DESIGN OF A MOBILE APPLICATION TO PROMOTE ORAL HEALTH IN CHILDREN

PROJETO DE UM APLICATIVO MÓVEL PARA PROMOVER A SAÚDE BUCAL EM CRIANÇAS

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Abstract

Objective: This study aimed to describe the construction of a mobile application designed to promote children's oral health. **Materials and Methods:** The application was named "Dente de Leite". The development of the application prototype followed a serial sequence of steps: planning, design, implementation and alpha testing, beta testing and feedback analysis, mobile application publication, release, and maintenance. The tools used to develop the application were Android Studio, the Flutter framework, and Firebase. Dart was chosen as the programming language. The Android Studio tool was used to build the application's functionality. **Results:** The content selection was based on the child's guidance and development curve, and included content such as tooth eruption, feeding, development of oral functions, harmful habits, prenatal dentistry, oral hygiene and care, and dental trauma. **Conclusion:** These findings suggest that mobile applications, such as the "Dente de Leite" app, could significantly contribute to health promotion activities and benefit the practice of oral health professionals.

Keywords: Mobile applications; oral health; children; health promotion; healthcare.

Resumo

Objetivo: Este estudo teve como objetivo descrever a construção de um aplicativo móvel projetado para promover a saúde bucal das crianças. **Materiais e Métodos:** O aplicativo foi denominado "Dente de Leite". O desenvolvimento do protótipo do aplicativo seguiu uma sequência de etapas em série: planejamento, design, implementação e teste alfa, teste beta e análise de feedback, publicação do aplicativo móvel, lançamento e manutenção. As ferramentas usadas para desenvolver o aplicativo foram o Android Studio, Flutter framework e Firebase. O Dart foi escolhido como a linguagem de programação. A ferramenta Android Studio foi usada para criar a funcionalidade do aplicativo. **Resultados:** A seleção do conteúdo foi baseada em orientações de saúde e curva de desenvolvimento da criança, e incluiu conteúdos como erupção dentária, alimentação, desenvolvimento das funções orais, hábitos nocivos, odontologia pré-natal, higiene e cuidados orais e traumatismo dentário. **Conclusão:** Esses achados sugerem que os aplicativos móveis, como o aplicativo "Dente de Leite", podem contribuir significativamente para as atividades de promoção da saúde e beneficiar a prática dos profissionais de saúde bucal.

Palavras-chave: Aplicativos móveis; saúde bucal; crianças; promoção de saúde; cuidados de saúde.

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Introduction

Mobile applications are software programs designed to be used on mobile electronic devices to facilitate everyday tasks[1]. Mobile technology has been driven by the increasing use of smartphones for functions other than interpersonal communication, such as mobile health (m-health), which is a digital strategy for delivering health services based on information technology tools[2,3]. The importance of m-health was reinforced during the global COVID-19 pandemic when there was an increase in the frequency of teleconsultations and other services mediated by mobile technologies[4,5].

M-health may provide an electronic platform that supports the management, monitoring, collection, and dissemination of information and healthcare services, to improve the quality-of-service delivery, reduce space-time constraints, expand coverage and engagement, and reduce costs[6,7]. In this context, pediatric dentistry is a field that can benefit from the use of digital tools, as they have great potential to support information transfer activities and the promotion of children's oral and dental health[8,9].

In Brazil, a country with continental dimensions, high social inequality, and problems of access to oral health care[10], the expansion of m-

health could help optimize the provision of oral health interventions. According to data from the 2010 Brazilian Oral Health Survey, an estimated 53.4% of 5-year-old children and 56.5% of 12-year-old children had dental caries[11]. In addition, Brazilian regional disparities in access to dental services, the profile of dental procedures, and the concentration of dentists may affect caries indicators[12,13].

Therefore, the purpose of planning this application was to combine mobile technology with health promotion activities to help parents and caregivers monitor children's oral health. This study aimed to report on the planning steps, software construction, and presentation of the digital tools of a prototype mobile application for use in children's oral health promotion activities.

Materials and Methods
Study Design

This study describes the design of a mobile application to promote children's oral health. This study was conducted at the Federal University of Maranhão, São Luís, Maranhão, Brazil, and is associated with a technological development and innovation project. The methodology used was of the Research and Development (R&D) type, associated with technological research, in which a new product was created to promote oral health knowledge among the population.

Prototype development

The development of the application prototype followed a serial sequence of steps to meet the diverse characteristics involved in the process of creating an application, ranging from scientific research of content to the application of information technology activities[14]:

- Planning: The process of understanding, defining system functions, and identifying constraints, both operational and developmental.
- Design: Transforming a system specification into a working system, describing the software structures and interfaces of the system components, i.e., building the system architecture.
- Implementation and alpha testing: Proving that the system meets the specifications and satisfies the user's needs. This can be done through simulated testing.

- Beta testing and feedback analysis: The objective is to evaluate the experience of users who have used the delivered versions of the application for testing and to identify any bugs or lost functionality so that they can be addressed before the official release of the application.
- Mobile application release: The system is put into operation. The publication in the application stores follows a relatively simple and well-documented process on the official sites of the stores.
- Release and maintenance: This stage can be lengthy and involves the discovery and correction of bugs that were not verified in the previous stages.

The tools used to develop the application were Android Studio, the Flutter framework, and Firebase. Dart was chosen as the programming language. The Android Studio tool was responsible for building the application's functionalities. The Flutter framework was used to build the application's user interface. Finally, the Firebase platform integrated the data. Together, these tools made it possible to develop complete, high-quality software.

The evolutionary prototyping methodology was chosen to improve the application and its interface, in which more complete versions of the software can be made available after updating the tools present in the program. This process of creating and evaluating prototypes can be repeated several times until the system is completed[15].

Content selection

The content development process was a narrative review of the major concepts of pediatric dentistry with a focus on early childhood, defined as the period from birth to 6 years of age. The selection of content was based on the guidance and developmental curve of the child and included content such as tooth eruption, nutrition, development of oral functions, harmful habits, prenatal dentistry, oral hygiene and care, and dental trauma. After preparing the theoretical part, the content produced was validated by a second person with an academic background in dentistry and a specialization in pediatric dentistry. Table 1 shows the description of the learning objectives for each piece of content included.

Table 1. Learning objectives for the thematic content included in the application.

Title	Objective	Content	Number of pages	Type of resource
Tooth eruption	Guide to the chronology of eruption and possible changes (natal and neonatal teeth).	Onset of dental eruption; Natal and neonatal teeth; Timing of eruption; General guidelines.	9	Infographic
Nutrition	Educate parents on healthy eating habits.	General guidelines; 12 steps to healthy eating according to the Brazilian Ministry of Health.	15	Infographic
Development of oral functions	Relating oral development to speech and dentition.	General guidelines; Stages of communication.	4	Infographic
Harmful oral habits	Educational information about harmful oral habits and their consequences.	General guidelines; Consequences of harmful oral habits; Frequently asked questions about the use of artificial nipples.	6	Infographic
Prenatal dental care	Emphasize the importance of dental care during pregnancy.	General guidelines; Reasons for prenatal dental care.	5	Infographic
Oral hygiene and care	Reinforce the importance of oral care and provide guidance on oral hygiene.	General guidelines; How to start oral hygiene; Toothbrush, toothpaste, and floss guides; Oral hygiene instructions; Suggested oral hygiene video.	9	Infographic
Dental trauma	Helping and preparing parents in cases of dental trauma	Instructions for dealing with different types of dental trauma.	3	Infographic

Application features

The main features of the app were listed after considering the two target audiences of the app (Table 2). After selecting the content and conducting the initial prototyping of the app, the online graphic design platform was used to create the visual identity of the app and to create the infographics in the guidance and development curve section. The visual part of the app followed the guidelines of a professional in the field of visual communication.

Table 2. Application features according to target audience.

| App sections	Parents and guardians	Dental surgeon
Records	To be aware of all the data related to the child's oral health.	To serve as a digital medical record, in which the professional will record all the information about the child's oral health.
Guidance	Learn about a variety of oral health topics.	Provide thematic guidance to parents and guardians.
Curve	Record the child's progress through the stages and know the developmental milestones to identify any delays.	Monitor the child's development and supplement the digital health record with information recorded by parents.
Treatment	Be aware of the treatments performed.	Record all procedures performed on patients.
Questions	Answer questions about information not covered in the Guide or Curve section.	Answer questions from parents and caregivers about their child's oral health. Know how to prepare content for the Guidance and Curve sections.
Health Units	Access the location of the nearest health facilities in case you need help.	Register your location so your parents and guardians will know if you need help later.

Results

The application's visual identity was designed with a bright and attractive color palette to attract the attention of the target audience. The fonts to be used for the textual elements presented were determined, opting for legible fonts that would appeal to children. Finally, the representative logos for the application were created, including the chosen name "Dente de Leite" as a reference to the eruption of deciduous teeth, combined with the previously defined color palette (Figure 1A). The Main Menu screen displays all the main functions designed for the application: Record, Guidance, Curve, Treatment, Questions, and Health Units (Figure 1B).

Figure 1. Composition of the visual identity of the "Dente de Leite" application, including color palette, logos and text font (A), main menu screen of the application (B).

Two initial registration templates were created: one for the child/guardian (Figure 2A) and one for the dentist (Figure 2B). The questions section was designed in text form so that parents and guardians could send their questions to the professionals (Figure 2C) or access answers to frequently asked questions (Figure 2D).

Figure 2. Child/Guardian registration screen (A), Dentist registration screen (B), Parent/Guardian section for submitting questions about the child's oral health (C), and Frequently Asked Questions section (D).
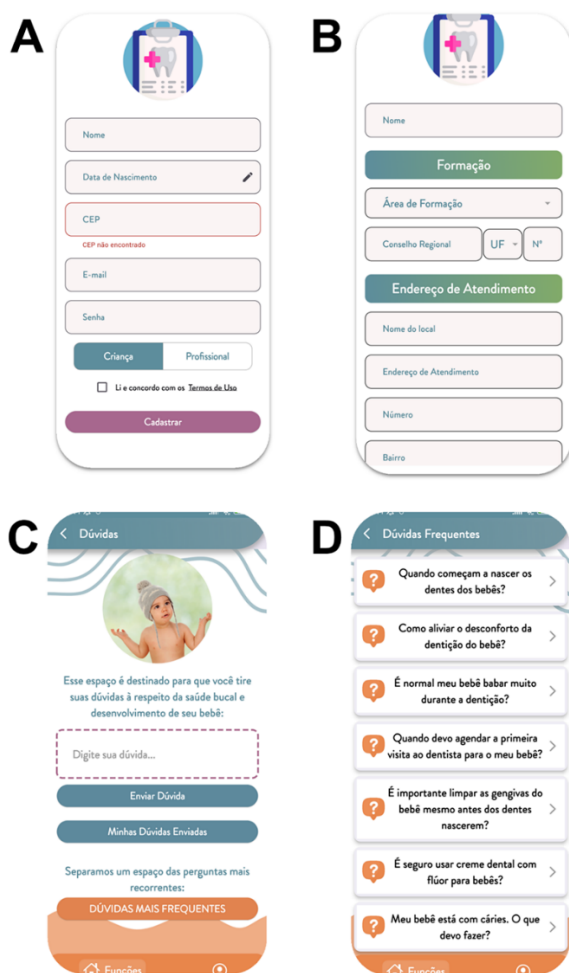
The infographics were directed to the Guidance and Curve sections. In the Guidance section, strategic content was defined for the preparation of initial content, as the application could be updated in the future and present a greater variety of information. Initially, the following topics were identified: tooth eruption, nutrition, development of oral functions, harmful habits, prenatal dental care, oral hygiene, and dental trauma.

The oral hygiene instructions emphasized information such as how to choose a toothbrush and toothpaste, how much toothpaste to use, how to use dental floss, and tips on how to get children to start brushing their teeth (Figure 3A). As support material, cartoons on the YouTube platform were suggested to teach and encourage children to brush their teeth (Figure 3B). Content on the importance of prenatal dental care was presented in a very relaxed and welcoming manner to encourage pregnant women to seek dental care during pregnancy (Figure 3C). Guidance on the prevention of harmful habits included the use of pacifiers and bottles and their main implications and clarified the most common questions about the use of artificial nipples (Figure 3D).

Figure 3. Screenshots of the guidance section with different content such as oral hygiene (A), complementary videos (B), prenatal dental care (C), consequences of harmful oral habits (D).

Figure 4. Screenshots of the Curve section (A - C) and the Health Units section (D).

In the Curve section, information was provided on the chronology of eruption, orofacial development, and the appearance of natal and neonatal teeth. The stages of communication have been addressed and explained within the topic of oral function development, highlighting some developmental milestones so that parents can be alert to cases such as speech delay (Figure 4A). The curve section can be assessed by recording the first words, taking into account the child's overall context (Figure 4B). In addition, parents and caregivers can record the eruption dates of each of the child's teeth. In this way, they can not only create a source of memories but also record information relevant to the child's dental history (Figure 4C). In addition, a geo-referenced map was developed to help users locate health centers that provide dental care (Figure 4D).

Discussion

This study describes the steps taken to develop an application for joint use by parents/guardians and dentists to reinforce guidelines and monitor children's oral health. The Guidance and Curve sections of the application were developed after the software was designed and built according to its technical specifications. The Curve section is designed as a tool to record information about the orofacial developmental curve. This mobile application can help dentists identify possible deviations in the chronology of tooth eruption and the development of orofacial functions. In addition, this application could serve as a remote support method in oral health promotion activities and potentially reduce oral diseases.

In light of what has been developed, it can be seen that the visual identity is an indispensable component in the creation of a mobile application. The elements that make it up must be carefully considered with the aim of creating an image that belongs to the application, is friendly and unique, and attracts the attention of the target audience by arousing emotions and sensations[16]. Consumers of mobile applications today are increasingly demanding when it comes to the representation of the product, so it is essential that the visual identity makes it possible to create a link between the product and the consumer[17].

In addition, it is important to note that mobile devices are useful tools for delivering health interventions due to their widespread use, powerful technical capabilities, and portability - people tend to have their mobile phones with them most of the time and form strong emotional ties to them. With the unprecedented growth in the use of technology in everyday life, the use of mobile applications is likely to play an increasingly important role in dentistry[18-20].

For the app presented in this study, the topics to be initially developed (Guidance and Curve sections) were selected in a structured manner. Oral health guidance is the main tool for promoting habit and behavior change, as it allows people to be guided through the transfer of information[21,22]. Furthermore, to promote oral health in children, it is necessary to guide parents and guardians, as they are responsible for guiding their children's eating and oral hygiene routines[23].

A systematic review has indicated that children's self-care apps, educational programs such as animations, and picture books were the most commonly used resources to teach tooth brushing, as children are highly influenced by animations and images and are stimulated to brush their teeth[18]. In addition, it was found that several apps primarily targeted at children used games to entertain and motivate children to observe oral hygiene, reduce their fear of the dental environment, and familiarize them with the dental environment and procedures. Therefore, the Guidance section is essential to guide oral health-related behaviors by attractively providing content on healthy habits and using complementary videos.

In addition, a study evaluating the effectiveness of using an oral health education app for mothers of children found that after one month, the apps were effective in improving mothers' oral health knowledge and practices, while oral health as measured by plaque control, as measured by the visible plaque index, was higher in children of mothers who used the gamified app. The authors report that health behaviors are established during childhood and that mothers play a key role. The authors also emphasize that future studies should focus on mothers' oral hygiene, as their oral hygiene practices also affect their children[24].

The next steps being planned by the team are to add all of the planned tools and to evaluate the effectiveness of the use of the app by a sample of the child's caregivers. This study will then examine the items with the highest frequency of use and the tools that require adaptation and modification. By using a quantitative-qualitative methodology to collect and analyze data, updated versions of the software can be more targeted. In addition, the effectiveness, efficiency, and satisfaction indicators will be evaluated, as these are important aspects to assess the usability of mobile applications that address oral health actions and aim to promote the adoption of healthy habits for the preschool population in general[25].

In this context, the app can allow the exchange of health information between the child's guardian and the dental professional. It is important to note that mobile oral health apps can be equipped with more modern tools or devices, such as sensors, cloud computing, or even online consultations. Therefore, further studies on children's oral health needs are recommended to guide the development of future apps.

CONCLUSION

The use of applications for mobile devices in the health sector has strengthened health promotion and disease prevention activities and can have a positive impact on oral health. Therefore, the improvement of the "Dente de Leite" app can significantly contribute to health promotion activities and benefit the practice of oral health professionals.

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