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Serious Game e-Baby Família: an educational technology for premature infant care

Serious Game e-Baby Família: tecnologia educacional para o cuidado do recém-nascido prematuro

Serious Game e-Baby Família: tecnologia educacional para el cuidado del recién nascido prematuro

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ABSTRACT

Objectives: to develop and assess the serious game e-Baby *Família* with parents of premature infants. **Methods:** a methodological study regarding the development of the serious game, with participatory design in scope definition, starting from parents' learning needs about premature infant care. A qualitative approach was performed in the assessment stage with parents, with content analysis of the speech of the eight participants. **Results:** the following categories emerged: *Realistic appearance of the virtual setting and game content* and *Gameplay implications for the use of e-Baby Família*. The game was satisfactorily assessed regarding content, appearance and dynamics use, motivating participants to learn. **Final Considerations:** in the context of prematurity as a public health problem in Brazil and the need to strengthen family health education for care, the serious game was assessed as motivating and appropriate for health learning.

Descriptors: Neonatal Nursing; Educational Technology; Infant, Premature; Family; Health Education.

RESUMO

Objetivos: desenvolver e avaliar o *Serious Game e-Baby* Família junto aos pais de bebês prematuros. **Métodos:** estudo metodológico quanto ao desenvolvimento do *serious game*, com *design* participativo na definição do escopo, partindo-se das necessidades de aprendizagem dos pais sobre os cuidados com o bebê prematuro. Abordagem qualitativa na etapa de avaliação junto aos pais, com análise de conteúdo das falas dos oito participantes. **Resultados:** na avaliação, emergiram as categorias: Aparência realística do cenário virtual e conteúdo do jogo e Implicações da jogabilidade para o uso do *e-Baby* Família. O jogo foi avaliado satisfatoriamente com relação ao conteúdo, aparência e dinâmica de uso, motivando os participantes ao aprendizado. **Considerações Finais:** no contexto da prematuridade enquanto problema de saúde pública no Brasil e da necessidade de fortalecimento da educação em saúde das famílias para o cuidado, o *serious game* foi avaliado como motivador e adequado para a aprendizagem em saúde.

Descritores: Enfermagem Neonatal; Tecnologia Educacional; Recém-Nascido Prematuro; Família; Educação em Saúde.

RESUMEN

Objetivos: desarrollar y evaluar el *serious* game e-Baby *Família* junto a los familiares de los bebés prematuros. **Métodos:** estudio metodológico en cuanto al desarrollo del juego, con diseño participativo en la definición del tema, partiendo de las necesidades de aprendizaje de los padres sobre los cuidados con el bebé prematuro. Enfoque cualitativo en la etapa de evaluación junto a los familiares, con análisis de contenido de las hablas de los ocho participantes. **Resultados:** en la evaluación surgieron las categorías: A. Apariencia realista del escenario virtual y contenido del juego, y B. Implicaciones de la jugabilidad para el uso del *e-Baby* Familia. El juego fue evaluado satisfactoriamente con relación al contenido, apariencia y dinámica de uso, motivando a los participantes al aprendizaje. **Consideraciones Finales:** en el contexto de la prematuridad como problema de salud pública en Brasil, y de la necesidad de fortalecimiento de la educación en salud de las familias para el cuidado, el serio juego fue evaluado como motivador y adecuado para el aprendizaje en salud.

Descriptores: Enfermería Neonatal; Tecnología Educativa; Recién Nacido Prematuro; Familia; Educación en Salud.

INTRODUCTION

It is estimated that every year 15 million infants are born prematurely worldwide (before reaching 37 weeks of gestation), accounting for about one in ten births[1]. In Brazil, they represent about 12% of births with little variation in the last five years[2]. More than high prevalence, the mortality rate generated by complications of prematurity has increased significantly and has become the leading cause of neonatal death and even among children up to 5 years old[3-4].

The Sustainable Development Goals (SDGs), with a resolution agenda by 2030, released by the United Nations, include the health agenda through "SDG 3: Good Health and Well-Being". SDGs highlighted goals related to the theme addressed in this study. It is intended that by 2030 there will be no infant and neonatal mortality from preventable causes and neonatal and infant mortality rates should be reduced to a total of 12 and 25 per 1,000 live births, respectively. It is emphasized the need to strengthen the capacity of countries, particularly those in the developing world, to recognize disease early, reduce health risks nationally and globally[5].

Among the main health problems of this population, enhanced by inherent immunological and physiological weaknesses, those related to respiratory system account for one of the major concerns, which are commonly manifested by respiratory discomfort and fatigue, as well as episodes of apnea[6]. Attention intensifies inversely in proportion to infants' gestational age, so that the consequences of incomplete lung development, marked by the absence or decrease of surfactant and ventilation control center failures, especially affect extremely premature and very low birth weight infants[7-8].

Clinical manifestations of this immaturity can occur both at hospital during hospitalization, and at home, after discharge. Thus, in both situations, but especially at home, it is essential to involve family members responsible for infant care in the early identification and management of respiratory complications, favoring UN's SDG reach, in terms of risk reduction, early identification of diseases and potentially reducing morbidity and mortality.

Two of the main concerns of parents of premature infants are insecurity and fear of not being able to provide the necessary care or of complications from infant immaturity[9]. These feelings are even more evident among parents who have their first child, but they are not uncommon among the others, since premature infants have specificities that require differentiated care from family members.

The early recognition of signs that reveal any alteration or respiratory complication in this population is decisive for their survival as it allows rapid intervention. Considering that parents, especially mothers, spend a large part of the infant's hospitalization time following them closely, in general they take on the role of caregivers at home. Strengthening health education about this early identification and how to act is crucial for their safety, whether in health prevention, promotion or recovery.

Such inclusion of the family in the participation of care overlaps with the division of tasks, focusing on favoring their autonomy for identification, management and decision-making in health, in alignment with the family-centered care framework[10]. Through health education based on scientific evidence and relevant to the context, good care practices adoption for premature infants by family members is encouraged.

Several strategies are used to strengthen health education and range from group meetings, usual practice in Basic Health Units, individual or family guidance in the outpatient or home context, campaigns to disseminate basic information in accordance with health policies and provision educational materials such as booklets, or digital content[11].

A more recent strategy involves the use of computer technology with gameplay aspects, that is, educational games, also called serious games (SGs), which can be accessed by computer or smartphone type cell phone[12-13]. It is an innovative approach in the field of health education. Some SGs have been developed to assist in the health education process in the management of chronic diseases such as asthma and diabetes[14], childhood obesity[15], and guidelines about postoperative pain and care[16].

Computer games stand out when compared to other media, as they enable the challenge and the player's involvement during interaction, in addition to being based on logical and emotional responses, allowing users to better integrate with technology and change the course of actions shown in the multimedia resource[12,17-19].

Regarding the potential of SGs in strengthening the effects of health education with the community, a review of the recently published literature found that among six studies on SG regarding childhood obesity control, user satisfaction was found in all. Three achieved significant results in changing children's eating habits and one pointed to a clinical effect of weight reduction[15].

For the development of educational technologies aimed at the population, one must have knowledge about the social and economic context in which it is involved, as well as their preferences in the learning moments. It is necessary to understand whether access is being guaranteed through technological devices, whether users feel comfortable using it in the interaction and whether they can process information transforming superficial learning into meaningful learning.

This research is justified by the potential of SGs to strengthen health education and by aligning the child health theme with family-centered care. As a product, it offers the Brazilian population free of charge an unprecedented digital game that combines entertainment with evidence-based education, with the theme of prematurity, which is a public health problem.

Thus, when considering the epidemiological relevance of the theme; the demand for actions aimed at the family in situations of vulnerability of knowledge about special care for their baby; ease of online distribution and public access; the potential for effectiveness of SGs in health education; and the scarcity of digital technologies for health education, it is estimated that the product resulting from the present work contributes to the strengthening of the Brazilian National Policy for Child Health Care (*Política Nacional de Atenção à Saúde da Criança*)[20] and SDG 3 within the scope of the child population[5].

OBJECTIVES

To develop and assess the SG e-Baby *Família* with parents of premature infants.

METHODS

Type of study

This is a methodological study regarding the SG e-Baby *Família* development, which used participatory design to define the game scope based on the learning needs presented by the target audience. As part of the methodological path, it used a qualitative approach to analyze the speeches of the participants, under the Bardin framework[21], considered the criteria for reporting of qualitive studies, present in checklist COREQ.

Theoretical-methodological reference

According to Muller[22], participatory design involves a set of theories, practices and studies related to users in the development of software, hardware or any activity related to the computer. One of its main characteristics is the active participation of software users throughout the planning and development cycle[23].

Muller, Haslwanter and Dayton[24] in 1997 described the existence of several practices for the development of participatory design, as they vary depending on the dynamics, structure and need. For this study, Storyboard Prototyping was used, which "can be understood as a sequence of drawings". It tells the story of what is intended to show in the interaction with the user in a provisional model and then progress to the execution mode[25].

Methodological procedures

To develop it, interviews were carried out with the parents of premature infants hospitalized in a Neonatal Intermediate Care Unit in order to identify their main learning needs. The neonatal unit is part of a public teaching hospital, a reference at the tertiary level for perinatal care in its regional health district. In this setting, parents were invited to participate in the study, considering the inclusion criteria: parents of infants with gestational age less than 37 weeks at birth and whose children were hospitalized in the neonatal unit; literate and without vulnerability represented by psychiatric disorders or comprehension deficits.

Ethical aspects

The study was approved by the Research Ethics Committee and identified as Protocol 24732113.6.0000.5393 and followed the current ethical recommendations, mainly guided by Resolution 466/2012.

Data source

Eight people agreed to participate in the research, seven of whom refused because they did not want to be away from their children during the interview, due to the limited time they had available to stay with them. The initial interaction lasted 30 minutes for data collection and it was not necessary to continue recruiting at other times, due to the saturation of the theme due to the similarity of the contributions that the parents gave to the formulation of the storyboard.

All interviews were recorded and transcribed, and notes were written in a diary by the researcher who conducted the discussions. After identifying the key themes, the scientific literature was consulted in search of evidence-based solutions to the questions of the research participants, composing the script with questions, answers and navigation proposal by the SG.

After sending the script to the computer game development team, the prototype was presented to the participants for new contributions in the assessment stage, containing aspects of interaction and gameplay. They played the SG prototype individually, observing and manipulating the screens, and they presented suggestions, criticisms, questions and comments about the gameplay, comprehension capacity, realism and educational capacity of the same.

Analysis of results

For the analysis of the data obtained in this step, the content analysis technique proposed by Bardin[21] was used, unifying homogeneous themes, categorizing from an exhaustive reading of the text and focusing on objective coders and aligned with the research content.

After the completion of the assessment cycles, the SG e-Baby *Família* was then developed in the format of Macromedia Flash 8®, Adobe Dreamweaver CS3® and WampServer®. It is noted that the development of the game with the active collaboration of the family, in the use of participatory design, generated successive comings and goings between researchers, technical team and participants, from the choice of the theme to the final assessment of the tool.

RESULTS

The main doubts of the participants converged on the epidemiological panorama of morbidity in children and, specifically, in premature infants: respiratory problems and care with oxygenation. Thus, from the perspective of basic human needs, among the 21 questions revealed by the parents, 18 (85.7%) were related to oxygenation, two (9.5%) to food and one (4.8%) to thermoregulation.

In particular, regarding oxygenation, participants would like to understand the meaning of the pulse oximeter monitor and its values (three questions), interpreting which values are considered normal (three questions). They intended to recognize only when looking at the infant, which situations require care of the clinical staff, so that the parents could request assistance from the health team (two questions).

At the home level, right after discharge, participants asked about the care with the baby isolated in relation to other people, with the perspective of avoiding the contagion of any respiratory virus or disease (three questions); about the safety of taking the baby for a walk, considering the risk of contamination by respiratory virus (two questions); about the necessary care if the baby choked and became cyanotic during the breastfeeding at home (three questions); and about what care to offer the infant if he had runny nose (two questions).

Therefore, the theme chosen to compose the SG was the oxygenation of the premature newborn, addressing the hospital and home contexts, as well as the identification of signs

and symptoms, management of health risk situations and good daily care practices. The answers to the parents' questions about oxygenation were carried out with the support of the literature, with high scientific evidence, thus composing the game's script.

After prototyping the technology, the participants played the SG e-Baby *Família* and a new interview was conducted to start the assessment process. From this stage, the categories emerged: A. *Realistic appearance of the virtual setting and game content*; B. *Gameplay implications for the use of e-Baby Família*, with subcategories presented in the text.

Category A - Realistic appearance of the virtual setting and game content

The SG, in the analysis of the parents, was very similar to the reality perceived and experienced by them in several aspects, from the visual of the game setting and the characters (Figure 1) to the content developed about situations recognized by them as real, either by existing in their current routine, or because they are subject to doubts that they presented.

Subcategory A1 - Virtual infant's realistic appearance

> *How cute this infant, he looks like mine* [...] (Mother 1)

> *When Gustavo* [son] *gets tired, his ribs appear like that* [in the game] (Mother 1).

> *Wow* [...] *he looks like Arthur* [son]. (Mother 6)

Subcategory A2 - Realism of e-Baby Família situations in relation to the experiences of parents

> *I will choose maternal breast* [about the moment when the game was chosen by the bottle or maternal breast]*, because we are already encouraging her to take it. And she sucks a little already.* (Mother 2)

> *This situation of disgusting an infant has happened to me several times, because my other son who is at home has a strong reflux, and is always choking. There was no way, right* [...] *I had to learn how to remove, and now I do the same thing shown in the photo* [image] *of the game* [refers to the animation that shows the virtual infant's chocking after feeding and disengagement maneuver]. (Mother 7)

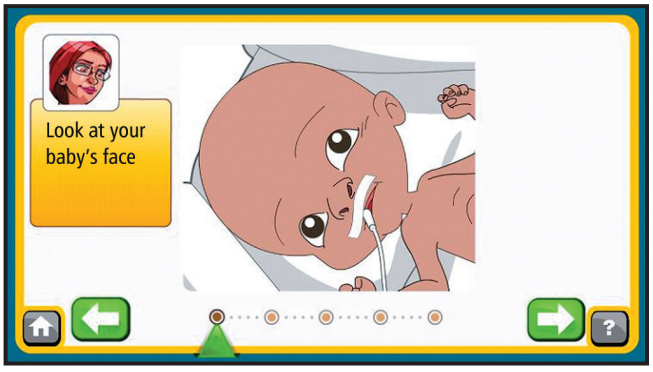

Figure 1 - Interface of representation of the premature infant in the SG e-Baby Família, Ribeirão Preto, São Paulo, Brazil, 2019

Subcategory A3 - Realism of e-Baby Família situations makes parents prepare for circumstances they have not yet experienced

> *I wouldn't let anyone with a cold or the flu visit my baby in the beginning, they are too sensitive, only the people who are here every day know what it's like to be hospitalized here. I've been here with him for three months now. Then when I leave, I will take good care of him, really protect* [...] *God forbid he will leave and go back to the hospital, I will be those very boring mothers.* (Mother 6)

Subcategory A4 - Improvement of the realistic appearance of e-Baby Família's virtual infant

> *I thought that when you say that the baby is tired, with difficulty breathing, the ribs do not appear so much. It should appear more, because when they get tired, the ribs are the ones that appear most on their chest.* (Mother 1)

Category B - Gameplay implications for the use of e-Baby *Família*

According to the interviewees, the SG left them satisfied with the content, appearance and dynamics of use, motivating them to learn. It was manifested that the game experience mobilized them to present the tool to other pairs who were insecure in infant care. E-Baby *Família* was considered as a support to clarify doubts, with great reach and ease of sharing because it is available in mobile format.

Subcategory B1 - Parental satisfaction of premature infants when playing e-Baby Família

> *I loved this game, how good it is to play, very good. At first, I didn't want to play much, but when it started, then I didn't want it to end anymore, I loved it.* (Mother 1)

> *This game is to be congratulated, a great idea, very intelligent* [...] *this game, congratulations, I loved it. I learned a lot today.* (Mother 5)

Subcategory B2 - Improvement in game access and availability

> *I really liked it* [the game]*, it's good to have it on your phone too, right* [...] *as an app. There are a lot of insecure mothers, it helps a lot to have them on their cell phones too, you can see them anywhere* [...] *it helps a lot.* (Mother 2)

Subcategory B3 - Learning through e-Baby Family

> *Ah, now I understand why I can't go to the nursery to see my son, it's because of my flu. I never understood why. But now I understand. It is to protect him and his little lung, and also the other children hospitalized here that it is closed. Nice, I understand.* (Mother 8)

> *They never taught me what makes the device on her foot* (daughter) *right. I only knew that he whistled when something was wrong or when she moved a lot* [...] *but now I know what those numbers are, and what is good for her or not. Very cool. I learned a lot today.* (Mother 5)

The IT team made changes to resource availability, according to the feedback from participants in subcategory B2. Its final version was programmed in Macromedia Flash 8®, Adobe Dreamweaver CS3® and WampServer® and made available, with free access, on the

website of the Nursing Research Group in Child and Adolescent Care through the electronic address: http://gruposdepesquisa.eerp.usp.br/gpecca2/.

The e-Baby *Família* presents situations in simulated hospital (Figure 2) and home (Figure 3), which are related to oxygenation, as demand identified in the participatory design. It concludes and reiterates that the whole game has animations and sounds of the infant and the words of professionals and family, objects of the simulated environment, to bring more realism and emotion to those who play.

Figure 2 - Simulated environment of the serious game e-Baby *Família* in the hospital for device recognition and basic interpretation by parents, Ribeirão Preto, São Paulo, Brazil, 2019

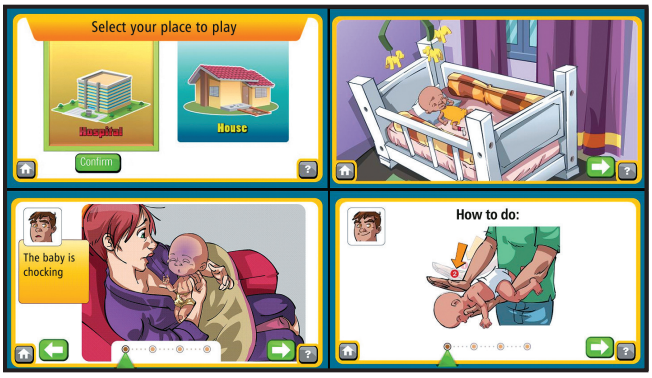

Figure 3 - Simulated environment of the serious game e-Baby *Família* at home to recognize problems in oxygenation and management by parents, Ribeirão Preto, São Paulo, Brazil, 2019

DISCUSSION

The SG theme, which was chosen by the target audience from participatory design, was quite pertinent when considering infant and neonatal morbidity and mortality data, especially among premature infants[3-7].

A concern of parents on infant care that emerged from the interviews, and has great relevance in the perspective of preparation for hospital discharge, refers to the risk of infections and respiratory problems of premature infants. This study was pertinent, above all, to make it possible to address the issue of health prevention with a view to avoiding disorders to which preterm infants are more susceptible, due to the anatomical and functional immaturity of their different organs and systems, especially the immune and respiratory, increasing vulnerability especially in aggravating environmental exposure situations[26].

Respiratory infections predispose them to episodes of apnea with bradycardia and cyanosis due to airway obstruction and may cause clinical instability. In addition to these signs, others are also likely to appear due to pulmonary immaturity, such as increased respiratory rate (tachypnea or bradypnea), respiratory effort characterized by beating of the nasal wings, retractions (intercostal, suprasternal, supraslavicular, intercostal) and irregularity of the respiratory rhythm, most of them represented by the SG e-Baby *Família* in grievance animations[27-28].

From the interviewees' statements (subcategory A1), it was found that the parents associated the animation of the virtual premature infant with the real figure of their child. This feature is extremely important because it is in the emotional integration of the user with the game that the learning potential increases, from the correspondence between the user's interest and the material presented, captivating and challenging them to solve the problem situations[29-30].

In addition, image realism makes the gameplay experience more meaningful, while mimicking feasible situations and motivating gameplay continuity[17]. In relation to SGs, where learning is a key goal beyond entertainment, situations that are expected to be realistic, are expected to arouse curiosity and interest, motivating the user to continue discovering and interacting with the digital resource.

Thus, methodological approaches of design that consider the opinion of the end user from conception to its assessment stand out, as the participative that was described in this work, whose advantages pointed out in the literature were reinforced by the findings from users' assessment (realism, satisfaction in playing and learning perception).

The various situations presented in the game made the interviewees reveal feelings and experiences, as demonstrated in subcategory A2, discussing important issues in child health, such as breastfeeding as a challenge and autonomy versus fear in home care in face of situations of risk or aggravation. It is believed that with access to the game, the population can answer questions that did not have the opportunity to heal health professionals together or even arousing new curiosities about the best way to provide care to premature infants.

Whereas the issues emerged from parents of hospitalized premature infants and their gambling was rated positively, as the data show, the SG has the potential to promote evidence-based health education in a pleasing manner, and strengthen family autonomy in premature infant care. It is therefore aligned with the family-centered care model and potentially impacting the lower demand for health services in situations where specialized care is unnecessary[31], as well as in the more assertive search for assistance through the early identification of health.

The greater participation of the family, especially parents, in neonatal units is recent, recommended by scientific and governmental publications, whose implementation has been proceeding in Brazil. Family-centered care is extremely important because it meets the needs of the child through family support, as it promotes autonomy and co-participation in decisions regarding child health[10] and demands dynamic, contextualized and active health education and guidance.

Such participation in care since hospitalization aims at preparing for continuity at home, supported by the primary health care network, and aims at empowering the family, in an informed and

conscious manner, in identifying injuries and performing the appropriate interventions.

It is possible, in the analysis of statements of subcategory A3, to identify discourses based on values of autonomy and empowerment. Both are related to decisions made by parents involving children care, either preventing the proximity of people with the flu or sick, or implementing interventions in the face of injuries. The relevance of this finding and the preventive potential of health education by e-Baby *Família* is highlighted, considering the high rehospitalization rate of preterm infants in the first year of life, reaching 39.4% of infants, mainly due to respiratory complications (56.3%)[32].

By analyzing the subcategories B1 and B3, it was concluded that the SG is in accordance with the following framework, being both educational and entertaining, being perceived as informative, enjoyable to play and motivating - important aspects to promote learning. Thus, assessing the educational technologies developed is an essential element and allowed, through the participatory design that permeated the development of the SG e-Baby *Família*, to make available to the public a tool built on their own doubts. Emotions generated by virtual games can influence the success of games and users' satisfaction in accessing them[17]. Importantly, positive emotions during information processing have been related to the enhancement of cognitive and learning processes[33].

Learning by playing is learning with pleasure, learning by playing. The game is an activity that makes the educational practice more enjoyable, because it establishes, through playful involvement, curiosity and interest[34].

Another important aspect for learning is the ease of access to desired information that formalizes a feeling of security in the user - emphasized in the subcategory B2 statements. Considering the breadth of smartphones and other mobile computing devices, content becomes easy to obtain through the game and enables sharing of material with others.

Using mobile devices as a learning resource anywhere and anytime makes access to information a growing trend[35]. In Brazil, according to the Brazilian Institute of Geography and Statistics (*Instituto Brasileiro de Geografia e Estatística*)[36], 92.6% of almost 70 million households had cell phones in 2016. Internet access was reported to be common to about 85% of young people between 14 and 24. 24.7%), and this distribution represents potential use by the target population of this study.

In the interaction with users of the Brazilian Unified Health System (*Sistema* Único *de Saúde*), in the midst of nursing care practice, it is evident how much people have increasingly consulted health information on blogs, commercial websites, social networks, among others. They manifest a tendency that the academic community must commit to by developing strategies to ensure or guide access to quality information, such as e-Baby *Família*.

One obstacle described in the literature is the quality of the internet in the country and the cost of access. Despite the advance of broadband coverage in recent years[37], there are still many challenges. Therefore, considering the risk of limiting access, especially among people of lower socioeconomic class, online gaming allows download and installation to be played offline whenever the user wants, even if they do not have internet access.

As a limitation of this study, it is pointed out the non-validation with experts on the subject, however, it should be clarified that several researchers participated in the process of formulating the answers to parents' questions, by searching the literature. Another limitation was the convenience sample. Further studies are suggested focusing on the impact on the learning of family members of premature infants through the use of the SG e-Baby *Família*.

In order to reinforce the importance of this study, the development and assessment of health education tools among the target population is fundamental, especially based on topics of interest that represent their learning needs. The topics addressed are expected to favor understanding of infant care, better criticality in the surveillance of signs of grievance, decision making, and consequently, impact on the maintenance and quality of life of the child.

Through technology, it is possible to expand access to quality health information and foster the autonomy of families in care. The SG e-Baby *Família* creation emerged in this context, with a view to improving premature infant care by their families, responding to difficulties and problems compatible with their reality, gathering the best scientific evidence produced by nursing and health.

FINAL CONSIDERATIONS

E-Baby *Família* was developed and assessed for and by parents of premature infants with child health researchers through participatory design as a health education resource using gameplay as a learning facilitation resource.

The findings of the study show that the SG e-Baby *Família* brought satisfaction and learning perception to parents of premature infants, remitting them to the reality of the neonatal unit, answering questions and awakening to reflections on care that may be performed later at home.

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