuality, homosexuality, bisexuality, etc. (Rizza, 2013). To avoid confusion, for the present study, it was understood that “Sexual Education” would be a more appropriate term.
- ³ In each questionnaire, this question included a description of the instructional objectives specific to that game section. The game sections and their respective instructional objectives are presented in Chart 1.



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