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DESENVOLVIMENTO E VALIDAÇÃO DO SERIOUS GAME "BEBÊXP": FERRAMENTA DE EDUCAÇÃO ALIMENTAR E NUTRICIONAL PARA A INFÂNCIA

DEVELOPMENT AND VALIDATION OF THE SERIOUS GAME "BEBÊXP": A FOOD AND NUTRITIONAL EDUCATION TOOL FOR CHILDREN

DESARROLLO Y VALIDACIÓN DEL JUEGO SERIO "BEBÊXP": UNA HERRAMIENTA DE EDUCACIÓN ALIMENTARIA Y NUTRICIONAL PARA NIÑOS

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RESUMO

Introdução: Os Jogos podem ser uma ótima estratégia como educação alimentar e nutricional para pais de crianças menores de dois anos, já que conseguem transmitir conhecimento de forma envolvente e são aplicáveis em diferentes contextos.
Objetivo: Descrever a produção do jogo "BebêXP" e a sua validação com profissionais expertises em materno-infantil para que esse possa ser utilizado na prática clínica de profissionais da área da saúde como uma ferramenta de educação alimentar e nutricional.
Métodos: Trata-se de um estudo descritivo metodológico sobre a construção e validação de um serious game desenvolvido no período de maio de 2023 a março de 2024 e validado de março a junho de 2024. Para o desenvolvimento, foi necessária uma equipe multidisciplinar e utilizou-se uma metodologia dividida em quatro etapas cíclicas: pré-produção, produção, testes e pós-produção. A validação ocorreu com 33 profissionais da área de saúde através de um questionário do Google Forms respondido após finalizarem o jogo "BebêXP". A amostragem foi por conveniência e considerou-se aceitável uma concordância mínima de 0,78 para o IVC.
Resultados: O jogo foi validado com 84% de concordância, correspondendo a 0,84 IVC, e está disponível nas plataformas Web e Mobile.
Conclusão: O jogo BebêXP pode contribuir com a prática clínica de profissionais da área da saúde que trabalham na área de materno-infantil.

Palavras-chave: saúde materno-infantil; nutrição da criança; comportamento alimentar; tecnologia digital; jogos educativos

ABSTRACT

Introduction: The Games can be a great strategy to utilize as food and nutritional education for parents of children under two years of age, since they are capable of transmitting knowledge in an engaging and applicable way, and in different contexts.
Objective: Describe the production of the “BebêXP” game and its validation with professionals specialized in maternal and childcare, so that it could be used in the clinical practice of professionals in the health sector as a food and nutritional education tool.
Methods: This is a descriptive methodological study on the construction and validation of a serious game developed from May 2023 to March 2024 and validated from March to June 2024. The development process required a multidisciplinary team and a methodology divided into four cyclical stages: pre-production, production, testing, and post-production. Validation occurred with 33 health sector professionals through a Google Forms questionnaire, who submitted their answers after completing the “BebêXP” game. Sampling was done for convenience, considering a minimum agreement of 0.78 for CVI.
Results: The game was validated with 84% agreement, corresponding to an IVC of 0.84, and is available on web and mobile platforms.
Conclusion: It was concluded that the game “BebêXP” can contribute to clinical practices of healthcare professionals who work in maternal and childcare.

Keywords: maternal and child health; child nutrition; feeding behavior; digital health; play and playthings

RESUMEN

Introducción: El juego puede ser una gran estrategia para utilizar como herramienta de educación alimentaria y nutricional para padres de niños menores de dos años, ya que es capaz de transmitir conocimientos de forma atractiva y aplicable y en diferentes contextos.
Objetivo: Describir la producción del juego “BebêXP” y su validación con profesionales especializados en atención materno-infantil para que pueda ser utilizado en la práctica clínica de profesionales del sector de la salud como herramienta de educación alimentaria y nutricional.
Métodos: Se trata de un estudio metodológico descriptivo sobre la construcción y validación de un serious game desarrollado de mayo de 2023 a marzo de 2024 y validado de marzo a junio de 2024. Para su desarrollo, se requirió un equipo multidisciplinario y una metodología dividida en cuatro etapas cíclicas: preproducción, producción, prueba y posproducción. La validación se realizó con 33 profesionales del sector de la salud a través de un cuestionario de Google Forms, que enviaron sus respuestas después de completar el juego “BebêXP”. El muestreo se realizó por conveniencia y considerando una concordancia mínima de 0,78 para IVC.
Resultados: El juego fue validado con un 84 % de concordancia, lo que corresponde a un IVC de 0,84, y está disponible en plataformas web y móviles.
Conclusión: Se concluyó que el juego “BebêXP” puede contribuir a las prácticas clínicas de los profesionales de la salud que actúan en el área materno-infantil.

Palabras clave: salud materno-infantil; nutrición del niño; conducta alimentaria; salud digital; juego e implementos de juego

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INTRODUCTION

Adequate food introduction, starting at six months of age for a full-term child, is crucial for healthy development. Natural and varied foods should be offered, avoiding salt, sugar, and ultra-processed foods, while ensuring age-appropriate consistency (Brasil, 2019). This approach can promote positive eating behaviors, creating a conducive environment for children to develop autonomy when eating and establish healthy eating habits throughout life (Lutter, Grummer-Strawn, Rogers, 2021). Instructing parents is essential, as they often demonstrate limited knowledge about food introduction, which may lead to inappropriate feeding practices and consequently pose risks to the child's health in the short and long term (Murari et al., 2021; Carreiro et al., 2018).

Food and Nutrition Education (FNE) is essential in the context of complementary feeding, contributing to appropriate growth and the development of healthy habits from early childhood. In this context, gamification strategies have been increasingly used in health education due to their potential to enhance engagement, motivation, and knowledge retention (Jagarapu et al., 2025; Buenadicha-Mateos et al., 2025). Unlike traditional educational approaches, which often rely on the passive transmission of information, serious games and similar strategies provide an interactive environment in which users can simulate real-life decisions without real-world risks (Ponte et al., 2024). This approach allows complex nutritional guidelines to be translated into experiential learning processes, fostering autonomy, engagement, and practical applicability through immediate feedback and narrative immersion (Meyer et al., 2026).

Games represent an alternative tool for instructing parents, as they promote knowledge, engagement, and immersion, while enabling learning through decision-making and its consequences, fostering autonomy and competence (Taylor et al., 2021; Gkintoni et al., 2024). By incorporating gamified strategies into the design of serious games (SG), it is possible to convey information in an engaging manner, avoiding monotony and enhancing the learning experience (Souza & Freitas, 2017; Baranowski et al., 2019; Nascimento et al., 2021).

Digital media are part of everyday life and can influence individuals' sociocultural contexts, thereby shaping behaviors (Evans et al., 2022; Romeo et al., 2019). Leveraging these media as educational tools can promote positive behavioral changes through exposure to new information and reinforcement strategies (Baranowski et al., 2019; Evans et al., 2022; Schoeppe et al., 2016).

Given the potential of serious games as educational tools, they have gained relevance in the health field as strategies to support prevention and health promotion. In the context of food introduction, such tools can complement the knowledge of parents and families regarding feeding practices and behavioral choices for their children. The development of the serious game is aligned with the Agenda 2030 (Shulla & Leal-Filho, 2024), as it focuses on child health and well-being, as well as quality education for parents and caregivers. The game was designed to support health professionals in guiding parents or caregivers of children under two years of age, focusing on complementary feeding and early eating behavior. Therefore, the objective of this study was to describe the development of the "BebêXP" game and its validation by professionals with expertise in maternal and child health, aiming to support its use in clinical practice as a food and nutrition education tool.

1. METHODS

It is a descriptive methodological study focused on the development and expert-based validation of a serious game, conducted from May 2023 to March 2024, with validation procedures carried out between March and June 2024. The validation process was multidimensional, including the assessment of content, appearance, usability, acceptability, and technical aspects. The research was approved by the Research Ethics Committee of Universidade Franciscana (UFN) in October 2023, under report number 6,421,468.

The validation process included the assessment of content adequacy, clarity, and relevance, as well as usability and interface aspects, based on expert evaluation, without aiming to test the effectiveness of the intervention in the target population.

1.1 Game Development

A multiprofessional team was structured to set up the software "BebêXP, composed of two nutritionists, one of whom is the lead game designer, a programmer with experience in Unity and C#, and an artist with experience in game illustration. The product building required a cyclical and pyramid-shaped development methodology (Chandler, 2009) with four stages: planning, developing, and validation testing.

The game is expected to be used by health professionals in their clinics, with parents and/or guardians of children under two years of age as a food and nutritional education tool. That way, it is intended for them to play in the household environment and bring doubts and new knowledge to their next appointment.

Supporting the methodology (Chandler, 2009), during the pre-production stage, it was decided that the "BebêXP" software would be a 2D card game with Role-playing game (RPG) elements in which the player's choices decide the course of the game, having a strong inspiration from the game Reigns (2016). The brand was sent for registration at the National Institute of Industrial Property. Game Engine Unity was the chosen program to develop the project, while the game itself would be available to play through Itch.io, a platform that is able to comprise both Web and future Android-designed games (https://nicholas-doviggi.itch.io/bebexp).

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In the production stage, Google Drive cloud was used as a management tool to store concept documents, Game Design Document (GDD) and sound and art assets. Game version control was managed through the Sourcetree software, which stores them in the Bitbucket cloud (Figure 1). Team meetings were held via Discord, and important notices were sent with the use of Whatsapp app.

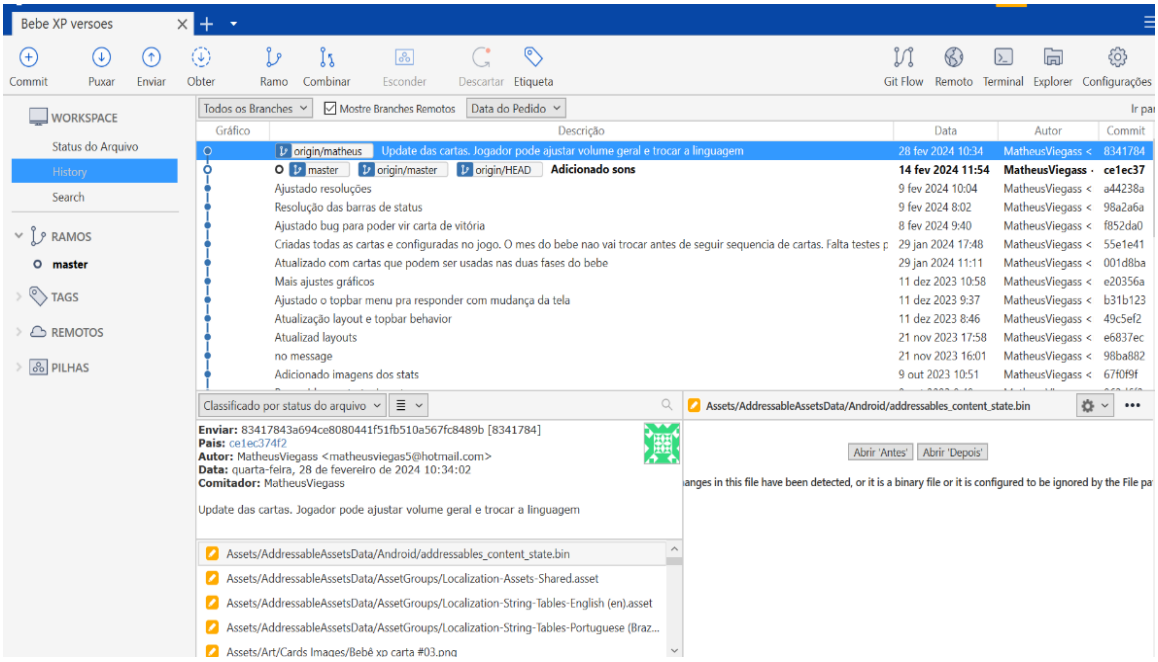

Figure 1 - Project display in Sourcetree

The game was designed to be accessible to non-players, allowing them to understand and engage with the mechanics without difficulty. Players resolve situations through cards presenting two possible choices, each leading to positive and/or negative outcomes reflected in three main statuses: health, family, and sociocultural education. The situations and consequences were developed based on clinical practice and a narrative review of the literature (Augello et al., 2016; González, 2018; Papalia, 2021). The game was intentionally designed to avoid strictly dichotomous right-or-wrong answers, encouraging a reflective approach in which players consider the potential trade-offs and contextual impacts of their decisions.

The game addresses key topics related to infant feeding, including complementary feeding practices, food choices, eating behavior, and parental decision-making in everyday situations. The content was based on the Dietary Guide for Children Under 2 Years Old (Brasil, 2019), supported by literature on child development and feeding behavior, and designed to simulate real-life decision-making in a playful and experiential manner. The entire development process was documented in a GDD, accessible to all team members.

Regarding the visual identity, the art was directed with the purpose of being easily perceived by the player, giving them the ability to correlate the items presented on the cards and in the interface with the proposed situation, in addition to being eye-catching for the target audience (Figure 2). The assets were designed in Procreate, and after the concepts were approved by the team, the final version of the design was created. Therefore, they were vectorized in Adobe Illustrator to be implemented within the game without pixel distortion. The game's theme is a combination of the alien concept and the contemporary world, with purple-skinned characters, creating a playful atmosphere. The cards were illustrated (Figure 3) according to the situation stated or the possible choices that the player could make, depicting the scenario in which the player should act.

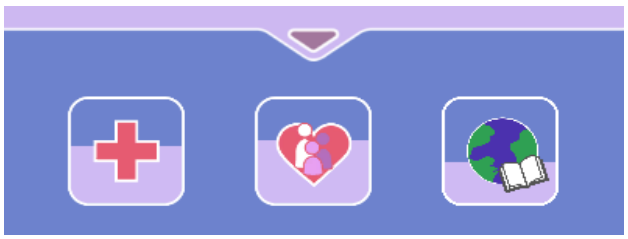

Figure 2 – Status Interface

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Figure 3 – Gameplay Cards

While developing the game's programming, techniques and functionalities provided by the C# programming language were used to create an immersive gaming experience. To implement the game's menus and interfaces, concepts of event control and User Interface (UI) manipulation were applied. In the construction of the game's objects and elements (Figure 4), data structures like lists were used to manage the cards. Furthermore, to organize the code in a modular and reusable way, object orientation was utilized, facilitating the maintenance and expansion of the project. The sounds were purchased in packs through the Humble Bundle website and are available for commercial use.

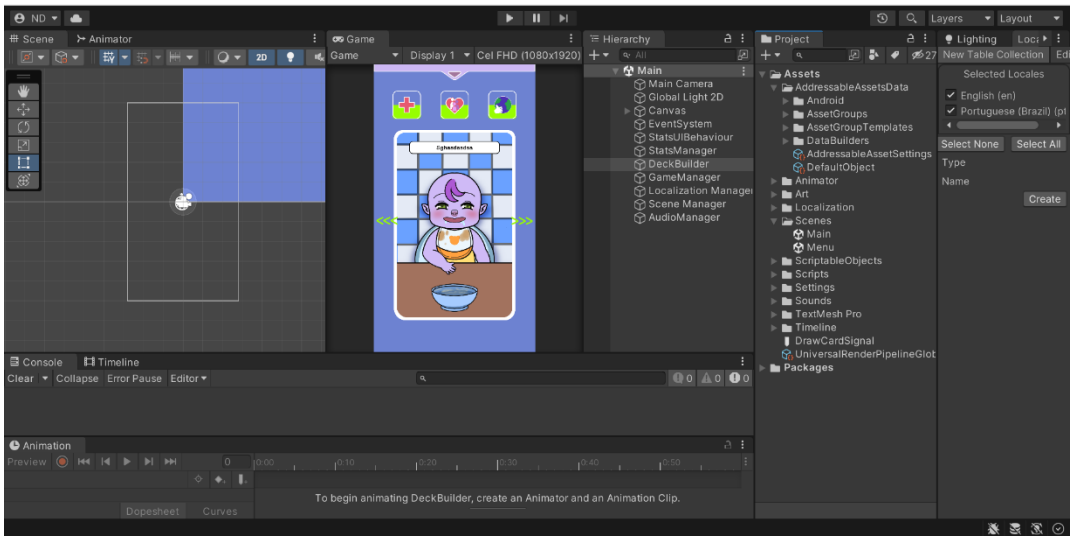

Figure 4 - Unity Programming

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2.2 Product Validation

Product validation was conducted online with professionals experienced in maternal and child health, using a remote and self-administered approach.. A questionnaire was administered via Google Forms after participants completed the "BebêXP" game, which lasts approximately ten to fifteen minutes. Participants were allowed to play freely, provided they completed the game and reached its end.

For instrument validation, a minimum of six experts is recommended (Damasio & Borsa, 2023). A convenience sampling strategy was adopted. Professionals were initially contacted via WhatsApp and subsequently received instructions, as well as access links to the game and questionnaire.

To participate, individuals were required to accept the Free and Informed Consent Form presented at the beginning of the questionnaire. Inclusion criteria comprised being a health professional (nutritionist, nurse, physician, speech therapist, psychologist, or physiotherapist) with experience in maternal and child health and infant feeding. Expertise was defined based on professional training and practical experience in the field, in line with the conceptual definition of expertise proposed by Jasper (1994) and commonly adopted in validation studies involving health technologies (Damásio & Borsa, 2023).

Exclusion criteria included professionals without experience in infant feeding and visually impaired professionals, as they would not be able to access and complete the game.

The validation process was conducted in two stages. In the first stage (April to May), eight nutritionists specialized in maternal and child nutrition participated. In the second stage (May to June), the same participants were invited for reevaluation, along with additional health professionals specialized in the area, totaling 33 participants, including nurses, nutritionists, speech therapists, psychologists, physiotherapists, and physicians.

No fixed deadline was established for questionnaire submission; however, participants received reminders every five days if no response had been recorded. The questionnaire was structured into two sections: the first collected demographic and professional data, including academic background and experience in maternal and child health, while the second focused on the evaluation of the game.

Questions regarding the validation of the game were prepared by the authors. The inquiries dealt with the art validation, to check its adequacy, the gameplay, to confirm if it was responsive and easy to understand, the interface, to verify the consistency of its elements, and finally, the content, to check whether the situations and consequences presented within the game are adequate with theoretical and practical reality (Chaves et al., 2017). An analysis was made using the Likert scale, with the response options "agree", "neutral", and "disagree", and, at the end of the questionnaire, a space for suggestions for improving the content or ideas that could be included in the game was also adopted (Curado et al., 2013).

All feedback, including divergent opinions, was systematically reviewed. Suggestions were incorporated when they contributed to improving clarity, usability, or content adequacy. Suggestions that implied substantial changes to the core pedagogical framework or game design were not incorporated, as they were outside the predefined scope of the proposed intervention, but were considered in the interpretative analysis.

2.3 Statistical analysis

Data were collected from Google Forms, exported to a Microsoft Excel spreadsheet, and analyzed using the Statistical Package for the Social Sciences (SPSS), version 23.0. The Content Validity Index (CVI) and percentage of agreement between evaluators were calculated. An acceptable agreement rate of 80% and/or a minimum CVI of 0.78 was considered (Alexandre & Coluci, 2011; Guarda et al., 2023).

For inferential analysis, variables were categorized, including familiarity with games (yes/no) and agreement responses (agree vs. neutral/disagree). Associations between variables (age, profession, and familiarity with games) and validation responses were analyzed using the chi-square test, adopting a significance level of 5% ($p < 0.05$).

3. RESULTS

At the first validation stage (March to April), 8 nutritionists participated, of whom 50% reported being unfamiliar with games. The comments and feedback provided were used to improve the product.

While all quantitative evaluations were included in the CVI calculation, four qualitative suggestions were analyzed but not incorporated into the final version. These proposals suggested modifications that would substantially alter the game's theoretical and pedagogical framework, such as replacing the fictional (alien) representation or adopting a dichotomous (right-or-wrong) quiz structure, which would diverge from the intended experiential learning design.

An agreement rate of 71% was obtained, corresponding to a Content Validity Index (CVI) of 0.71, which is below the recommended threshold (Table 1).

At the second stage, 33 health professionals participated, aged between 23 and 59 years (M = 33.0; SD = 9.5). Regarding professional background, 30.3% (n = 10) were nurses, 30.3% (n = 10) nutritionists, 12.1% (n = 4) physicians, 12.1% (n = 4)

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physiotherapists, 9.1% (n = 3) speech therapists, and 6.1% (n = 2) psychologists. Additionally, 54.5% of participants reported being unfamiliar with games.

The answers to the three questions with the lowest percentage of validation were analyzed, and a comparison was made between participants who said they were familiar with games and those who said they were not. In the question of interface organization, 55.6% of those unfamiliar agreed, while those familiar agreed, 80% (p=0.25). Regarding the issue of the interface being easy to understand, 61.1% of those unfamiliar with it agreed, and those familiar with it, 60% (p=0.93). Assessing whether the mechanics are easy to understand and master, in the unfamiliar group, 50% agreed, while in the familiar group, the percentage was 60% (p=0.60). Therefore, there was no statistically significant difference in the responses between those who are or are not familiar with games. However, in general, those who stated that they were not familiar responded negatively more often.

A total agreement of 84% was obtained, corresponding to a Content Validity Index (CVI) of 0.84, supporting the validation of the game. Content-related items, such as scientific accuracy, relevance, and practical applicability, showed high agreement among evaluators (Table 1).

Based on feedback analysis, some nutritionists maintained their initial criticisms, even after the implementation of suggested improvements. Feedback from other professionals mainly involved requests to expand the game content and include additional explanation cards, which were partially incorporated and are being further developed in subsequent versions of the product.

Suggestions to transform the game into a multiple-choice quiz or to replace the main character with multiple human characters of different ethnicities were not considered, as they were outside the scope and original pedagogical proposal of the game.

Table 1 - Presentation of the variables relating to game validation through the percentage of agreement

	Validation agreement	
Queries	**Stage 1**	**Stage 2**
The scientific information presented in the game is accurate and reliable.	5 (62,5%)	30 (90,9%)
Scientific questions contribute to enriching the overall experience of the game's narrative.	8 (100%)	33 (100%)
The scientific questions addressed in the game are relevant to the context of the game and its plot.	8 (100%)	33 (100%)
There is practical application of the game's scientific information in the real world.	7 (87,5%)	33 (100%)
The game's visual style aligns with the game's theme and genre effectively.	7 (87,5%)	31 (93,9%)
The game's visual style is appealing to its designated audience.	4 (50%)	25 (75,8%)
The game's current graphic quality contributes to a satisfying visual experience.	6 (75%)	31 (93,9%)
The game's art and visual elements are cohesive with the content and create a harmonious visual experience.	8 (100%)	30 (90,9%)
The menus, icons and interactive options (buttons) within the game are organized.	3 (37,5%)	22 (66,7%)
The icons and visual elements used are understandable and clearly represent their functions.	4 (50%)	24 (72,7%)
The chosen color palette improves the readability and overall experience of the interface.	8 (100%)	30 (90,9%)
The interface is intuitive and/or easy to understand.	1 (12,5%)	20 (60,6%)
Buttons and interactive elements respond appropriately when you interact with them.	5 (62,5%)	26 (78,8%)
The game does not suffer from problems such as freezing or closing itself.	6 (75%)	32 (97%)
The game mechanics are easy to understand and master.	4 (50%)	18 (54,5%)
The choices the player makes during the narrative have an impact on the outcome of the game.	7 (87,5%)	26 (78,8%)

Note: Values are presented in n (%).

4. DISCUSSION

The game mechanics were designed so that players could make mistakes without suffering severe punishment, and to understand that certain actions, even if apparently correct, can have significant impacts in other areas. For example, in the game's gameplay, some actions may benefit health, but harm family status and sociocultural education. In this way, it is shown that rigidity is not always the best choice, and that although some options should be avoided, situationally they will not harm the baby's health. This interaction with the SG allows parents to learn passively due to the immersion caused by the game, but they can also bring discussion about possible doubts with their professional (Priego-Ojeda, 2024).

One of the main priorities of the game was to provide easy gameplay, requiring minimal adaptation from the player, so that the basic mechanics could be understood within one or two sessions. Evidence suggests that the effectiveness of short game-based interventions depends on appropriate design and well-structured mechanics, such as clear objectives and feedback, to avoid compromising learning depth (Khoo et al., 2025). In remote application contexts, without direct interaction between researchers and participants, ease of adaptation to game mechanics becomes even more essential to ensure engagement with the content (Kaimara et al., 2019).

The game was applied remotely as an unsupervised and self-administered study, with no interaction between researchers and participants during the validation process. This approach presents important advantages for user testing, such as minimizing interference in player behavior by allowing participants to interact with the system in a more natural and less constrained environment, outside of a formal laboratory setting. Furthermore, the absence of direct supervision or evaluator influence may encourage participants to provide more spontaneous and honest qualitative feedback, a strategy that has been associated with a higher proportion of high-relevance responses (Ratcliffe & Tokarchuk, 2022).

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However, this approach also limits the ability to monitor gameplay time, user actions, and decision-making processes during the interaction. In contrast, other studies have adopted in-person or synchronous approaches, such as video calls, enabling researchers to observe players' reactions during gameplay and conduct post-session discussions to better understand the reasoning behind their choices. These strategies may enhance engagement and provide deeper insights into the user experience (Jackson & Iacovides, 2022). Therefore, both approaches present methodological advantages and limitations, and their suitability depends on the objectives and design of the study.

The choice of 2D art for the game was to facilitate the visualization of the two-dimensional card designs, perfectly meeting the proposed objective. The use of 3D art would be unnecessary and could make the game heavier, requiring greater processing power and restricting the audience to more powerful devices. Choosing this art style proved to be a good decision, as 93.9% (n=31) of reviewers stated that the visuals align effectively with the game's proposal and that the graphic quality contributes to a satisfactory visual experience. Furthermore, 90.9% (n=30) consider the visual elements to be cohesive, creating a harmonious visual experience. A study (Kaimara et al., 2019) compared students' preferences in SGs and demonstrated that they prefer 2D games, as they provide better immersion and usually more intuitive gameplay.

The game proved to be competent in the educational aspect, with 100% (n=33) of evaluators stating that the scientific questions enrich the experience, are relevant to the game and have practical application, emphasizing the importance of a content based on literature (Augello et al., 2016; Gonzáles, 2018; Papalia, 2021) and making scientific technical knowledge reliable, playful and applicable in real life.

Most evaluators considered the interface (60.6%) and mechanics to be intuitive (54.5%). However, 38.9% of participants who said they were unfamiliar with games did not consider them intuitive, and some suggested that the game should just be a multiple-choice quiz. The lack of experience means that even basic interfaces and mechanics have a learning curve. On the other hand, people familiar with games already expect a period of adaptation to new mechanics in any game. For these inexperienced evaluators, a truly intuitive interface would possibly be one with no learning curve. A study (Ziv et al., 2022) noted similar adversities with non-gamers, such as difficulties in the adaptation period, managing multiple tasks, and shorter response times, among others.

Another factor that may be associated with adaptation to the game mechanics is that 54.5% of evaluators were over 30 years of age and reported not being familiar with digital games. Evidence suggests that interaction with digital games may vary according to user characteristics and prior experience, highlighting the need for adaptations in mechanics and interface design for different user profiles (Suleiman-Martos et al., 2022). These aspects were not specifically addressed during the initial development of the "BebêXP" serious game and may be explored in future iterations. Nonetheless, most evaluators validated the game in its entirety, indicating that it was considered satisfactory by the target adult audience.

The game has shown promise, seeing how it is positively evaluated by the majority of jurors. It has beautiful graphic elements, intuitive gameplay, and evidence-based technical-scientific content. The main weakness found through this study is the uncontrolled playing time; therefore, there was possibly a divergence in the playing period between evaluators. Furthermore, the game may initially prove non-intuitive for people who have little or no familiarity with mobile games.

CONCLUSION

The BebêXP digital game can be an excellent food and nutritional education tool to assist clinical practice in the workplace of health professionals who work in the maternal and child area, especially nutritionists, as it addresses food introduction and children's eating behavior.

The software was validated by healthcare professionals from different areas, and the instrument was considered reliable. However, further testing with the target audience is still needed to determine whether interface and gameplay improvements will be necessary. In this sense, future studies are planned to include parents of children up to two years of age, in order to explore their perceptions and experiences with the game.

Currently, the game app is only available in Brazilian Portuguese, due to its initial purpose to be evaluated and utilized within brazilian national territory. However, as the research, efficacy, and interest in the game progress, there is an intent to develop an English translation in order to reach international audiences.

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AUTHORS' CONTRIBUTION

Conceptualization, N.D.M., M.M., M.V. and F.J.B.; data curation, N.D.M. and F.J.B.; formal analysis, F.J.B.; funding acquisition, N.D.M.; investigation, N.D.M. and F.J.B.; methodology, N.D.M., M.M., M.V. and F.J.B.; project administration, N.D.M. and F.J.B.; resources, N.D.M., M.M., M.V. and M.D.S.; software, N.D.M., M.M. and M.V.; supervision, N.D.M. and F.J.B.; validation, N.D.M., M.R.S. and F.J.B.; visualization, N.D.M., M.M., M.S. and F.J.B.; writing – original draft, N.D.M. and F.J.B.; writing – review & editing, N.D.M., M.M., M.V., M.R.S., M.D.S. and F.J.B.

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CONFLICT OF INTERESTS

The authors declare no conflict of interests.

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