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Serious games for children's oral hygiene education: an integrative review and application search

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Abstract *This article aims to perform an integrative review on publications that discuss the use of serious games focused on education of children's oral hygiene and a search for available apps with this same purpose. An integrative peer review was conducted in the databases IBECS, LILACS, SCIENCE DIRECT, SciELO, PUBMED, SCOPUS, MEDLINE and Scholar Google, from January to November of 2017 and in parallel a search of available applications on the Android® platform, and websites of computer science, such as the IEEE Xplore. In the integrative review, 12 articles were selected that fulfilled the inclusion criteria. In searches on websites, 11 games were classified as serious games aimed for oral hygiene. A total of 284 apps were identified at Play Store®, with predominance for interventionist activity in dental offices, with pain, dental cavity and trauma being the main plots. Few applications focused on oral hygiene education are available. As for intended audience, there is the prevalence of children's public. Despite the scarcity of publications on the subject, exploring technological resources as educational options for children's oral hygiene indicate an area of knowledge with academic potential and possible applications for public health.*
Key words *Video game, Health education, Oral hygiene*

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Introduction

Interactive digital media have reached most spaces in contemporary society, while surveys have proved the effectiveness of computers in increasing motivation and consolidating knowledge during the teaching-learning process[1,2]. In this context, computer games stand out when compared to other media, as they enable a balance between the challenge and the player's involvement during the interaction[3].

The benefits of using mobile technologies (*smartphones, tablets, notebooks, E-readers*) to access educational content have been highlighted by some authors[4-7], who use the concept of mobile learning (*or m-learning*). For these authors, mobile learning is defined as extended and supported learning based on the use of mobile devices, with characteristics such as portability, integration with different media and not physical and geographical limitations of users. From this perspective, *serious games* deserve to be highlighted, games whose main characteristic is to teach or inform specific concepts of disciplines or to train operational and behavioral skills of the player[8].

Some difficulties in Health drove the use of *serious games*. Among them, the complexity of the procedures, the costs of training and obtaining materials, as well as the need for new approaches to rehabilitation and teaching healthy habits[9] are emphasized. *Serious games* have several purposes, such as: distracting patients from painful therapeutic interventions, training professionals, health promotion, physical conditioning and health monitoring[10].

The use of *serious games* in training and medical simulations has, according to research carried out, the following advantages: low cost of training platforms, wide availability and portability of games, drastic reduction in the number of human errors and improvement in the execution of specific procedures[11]. Within the *serious games* applied to Health, the ones directed to Dentistry stand out, because the growing demand for tools to stimulate decision making, training, teaching and education in the area encourages the development of this group of games[9,12-15].

Considering the above, this integrative literature review was carried out in order to identify scientific publications that address the use of *serious games* aimed at education in children's oral hygiene and to search for applications available on the Play Store and on websites specialized in game development. Such objectives converge to potential areas whose interdisciplinarity between technology and health promotion finds room for development.

Method

An integrative peer review[16] was carried out in the following databases: IBECS, LILACS, SCIENCE DIRECT, SciELO, PUBMED, SCOPUS, MEDLINE and Google Scholar. Two independent researchers did the searches to identify the primary studies. Once this step was completed, the analysis of the selected studies was carefully followed to establish the *corpus* of this review. As a representative of gray literature, it was decided to include small newspapers and magazines, unpublished research, conversations with experts, data obtained from dissertations and theses published in the thesis database of the Coordination for the Improvement of Higher Education Personnel (CAPES), as well as articles identified in manual search in article references, especially those with extensive review and other integrative reviews.

The searches were carried out from January to November 2017, with an initial time limit of the last seven years. A search was made on websites specialized in Computer Science content, such as IEEE *Xplore*, for *softwares* aimed at children's oral hygiene; a search for educational materials in the form of computer games developed by the companies Colgate and Oral B; and the American Dental Association (ADA). In order to broaden the scope of the research, a search on the *Play Store* was conducted with the purpose of verifying the availability of applications developed for the *Android*® platform for the same purpose.

The guiding question of the research was elaborated using the P.V.O. (P – Population, V – Variable and O – outcome): "Which serious games are aimed at education in children's oral hygiene?". Once it was established which databases would be used, the uniterms (descriptors or keywords) were used, used to collect publications. This choice is vitally important to access documents that are really relevant to the object of study. In general, keywords are recommended that include the condition or disease and the intervention or exposure assessed as sufficient to obtain relevant works[17].

The general search term used was ((((((((video games [MeSHTerms]) AND oral hygiene [MeSHTerms]) AND health education [MeSHTerms]) AND children

[MeSHTerms])))))). In another search, it was decided to replace the descriptor video games with the keywords serious game and serious game. This substitution was purposeful because there were no findings with the descriptors. The objective was to expand the search field.

Among the criteria that determined the inclusion of a study, relevance in relation to the research question was considered, analyzed from the title, the descriptors, the *abstract* and the conclusion. The inclusion criteria were defined with the following parameters: a) designs: methodological studies, whose objective has been the development of technology (serious game); b) Target population: children; c) Adherence: professionals or users who used technology for educational purposes; d) Languages: Portuguese and English.

The exclusion criteria were: a) literature and editorial review articles; involving the development of a serious game or application for a purpose other than oral hygiene; b) observational or intervention study protocols.

In this process, the studies went through two filters for selection and evaluation. The first filter was the selection of relevant publications. The initial screening of the articles was carried out by two researchers and was based on the review of the title and abstract, which determined the fulfillment of the eligibility criteria. This stage initially aimed at discarding articles that did not meet the inclusion criteria. Each researcher came up with a list of primary studies. The two lists were compared and a single list was arrived at. Included in this first filter were studies in which there was disagreement regarding inclusion or exclusion. The flow of analysis of the articles in this first filter is described in Figure 1. The twelve selected studies were read in their entirety and their references were examined manually.

The second filter was the selection of relevant data. In this, for each work approved by the selection process, the researchers used a form for which they extracted all the necessary information. The following information was collected: authors, year, objective, target audience, methodology, results and conclusion, as shown in Chart 1.

For description and analysis, this data was divided, in this research, into two groups: one that deals exclusively with *serious games* and the other dealing with applications aimed at the Dentistry area. The following criteria were used: the theme explored, children as a target audience, distribution of the tool (*web and Play Store*) and, specifically in the case of *serious games*, having a pedagogical approach.

A search strategy was carried out on websites of companies that develop games and *serious games*. In Chart 2, the researched repositories are listed:

The *serious games* selected were: "*Dental Space Odyssey*", "*Tooth brush patch, Dr. Rabbit Dentist*", "*ToothPaste Tower*", "*Dental Defenders*", "*Pasta contra bactérias*", "*Serious game*", "*To Tell the Tooth*", "*Quickbrush toothbrush*", "*Happy Teeth Kids*", "*Grush the Gaming toothbrush*", "Uma aventura na floresta da Dentolândia (An Adventure in the Toothland Forest)".

Results

Characteristics of studies on *serious games*

In this review, it was observed that five studies, including four articles and a dissertation, were carried out by a team of researchers and aligned themselves as a sequential chain. They are: "*Serious games* in Dentistry: applications, characteristics and possibilities"[13]; "A *serious game* for education about oral health in babies"[12]; "Planning a *serious game* aimed at oral health in babies"[14]; "Defining the communication approach when planning a *serious game* aimed at oral health in babies"[15]; and "Planning and development of a *serious game* aimed at oral health in babies"[18]. These studies were carried out in a chain with the objective of developing a *serious game*. One article dealt with a systematic review, in which it was noticed the lack of games with an approach aimed at babies' oral health. Another brought the audience the kind of approach that was used for the game's development. Another dealt with the planning stages. And finally, the dissertation presented the game 'An Adventure in the Toothland Forest[18].

In the dissertation, the author highlights the lack of *serious games* aimed at babies and mothers. The product presented was the game "An Adventure in the Toothland Forest", whose development methodology was based on the Communicative Approach (CA) with the target audience. According to the author, the data were analyzed and presented as results: "[...] 87% of the mothers who played learned some new knowledge and 53% managed to win (successfully complete) the game"[18].

PEPE is a serious game to support the dental treatment of special children as a form of play-

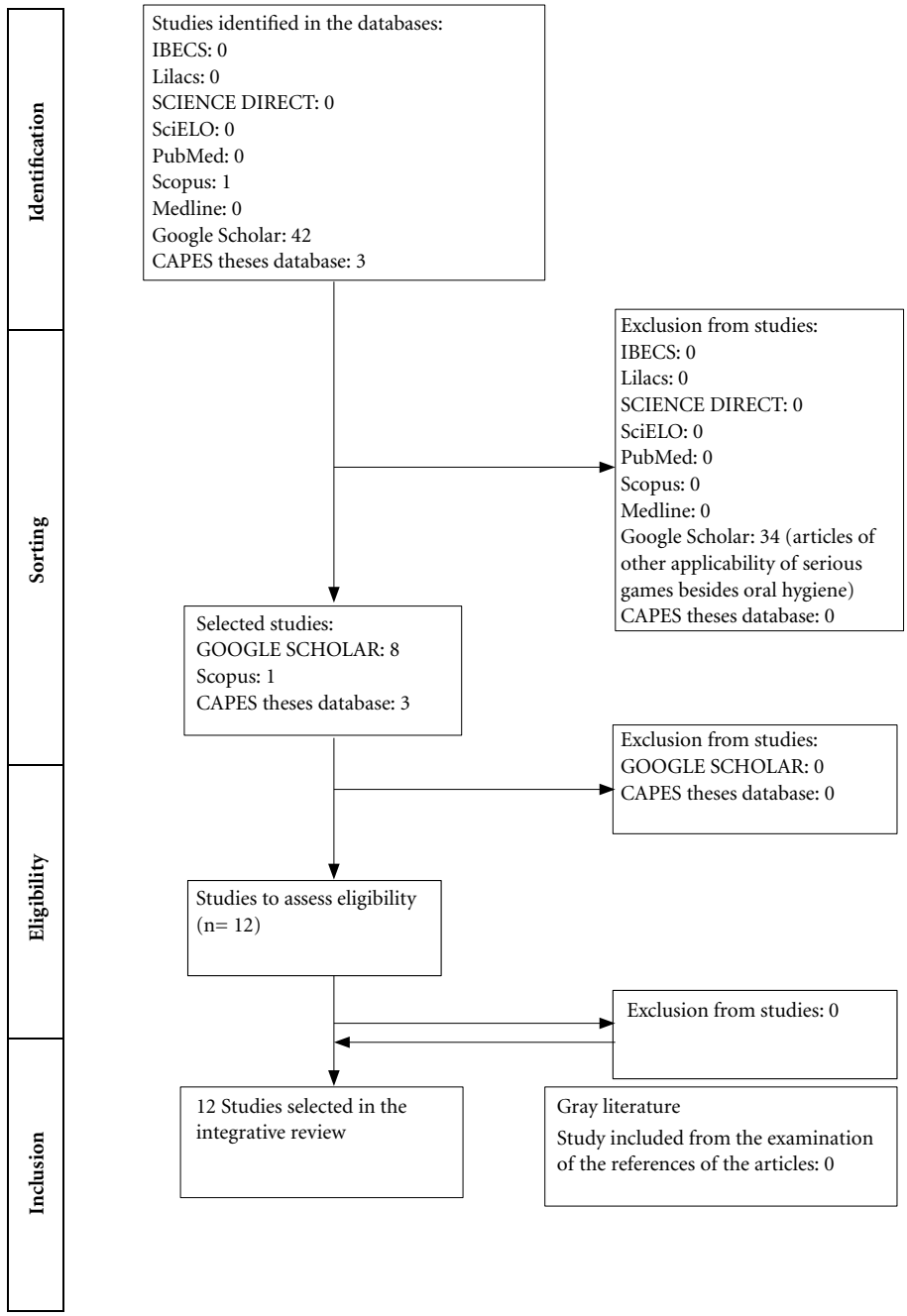

Figure 1. Flow of analysis of articles, Fortaleza/CE, 2017.

Source: Elaborated by the author (2018).

ful approach through a serious game for mobile platform. It was thought of as a support strategy during dental intervention and oral hygiene of the child with Cerebral Palsy. The game was developed based on participatory user-centered[19] *design*, game design and practices in the areas of Human-Computer Interaction (HCI). The game is based on an animated scenario and features Su-

Chart 1. *Websites* surveyed.

Repository	Website address
Repository	Website address
All doctors game	http://alldoctorsgames.com/dentist
Game salad	http://arcade.gamesalad.com
Jogos de dentista	http://jogosdedentista.com
Colgate	http://www.colgate.com.br
Oral b	http://www.oralb.com.br

Source: Elaborated by the author (2018).

persaliva as a character, as well as some requirements on the aseptic issue and motion sensor integrated into the device. The proposed application was evaluated during the dental treatment of 20 children, aiming to ascertain its efficiency as a facilitator of the supervised brushing process, having shown positive results[20].

The dissertation 'Applying Haptic Systems in *Serious Games*: A Game for Adult's Oral Hygiene Education[21] stands out for the incorporation of haptic systems for expanding the sense of realism and bringing a more attractive form of involvement. It proposes an immersive game. It also proposes a model for the development process of *serious games* in order to approach a harmonious set of approach, content and technology for correct game planning.

In the article 'A *serious game* proposal to be applied to oral health education'[22], it is intended to prove the usefulness of the haptic device in terms of its use in different age and social groups for oral health education. The article presented a proposal for the design and development of a serious game based on virtual reality for oral hygiene[22].

The dissertation 'Conception, development and application of an educational *serious game* called– I Fell Down and Lost my Tooth, So?' Reinforces the scarcity of educational materials for prevention, especially those aimed at children[23]. The proposal is to present the *serious game* I Fell Down and Lost my Tooth, So?, whose theme explored refers to dental avulsion of permanent teeth[23]. It was also based, similarly to PEPE, on the interactive *design* centered on the user[19].

Two publications bring the scientific community a more methodological perspective regarding the use of *serious games*. 'Methodological', in the sense undertaken here, assumes the concept and direction of an intervention study, like a randomized clinical trial. This sense deserves due attention since the other works presented had as a research method or a literature review or the design and development of a serious game followed by its evaluation.

These studies gained prominence due to the debate that arose about their inclusion. The debate among reviewers is recommended because it is reflective, critical and productive, as long as the method is preserved and followed carefully. In the first[24], we have the protocol of a randomized clinical trial. It deals with phase II of the intervention and was applied to children at high risk of cavities and their families. According to the exclusion criteria, observational or intervention research protocols, for example, would not be accepted. In the second[25], we have the article that was produced from this intervention. The full reading of this article was the key criterion for including both. The protocol was included because it supported the method of conducting the research, which resulted in the article 'Can oral health education be delivered to high-caries-risk children and their parents using a computer game? – A randomized controlled trial'[25].

This was the case for another study. The discussion was raised from the terms "digital game", which conceptually differs from the term "*serious games*", and "oral health", which is much more comprehensive than "oral hygiene". Similarly, after reading the entire article 'Development of an Educational Oral Health Digital Game for Children', it was decided to include it, as it is relevant and consistent with the proposed objective.

The article 'Development of an Educational Oral Health Digital Game for Children' deals with the game "Dr. Trata Dente"[26] and was based on the approach of three different topics on oral health: plaque, oral hygiene methods for plaque and dental caries control and their preventive measures. These topics were exposed in the three phases of the game. Dr. Trata Dente is represented by the figure of a dentist, who awakens in the children's imagination the image of the superhero who talks to children about oral health during the game. After its development, the game was analyzed by professionals from Dentistry, Pedagogy and Psychology (n = 9).

Searching for apps on specific websites and on *Play Store*

The search on electronic sites, with the purpose of developing games, and in the specified

Chart 2. Characterization of selected studies. Fortaleza/CE, 2017.

Authors	Year	Objective	Target Audience	Methodology	Results	Conclusion
Morais et al.[15]	2011	*Define the communication approach in the planning and development of serious games.*	Mothers and babies	The communication approach involves the following characteristics: artistic concept, type of narrative, script, plot, environment, interactivity, game genre and gameplay. These elements define how the pedagogical content is presented. The development involved pedagogical planning, a multidisciplinary team: specialist, art, design and programming. CyberMed free Framework. Planning methodology based on the communication approach with the target audience.	Mothers used both prototypes and replied to a form.	The playful approach prototype showed a slight advantage when compared to the formal approach to motivation. Regarding printing, both were tied.
Rodrigues[20]	2011	Develop and discuss haptic systems in serious games for oral hygiene for adults.	Adults		*O game touch brush game.*	Users found it easy to use the prototype haptic device.
Morais[17]	2011	Plan and develop a serious game for babies oral hygiene.	Mothers and babies		87% of mothers who interacted with the device learned some new knowledge, and 53% managed to complete the game.	The importance of application planning together with a multidisciplinary team.
Rodrigues[22]	2014	Develop a serious game about dental avulsion of permanent teeth.	Children	Mothers used both prototypes and replied to a form. O game touch brush game. 87% of mothers who interacted with the device learned some new knowledge, and 53% managed to complete the game. Game 'I fell down and I lost my tooth, So?' Children liked the game for its attractive and captivating content.	Game 'I fell down and I lost my tooth, So?' Children liked the game for its attractive and captivating content.	The proposed objectives were fully met, not only within the limits of the game, but in all the media to which the players belong: educators and family members.
Vasconcelos Filho et al.[19]	2014	Develop a serious game to support oral hygiene in patients with cerebral palsy (CP).	Children		GC with 35% of general observation, 50% in GCO and 100% in GCO_2.	The application, when used in children with CP, was a means of facilitating oral hygiene.
Morais et al.[14]	2011	*To present the methodology used in planning a serious game.*	Mothers and babies		60% were over 38 years old, 65% reported not having knowledge of computers, but this fact did not affect interaction and motivation during the game.	Formal and playful approach, with respect to printing, motivated in a similar way. However, in the aspect of involvement in the playful approach, there was greater motivation.
Morais et al.[13]	2010	Survey and analyze the games related to Dentistry present in the literature and in the games market.	-	Database research, selection of commercial games and serious games presented in educational campaigns.	In Dentistry, games focused on oral health and oral hygiene predominate, with 79% targeting children and 69% exploring oral health and hygiene.	There is a lack of games aimed at babies' oral hygiene.

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Chart 2. Characterization of selected studies. Fortaleza/CE, 2017.

Authors	Year	Objective	Target Audience	Methodology	Results	Conclusion
Morais et al.[17]	2010	Develop a serious game for babies oral hygiene .	Mothers and babies	Database research, selection of commercial games and serious games presented in educational campaigns, Storyboard, test with prototypes and evaluation.	Game 'Uma aventura na floresta da Dentolândia'.	Subjects such as oral hygiene for babies, oral hygiene for the elderly, care related to orthodontic appliances present real possibilities of use.
Aljafari et al.[23]	2015	Assess the acceptability and efficiency of an oral hygiene education game by children and parents.	Fathers and children	Clinical trial protocol. Control group: conventional educational material (oral). Intervention group: educational material through serious game.	Primary outcome: Parents and children, increase in knowledge regarding the diet measured by the application of a quiz, an increase in daily brushing and better food selection avoiding sweet foods.	There are few clinical trial protocols like this available, and it suggests that further studies in this line be carried out.
Aljafari et al.[24]	2017	Compare oral health education through a computer game with oral education.	Fathers and children	Blind randomized clinical trial. Primary outcome measured the family's level of satisfaction, improved knowledge about diet and, finally, changes in daily oral hygiene and consumption of snacks.	After 3 months, 55% had better knowledge about the diet, improved daily brushing, but little change regarding snacks.	Education through computer games can be satisfactory and effective in improving the knowledge of children at high risk of cavities regarding food care and daily brushing routine.
Dotta et al.[25]	2012	Develop a digital game on oral health for children aged 5 to 7 years.	Children between 5 and 7 years old	After development, the game was analyzed by three professionals: dentist, pedagogue and psychologist.	According to dental surgeons, the dental concepts issued are adequate. For educators, the choice of a superhero was correct and the explanations given are well elaborated. For psychologists, the game potentially has a positive effect on children's learning.	Despite the suggested changes, the game is suitable for teaching oral health through play.

Source: Elaborated by the author (2018).

companies in the field of Dentistry, identified 11 games classified as *serious games* aimed at oral hygiene.

On *Play Store*, 284 applications for Dentistry were found. *Softwares* with a dental office plot is prevalent when compared to those focused on oral hygiene education. When it comes to this plot (consulting room), there is an approach present in all games: either the game brought the story of a character who suffered some type of trauma, with toothache or with a decayed tooth.

Morais et al.[13] outlined a survey on the *serious games* in use in Dentistry. The authors observed that the available technologies were restricted to the following themes: basic concepts of oral health, oral hygiene of children and adults, going to the dentist and training professionals. There were 15 games available on the *web*, three of which were paid for and only one categorized as *opensource* – software whose source code is made available (open).

The predominance of games in a 2D environment was observed (73.3%). As for the themes, oral health showed a discreet number of more occurrences (53.84%) when compared to the theme of oral hygiene[13]. The predominant target audience was children.

It is noteworthy, according to the results presented by the authors[13], the considerable percentage (26.66%) of *softwares* for dentistry students. The game Odonto Quiz is an example. It was designed to support the study of dental prosthesis. The game proposes the immersion of the user in a very common plot in the dentistry curriculum. The game was proposed to be integrated with the practice of the dental prosthesis discipline, in which the virtual results obtained by the student can be exchanged for bonuses in the discipline[35].

The *Disney Magic Timer* app, by ORAL-B, is for free and takes longer brushing time into account. To unlock it is necessary to have the product Crest or Oral-B Pro-Health Stages. While the kids follow the recommendations of their dentist and brush their teeth for two minutes, the timer makes the experience more fun because it is animated by the kids' favorite Disney characters. Children will be delighted to have achieved new achievements each time they receive the stickers and track their daily progress on the brushing calendar. However, there is a very large focus on entertainment.

The application 'I Fell Down and Lost my Tooth, So?' Addresses a matter of concern and, at the same time, common to parents, educators and school children: tooth avulsion. This subject is commonly dealt with through pamphlets, booklets and animation. Such an application proved to be effective in the interactive approach when combined with the educational approach[22].

As the predominant target audience is the infant, it is not surprising the use of playfulness, appeal to the imaginative (e.g. tooth fairy), creativity, sonority, differentiated and graduated levels of difficulties, customizations and the presence of characters known by this audience, as in animated films (e.g. Elsa and Anna, from Frozen animation; Barbie; and Po, from Kung Fu Panda animation).

Discussion

Nowadays there is a great diversity of digital games, but those that are developed for educational purposes are still scarce, which bring the proposal of being an auxiliary instrument for the formation of healthy habits and that simultaneously engage children and their guardians.

The advent of "*serious games*" seems to corroborate the tendency to believe in the benefits of video games (e.g. GBL - Game Based Learning). The term "*serious game*" was used for the first time with a sense close to what we use today, in Clark Abt's book '*Serious Games*', published in 1970, prior, therefore, to the birth of video games[31].

According to the author of the book, serious games would be games carefully thought out with the explicit purpose of educating, this being the main objective. This does not mean that serious games are not or should not be fun.

The term, according to Djaouti[31], was adapted in its current sense for video games in the text 'The "*Serious Games*" Landscape', by Ben Sawyer[32]. In that work, the author defines a serious game as any significant use of a computer game or computer game resource, in which the main mission is not entertainment[32]. This definition is similar to that found in Michael and Chen[33].

Video games provide cognitive benefits, such as: faster and more accurate focus of attention, better performance in spatial resolution (visual processing, rotation), problem solving ability and creativity; motivational: persistent and optimistic view of the environment; emotional: improved mood and increased positive feelings; social: increase in social behaviors, such as cooperation and civic engagement[28]. Video games designed for individuals with conditions that cause learning difficulties (autism and attention defi-

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cit) and video games used as supporting methods in health care and disease prevention[29].

In the publication portraying the clinical trial[23], the authors write the term *serious* in quotation marks. Although it is an intervention study, it is not necessary to evaluate, describe or classify the artifact (game). However, the use of quotation marks draws attention. It is evident from the beginning of the research design that it is an intervention and the subsequent evaluation of an educational approach through a game. The authors prudently point out the possibility of using "*serious*" games to support oral hygiene education[24]. They also emphasize the need for more long-term studies to assess the effectiveness of such technology for educational purposes.

Educational actions in oral health and hygiene are carried out through curricular activities in undergraduate Dentistry courses, activities relevant to the services provided by the Oral Health team of the Family Health Strategy (FHS), in compliance with the requirements of the programs. To this end, they make use of flyers, *banners* and lectures with health professionals.

It is safe to take into account that the reconciliation of these educational activities with the dynamics of games can be a good strategy, since there is research that shows an effective learning in the use of this method[34].

Educational actions, when used in a dynamic environment, tend to produce better results. Creating this environment through a serious game involves multiple variables: a specialized multiprofessional team (e.g. the game *designer*), time and budget. The possibility is admitted that, when attention is paid to these variables, the conceptual foundation of a serious game is lost sight of: pedagogical action.

There are still methodological limitations in relation to *serious games*, including conceptual aspects – e.g. the translation of the term into Portuguese is not yet a consensus, as they understand that the term 'serious game' does not cover all the significance of its English counterpart.

Three assumptions are present in a *serious game*: interactive media, games and pedagogical action. There is a factor that emerges when serious games are analyzed and that was pointed out in many of the results presented here. Although the use of a character, a superhero or avatar, for example, is predominant and strategic, and the explanations given in the course of the game are well elaborated, organized and with appropriate language, the pedagogical action needs to commune with intrinsic motivating factors or extrinsic to the game. This was also the opinion of the psychologists who evaluated the artifact, the result of which was that the game has a positive motivating effect on children's learning[26]. One of the PEPE[19] game proposals is for the Supersaliva character to be a link between the patient and the dentist and that, to advance the stage, the patient demonstrates to the dentist that he has learned or developed the expected skills. With this, he wins prizes (extrinsic motivation) and phase progress.

When talking about the participation of parents in the education of their children, as promoters of learning, according to Carvalho[36], the following were not considered: historical changes and cultural diversity in the modes of education and social reproduction; the diversity of family arrangements and the material and cultural disadvantages of most families. The advancement of technology and the popularization of social networks lead us to rethink these considerations by Carvalho[36], at the same time that they challenge us to take into account the changes in modes of education and the diversity of family arrangements.

The serious games, as evidenced and, in accordance with the objective proposed in this integrative review, were developed strictly within their respective objectives, their conceptual development methodologies, their pedagogical approach and according to the evaluation methods concerning the artifacts. The very varied quality of the games available in terms of *design* and art, storyline and immersion environment, gameplay, transfer, incorporation; and the number of articles included in the research reinforces this trend. The novelty that is now perceived is the convergence of the use of such technologies applied to public health.

Reconciling technological resources with new forms of health education is a strategy that cannot be neglected either by those working in public health or by managers. Although the application of these technological resources in public health is incipient, they already have some characteristics, among which: the look focused not only on cognitive and entertainment, but also on the management and monitoring of chronic diseases, such as hypertension, for example.

Applications for monitoring high-risk pregnant women, with a view to reducing maternal and child mortality, and applications aimed at controlling blood pressure are examples of how such technologies can be powerful allies in health promotion.

Smartphone-based medical applications (*mHealth*) have facilitated self-management of

hypertension[37]. This same author states that most applications designed for hypertension strives for health management through blood pressure tracking. Consumers have a strong tendency to *download* and favorably rate apps for measuring blood pressure and heart rate. However, it affirms the need for an adequate validation of these technological resources for such purposes[37].

This scenario has awakened the academic community. In a recent study, Plate et al.[38] highlight this clinical relevance in public health. In this light, the study supports regulation by the appropriate public bodies for setting standards for safe and validated *mHealth* technologies[38].

Final considerations

Serious games focused on the health and oral hygiene of babies, pregnant women and that educate users on regular and preventive visits to the dental office are still incipient when compared to the large number of applications provided by the *Play Store*, in which the main attention is given to entertainment. Similarly, *serious games* have the proposal of being domestic tools that work simultaneously with children and their guardians in the adoption of healthy oral hygiene habits.

Thus, an area that requires a judicious, methodological-pedagogical look is highlighted, in which *serious games* and applications serve as support for health promotion, prevention and education activities.

Despite the scarcity of publications on the subject, exploring technological resources as a means of education in children's oral hygiene signals an area of knowledge with academic potential and with applications in public health.

New reviews should be undertaken, in order to confirm the impact of *serious games* on education and the adoption of healthy oral hygiene habits in a family environment. The small number of studies used for this research can be interpreted as a limitation for the generalization of the data. However, it can also be useful, as a subsidy for more technologies to be developed and more studies to be done.

Collaborations

ER Morais participated in the conception, planning, analysis, interpretation of the PRISMA protocol and writing of the work. CMAC Vergara participated in the interpretation of data and analysis of the writing of this article. FO Brito was another reviewer of the PRISMA protocol, contributing to the formatting and discussion aspects of the election of some articles. HAC Sampaio brought contributions to the critical review of the discussion section.

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