



## "Reanimabebê": serious game for nursing team in cardiopulmonary resuscitation in pediatrics

*"Reanimabebê": serious game para equipe de enfermagem na reanimação cardiopulmonar em pediatria*

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### ABSTRACT

Describe the process of planning and developing a digital technology, a serious game, aimed at assisting infant cardiopulmonary arrest by the nursing staff at an emergency care unit. Methodological study, developed according to Participatory Design in a Child Emergency Care unit. Participants corresponded to the nursing staff and expert judges. The game was constructed based on the choice of the theme by the staff, preparation of the script, referral to the computer team, making the game available to users and subsequent evaluation. For that, the EGameFlow instrument was used. Expert judges evaluated the game as a technological innovation, confirming its suitability for application in the aforementioned population of interest. The potential positive impact of using this type of tool in this complex care setting indicates the possibility of incorporating the serious game into continuing health education strategies, with a view to increasing the qualification of pediatric emergency care.

**Keywords:** Cardiopulmonary resuscitation. Educational technology. Emergency. Nursing. Pediatrics.

### RESUMO

Delinear o processo de planejamento e desenvolvimento de uma tecnologia digital, *serious game*, voltado ao atendimento à parada cardiorrespiratória infantil pela equipe de enfermagem em unidade de pronto atendimento. Estudo metodológico, desenvolvido segundo o *Design Participativo* em unidade de Pronto Atendimento à Criança. Os participantes corresponderam à equipe de enfermagem e aos juízes-especialistas. A construção do game ocorreu a partir da escolha da temática pela equipe, confecção do roteiro, encaminhamento à equipe de informática, disponibilização do jogo aos sujeitos e posterior avaliação. Para tanto, utilizou-se o instrumento *EGameFlow*. Juízes-especialistas avaliaram o jogo como uma inovação tecnológica, que atestam sua aptidão para aplicação na referida população de interesse. Face ao impacto potencialmente positivo da utilização dessa ferramenta neste complexo cenário assistencial, vislumbra-se a possibilidade de incorporar o uso do *serious game* às estratégias de educação permanente em saúde, visando à qualificação crescente da assistência emergencial pediátrica.

**Palavras-chave:** Enfermagem. Emergências. Pediatria. Reanimação cardiopulmonar. Tecnologia educacional.

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## INTRODUCTION

In emergency situations, especially in the childhood scenario, it is worth noting that the health professional deals with a whirlwind of feelings facing the prospect of the child's death. The death of this clientele is interpreted as a sudden disruption in the biological cycle and this, by itself, causes feelings of impotence, frustration and suffering in the staff<sup>1</sup>.

The nursing staff is the one who has the first contact with the child, and it is up to them to assess and prioritize the needs presented. Nursing has a unique role in child care, in which technical dexterity and a high level of theoretical knowledge area considered essential for these professionals to provide assistance<sup>2</sup>.

In this scenario, in which the expertise and constant updating of the team are essential for the efficient performance of professionals, the question is: how to provide the nursing staff, in a continuous, dynamic and effective way, with knowledge and technical skills necessary for care in child emergency situations?

Studies point to virtual simulation as a methodology that has been used to instruct and guide health professionals and students. In this field, the construction and application of educational games, also known as serious games, stands out as a strategy<sup>3-9</sup>.

Serious games are electronic games with characteristic content focused on some

thematic area of learning that motivates the player due to their playful and interactive aspect. It is further defined as “any computer application whose initial scope is to coherently combine serious aspects with video game fun”<sup>10</sup>.

For teaching-learning purposes, circumstances in which the use of knowledge is necessary for progress in the game are simulated; in such a way that the user is encouraged to use reasoning to overcome the causes of the specific problem or seek possibilities to minimize it, while knowing their characteristics<sup>11-12</sup>.

A study carried out with Swedish medical students, after using a serious game aimed at Cardiopulmonary Resuscitation (CPR), revealed an engagement of students in the theme and in the game. During training, the level of mental tension was low to moderate, as the students stated that the game caused a decrease in stress due to the unrealistic nature of virtual games, contrary to the important worry experienced in a real situation of cardiac arrest (CPA). According to the authors, the low level of stress has the potential to create a more structured learning situation during the initial training phase<sup>13</sup>.

Given the current scenario, in which health professionals experience more and more episodes related to CPA care, it is essential that they are technically and scientifically prepared to know how to act, in order to ensure the patient's survival. Thus, the present study aimed describe the

process of planning and developing a digital technology, a serious game, aimed at assisting infant cardiopulmonary arrest by the nursing staff at an emergency care unit.

## METHODS

This was a methodological study, whose objective was to develop a digital educational technology in portuguese, a serious game, aimed at the nursing staff in children's emergency situations. To guide the methodology, we used the Equator instrument, COREQ checklist.

For software creation, the study took as its starting point the learning needs of the nursing staff in relation to emergency situations in children, following the principles of Participatory Design (PD), which considers the perceptions of the research subjects as a fundamental part for the conception of the idea, encompassing them throughout the game generation process. The PD aims to propose means for the subject to effectively participate during the project design and development cycle, enabling the software's perspectives and needs to be proposed, developed and evaluated by those who will effectively use it<sup>14</sup>.

After developing the game and before making it available to the healthcare staff, it was evaluated by expert judges on the subject, called secondary subjects. The experts were selected through tracking on the Lattes Platform or by indication of

people known in the area. The inclusion criteria were: having a university degree in the area of health or computer science, and a master's degree or specialization in the areas, as well as experience with the themes: child emergency, health technologies and/or software development and/or digital educational games

After choosing the topic, a dense reading of the literature was carried out so that the identification of solutions for all the actions and occurrences present in this situation, namely the CPA in babies under one year, was based on scientific evidence, ensuring at the same time, the veracity/reliability of the actions and the safety of children and professionals. The principles of the Pediatric Advanced Life Support (PALS) of the American Heart Association (AHA) and its updates were used as a reference for conduct<sup>15-16</sup>.

The game script was built in Microsoft Power Point slides, in order to outline the plot and facilitate the understanding of the technical team responsible for developing the game. These slides are related to the steps, in a sequential logic of events that represent the step-by-step emergency care for the baby in CPA.

The place of application of the study was the Emergency Care for Children (ECC), located at the Emergency Care Unit (ECU) of a municipality in Northwestern Paraná. The group of primary subjects consisted of nurses and nursing technicians from different shifts. Inclusion criteria

were: age over 18 years and experience in pediatrics for more than six months. Workers who were on vacation or leave at the time of data collection were excluded.

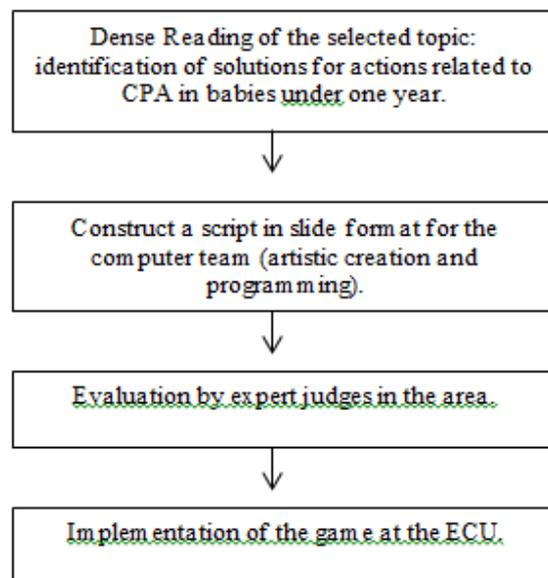
After the end of the game by the computer team and, prior to the use of the game by the nursing staff, it was made available to expert judges in the area of health and information technology to assess the educational content, usability and mechanics. The expert judges were invited by letter of invitation. We opted for the application of the evaluation scale to the expert judges by email. In addition, for all subjects, a characterization instrument with closed questions was designed and applied.

The purpose of the evaluation by experts in the field is to eradicate gaps and deficiencies in gameplay, aiming to facilitate players' understanding<sup>17</sup>. Thus, the EGameFlow instrument was used, which consists of a questionnaire composed of eight dimensions related to the educational content of the game, namely: Concentration, Challenge, Autonomy, Goal Clarity, Feedback, Immersion, Social Interaction and Knowledge Improvement<sup>18</sup>.

This is presented in a Likert scale containing 56 items, with 1 and 7 representing respectively the lowest and highest level according to the subjects' agreement.

The doctoral thesis, from which this study originated, was composed of three moments, as described in Figure 1, as follows: Moment I: Recognition of the topics of interest to learn by the staff (March 2017); Moment II: Development and implementation of the Serious Game (April 2017 to January 2019); Moment III: Evaluation of digital technology from the perspective of the staff (February 2019).

In Moment I, through a focus group involving the nursing staff, it was possible to outline the reality of continuing education at the ECU, as well as list topics of interest to the staff, for further development of the serious game. The participants decided by consensus that the priority topic was CPA in babies under one year old. Moment II, focus of this article, was based on the planning, development and implementation of the game, as shown below:



**Figure 1.** Development stages of the serious game *Reanimabebê*, Maringá, state of Paraná, Brazil, 2019.  
Note: CPA (Cardiopulmonary Arrest); ECU (Emergency Care Unit).  
Source: Prepared by the authors, 2019.

Data from the questionnaire were quantitatively analyzed using simple descriptive statistics and organized in a table, following the dimensions and their items. After the experts' evaluation, the game was made available to primary subjects for 15 days (time defined with the staff), for later completion of the research, in Moment III. This step aimed to evaluate the technology from the perspective of the nursing professionals involved, in terms of the repercussions of this practice on the teaching-learning process.

Data in this article are part of a doctoral thesis, which followed all ethical precepts of Resolution 466/2012 of the National Health Council and was approved by the Human Research Ethics Committee, under opinion 2.424.019, CAAE

79615917.6.0000.0104 on December 8, 2017.

## RESULTS

Regarding the primary subjects, participants were 10 health professionals, three nurses and seven nursing technicians. Of these, eight were women and two men, aged between 28 and 42 years (mean 34.5 years); seven married and three single. As for the education level, six subjects had a bachelor degree in nursing, and four people had a graduate degree. The time of training ranged from two to 20 years (average of 7.7 years), with experience in pediatrics from one to six years (average of three years) and time working in the ECC between one and three years (average of 2.4 years).

In terms of experience in pediatrics, only two people reported having no experience, despite having worked for one year in the service. All professionals said they participate in training, one of them very often, two with reasonable frequency and seven rarely.

With regard to secondary subjects, the group of expert judges totaled nine people, five men and four women, aged between 27 and 46 years (average of 35 years). The staff consisted of four nurses, three physicians and two bachelors in computer science. Regarding the level of education, three were Ph.D., four masters and two specialists. The areas of activity were urgency/emergency, health management, system analysis, pediatrics, and information and communication technology.

Based on the topic of interest listed by the health team, namely, CPA in babies under one year of age, the slides were assembled together with the text to be inserted, totaling 98 slides. The artistic part was then presented to the health team by a Whatsapp group, where suggestions and criticism were received, following the principles of the Participatory Design framework. The suggestions included changes in the arrangement of equipment in the scenario, changing some colors in the images, the presence of the timer in the scene that addresses the baby's ventilation and the use of sounds on some occasions.

After finalizing the script, there was a thorough review of all the steps in the evolution of the game, with the material being sent to the team hired for developing the game. The time between the delivery of the script to the IT team and the completion of the game version to be made available on the Google Play Store (official application store for the Android operating system developed by the technology company Google) was six months (July 2018 to January 2019). It was decided not to make the game available for the iOS operating system (a system developed for Iphone) as it is a primary version of *Reanimabebê*, which will allow modifications after the end of the research.

During this time, the IT team maintained weekly contact with the researcher via email, telephone and videoconference in order to resolve doubts with a view to aligning the game. The main questions were related to the material and procedures (endotracheal tube, bag-valve-mask, emergency trolley, aspirator, cardiac monitor, cardiopulmonary resuscitation maneuvers and medications) used in the hospital context.

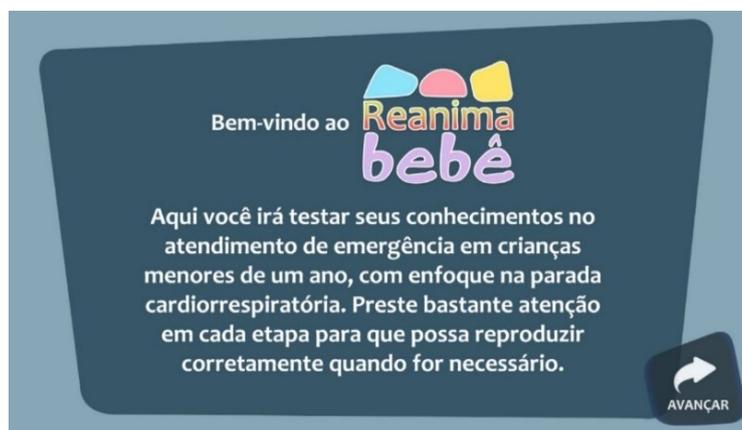
## **DISCUSSION**

### **SERIOUS GAME PRESENTATION**

The main objective of the *Reanimabebê* serious game (Figure 2) was the development of skills and abilities

through digital simulation, with a focus on caring for children under one year of age who are victims of CPA, in addition to approaching the patient based on updates on

the topic. The game's scenario and narrative took place in a red room (emergency room) of an ECU.



Subtitle: Welcome to Reanima Bebê - Here you will test your knowledge of emergency care for children under one year old, with a focus on cardiorespiratory arrest. Pay close attention to each step so you can play it correctly when needed.

**Figure 2.** Presentation screen of the Reanimabebê serious game. Maringá, state of Paraná, Brazil, 2019.

Source: Prepared by the authors.

In the initial interface of the serious game, it is possible to start case 1 or case 2, which will not be saved later, as they are simple cases and do not take longer. In addition, the technical sheet with information regarding the development of the game is available.

## GAME DESCRIPTION AND CONTENT

The scenario is presented to the player through the following statement: “You are part of the nursing staff of a 24-hour Emergency Care Unit located in a medium-sized municipality. Today you are assigned to pediatrics. The unit has two beds in the pediatrics red room”.

We opted for the development of two scenarios with emergency situations, as

follows: Case 1: “Infant, 44 days old, brought by parents in their own car, is admitted to the Emergency Care Unit where you are on duty during the night. The mother reports that she noticed that the child was “bluish”, was not breathing and did not wake up. Denies history of trauma. The mother cries a lot and the father is distressed, screaming down the hall”. Case 2: “Infant, 43 days old, under observation at the Emergency Care Unit for one day due to fever without a focus. At 2 am, the desperate mother brings the unconscious baby to the nurses station, saying that he “drowned” while breastfeeding. At that moment, you, a nursing technician and a physician are available”.

The player chooses the “case” they wish to play first. Afterwards, select their

avatar, male nurse or female nurse. It is known that the avatar has been widely used by information technology, as images are created similar to the user, allowing customization within the computer, attributing a situation closer to reality. The player must use the objects in the scenario and actions to advance through the stages, in addition to correctly answering the questions that arise. Subsequent to the decisions made by the player, they receive feedback. It is not possible to progress to the next question without the previous one being correct.

Questions appear as the player progresses through the game. After developing the questions, the content was revised and validated through evaluation by expert judges in the area and based on scientific evidence. This process ensured the reliability of the information provided in the game.

Learning occurs gradually, starting with the approach of fundamental components, such as the identification of

the CPA and the request for help, when the character is alone, ending at a more complex level, with the baby using an endotracheal tube, continuous chest compressions, preparation and administration of medication and finally, return of heartbeat, as seen in Figure 3.

The Cases focus on the following steps of the CPR: Identification of the CPA and request for help; Pulse check and cardiac monitor; Chest Compressions (two-finger technique and two-thumb technique); Airway and ventilation inspection; CPA medication (preparation and administration); Pulse check and cardiac monitor; Transfer to Hospital Unit.

It is known that CPA is the cessation of blood circulation as a result of the absence or ineffectiveness of cardiac mechanical activity. The individual is not responding or not breathing. There is no detectable pulse. Cerebral hypoxia makes the child lose consciousness and stop breathing<sup>15</sup>. High quality CPR is essential for the success of the care provided.



**Figure 3.** Chest compressions + constant airway ventilation + medication administration in the Reanimabebê serious game. Maringá, state of Paraná, Brazil, 2019.

Source: Prepared by the authors, 2019.

## DEVELOPING THE SERIOUS GAME

The development of the game consisted of the following steps: Artistic creation: elaboration of the elements that were used, such as two-dimensional (2D) models, sounds, among others in the software; Programming: software exercise of the game's logic mechanism for integration of graphics and strategies. Includes composing tasks such as managing sounds. This stage began with the development of a prototype, that is, a preliminary version that evolved over the course of the game.

Regarding art, the storyboard (comic book script) was first made, based on the script sent by the researcher. On the storyboard, the artist and developer worked together and outlined how the game's features and interactions would be.

Next, the characters were created: female nurse, male nurse, baby, father, mother, nursing technician João and the scenarios depicting the places of care, as can be seen in Box 1. All illustrations were made using Adobe Photoshop software (two-dimensional raster image editor, developed by Adobe Systems).

Illustrations were carefully designed with the aim of providing scenes of suffering as close as possible to the reality of the health team and family of the child at risk of death.

Regarding programming, user interactions on the graphic elements were coded with the appropriate feedback for each interaction, with animations when necessary. Godot game engine was used for development.

## EDUCATIONAL GOALS

Reanimabebê is defined as a teaching tool developed to update and guide health professionals and students who deal with childhood emergencies. Its educational objectives are: To guide and update professionals and students on the care of babies under one year of age in CPA; Make future professionals aware of the importance of continuing education at work; Achieve greater adherence to the methodology by professionals, due to the flexibility of this tool and respect for the specificities of each student, taking into account the individual pace of learning; Expand the offer of innovative technologies that qualify care, promoting research in the field of informatics applied to nursing; Provide the professional or student with realistic situations of patient care within the context of nursing work.

## TARGET AUDIENCE

The target audience of the Reanimabebê serious game are students of

high school professional education and higher education in nursing, in addition to health professionals working in pediatric emergency care.

#### EVALUATION BY EXPERT JUDGES

After programming the game and approval from the production team, it was presented to expert-judges in the area of health and computing to evaluate the first functional version of the game, which took

place through the use of the EgameFlow questionnaire.

Health specialists emphasized the evaluation of the content of screens and illustrations, while computer specialists were more focused on mechanics, interface and gameplay, as shown in Table 1. The score, which can range from 1 to 7, assigned to each dimension is an average of the evaluations of the related items, considering the final scores given by the evaluators.

**Table 1.** Average of the evaluations of the Reanimabebê EGameFlow instrument. Maringá, state of Paraná, Brazil, 2019

Concentration		Average
C1 – Does the game hold my attention?		6.5
C2 – Does it present content that stimulates my attention?		6.5
C3 – Are most activities related to the learning task?		6.8
C4 – Are any distractions from the task highlighted?		6.0
C5 – Overall, can I stay focused on the game?		6.5
C6 – Am I distracted from tasks I should be concentrating on?		2.0
C7 – Am I overloaded with tasks that seem unimportant?		1.5
C8 – Is the game workload adequate?		5.8
	Final Average	6.3
Challenge		
H1 – Do I enjoy the game without getting bored or anxious?		5.8
H2 – Is difficulty adequate?		6.0
H3 – Are there “tips” that help with the task?		5.0
H4 – Does it have online support that helps with the task?		NA
H5 – Does it have video or audio that help with the task?		6.3
H6 – Do my skills increase as the game progresses?		6.0
H7 – Am I motivated by improving my skills?		6.2
H8 – Do challenges increase as my skills increase?		6.0
H9 – Does it present new challenges at an adequate pace?		6.0
H10 – Does it have different levels of challenges that suit different players?		5.8
	Final Average	6.5
Autonomy		
A1 – Do I feel in control of the menu?		5.0
A2 – Do I have a sense of control over functions and objects?		5.0
A3 – Do I have a sense of control over the interactions between functions and objects?		5.5

A4 – Is it possible to make mistakes that prevent the game from progressing?	6.8
A5 – Can I recover from any mistakes made?	5.0
A6 – Do I feel I can use any strategies?	5.5
A7 – Do I have a sense of control and impact on the game?	6.0
A8 – Do I know the next step in the game?	5.0
A9 – Do I feel in control of the game?	6.0
Final Average	5.5
<b>Goal Clarity</b>	
G1 – Are the general objectives presented at the beginning of the game?	7.0
G2 – Are the general objectives clearly presented?	7.0
G3 – Are the intermediate objectives presented in the appropriate place?	6.0
G4 – Are the intermediate objectives clearly presented?	6.0
G5 – Do I understand the learning objectives through the game?	7.0
Final Average	6.6
<b>Feedback</b>	
F1 – Do I get feedback on my game progress?	6.0
F2 – Do I get immediate feedback on my actions?	6.0
F3 – Am I notified of new tasks immediately?	5.5
F4 – Am I notified of new events immediately?	5.5
F5 – Do I receive information about the success or failure of intermediate goals immediately?	6.0
F6 – Do I receive information about my status, such as level or score?	NA
Final Average	5.8
<b>Immersion</b>	
I1 – Do I forget about time while playing?	5.8
I2 – Do I forget the things around me while I play?	6.5
I3 – Do I forget the day-to-day problems while playing?	6.5
I4 – Do I feel an altered sense of time?	5.3
I5 – Can I get involved with the game?	6.0
I6 – Do I feel emotionally involved with the game?	7.0
I7 – Do I feel viscerally involved with the game?	5.0
Final Average	6.0
<b>Knowledge Improvement</b>	
K1 – Does the game improve my knowledge?	7.0
K2 – Do I get the basic ideas of the content presented?	6.0
K3 – Do I try to apply knowledge in the game?	7.0
K4 – Does the game motivate the player to integrate the content presented?	7.0
K5 – Do I want to know more about the content presented?	6.5
Final Average	6.7

According to the responses in the “Concentration” dimension, the evaluators revealed that they remained concentrated

during the game, with an average score of 6.3. It can be inferred that the stages of the game are harmonic and direct, thus

facilitating concentration. It should be noted that items C6 and C7 had a lower score due to negative responses from experts regarding distractions or tasks that seemed unimportant, configuring positive points in the evaluation.

The “Challenge” dimension received a final score of 6.5, demonstrating the identification of a provocation for dispute in the player, fulfilling the requirements mentioned in the category.

Regarding “Autonomy”, judges presented good autonomy from the answers given in the third category, with a final score of 5.5. Some items (A1, A2, A5 and A8) referred to access to the “menu” or recovery from mistakes made during the game. As it is an Alpha version, errors and/or suggestions can later be realigned in the game.

In the “Goal Clarity” dimension, the final score was 6.6, configuring a positive evaluation of the game, considering the clarity of goals and accessibility.

It is believed that the “Feedback” dimension was quite adequate, considering the final score of 5.8, which reflects the immediate feedback (positive and negative feedbacks) provided by the game to each decision taken by the player. However, it was suggested to add the percentage of hits/errors that the player gets during the game's actions.

Experts judged the “Immersion” dimension as adequate, with an average score attribution of 6.0. Thus, it can be seen

that the ability to bring the player to the game environment, with concentration on the game and teaching-learning process inherent to each stage.

Finally, the “Knowledge Improvement” dimension was given a final score of 6.7, reflecting a positive evaluation of its potential for acquiring knowledge through this educational technology.

The evaluators pointed out some errors, not previously identified by the researcher and the information technology team, in addition to suggestions, such as: addition of information regarding the player's performance (percentage of errors and successes); as to when it is necessary to start the baby's ventilation - after two wrong attempts, and as to how this should be performed; change in the tonality of some objects, in order to provide greater visual prominence.

In general, expert judges would positively evaluate Reanimabebê, considering it innovative and with great potential for use by the target audience.

In this sense, the development of skills in professionals who attend to emergencies is a predictor of success during care delivery to critically ill patients. The continuity of the teaching-learning process, beyond undergraduate studies, with a view to deepening knowledge and skills, is essential for the evolution of the care practice of these workers in different work scenarios. It is expected that the investigative experience in question has

mobilized the interests of all involved, in the sense of valuing health education, as a driving force for continuous professional development and care qualification with a view to health promotion and disease prevention.

## STUDY LIMITATIONS

Regarding the study's limitations, the main obstacle, considered relevant for the development of the game, was the high cost related to hiring professionals specialized in the field of illustration and programming. Importantly, the objective of the study was not to carry out a comparative assessment of the professionals' learning before and after using the game. It is suggested, therefore, the development of new studies that proceed with the application and evaluation of this tool in other realities.

## CONTRIBUTIONS TO THE NURSING FIELD

With regard to nursing practice, the tool (serious game) developed proved to be adequate to compose a process of permanent education for the nursing team. The implications are related to the possibility of reducing the mortality of infants in CPA, as it allows the professional to achieve greater knowledge on the topic, with a consequent increase in safety and

resourcefulness in the service, impacting the quality of care provided.

Furthermore, the development of optimizing strategies for this teaching-learning process has positive consequences, whether in initial training, through the provision of tools for technical education and undergraduate studies in nursing, or in the context of continuing health education.

## CONCLUSION

The study sought to address a growing challenge present in the educational area, represented by the training of human resources to work in health. The contours of this challenge are outlined by the diversity and complexity of the problems observed in this area, which go beyond the limits of knowledge built or accumulated throughout the initial training of professionals in the area.

In this sense, it is necessary to think and rethink the ways in which teaching has been organized, and about the strategies capable of increasing it, in order to promote the overcoming of gaps in interdisciplinary and continuous knowledge in the health area.

The use of the serious game is noteworthy, in view of the ease of adherence to the activity, due to its playful configuration, with positive consequences for the greater effectiveness of the educational action, and important social impacts, resulting from the qualification of

work and care in health. In addition, the lower expenditure on materials provided by the use of a virtual learning environment, as well as the lack of early exposure of professionals to psycho-emotional wear present in clinical learning situations, stand out as extremely positive characteristics of the use of the serious game.

As a result of this type of educational approach, it appears that the existence of trained professionals in care contexts is reflected in the provision of better-quality care for patients and their families. Furthermore, a differential of Reanimabebê is the fact that it is a free and open educational resource. The expert judges evaluated the game as a technological innovation, attesting to its applicability in other populations of interest. The main obstacle, considered relevant for the development of the game, was the high cost related to hiring professionals specialized in the field of illustration and programming.

In conclusion, it is recommended to incorporate the use of the serious game into continuing health education strategies, whether in this specific case, contributing to the qualification of care to babies in in CPA, or applied to other realities as an innovative teaching-learning tool in health.

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