

Development of a Mobile Application for Acquiring Clinical and Laboratorial Skills and Abilities in Pediatric Dentistry and Orthodontics

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Abstract

Objective: To develop an educational mobile application as a dynamic platform provided free of charge, including several clinical and laboratory protocols for a wider range of skills and greater knowledge on the strategic axes of child dental care: Pediatric Dentistry and Orthodontics. **Material and Methods:** The prototype tool was structured as follows: development of clinical and laboratory contents to be addressed, software selection, layout format, inclusion of features, applicability and acceptability tests of the operational system, and indexation on the Play Store® application store (free of charge). **Results:** The mobile application has shown to be a tool capable of storing and providing data through various audiovisual media formats on clinical and laboratory contents of child dental care. Media resources were developed for the following themes: restorative dentistry in pediatric dentistry, radiographic techniques with pediatric patients, pulp therapy in deciduous teeth, traumatic injuries in the primary dentition, and preventive and interceptive orthodontics. The short-duration multimedia content, with different audiovisual formats, proved to be coherent with the peculiarities of each procedure, enabling to better visualize and understand the techniques. Moreover, the rewind, fast forward, and pause features were included in the mobile application, as well as the possibility of saving print screens, as well as highlighting and searching for contents of interest. **Conclusion:** The OdontoPed-Helpbox® demonstrated to be able to reach new strategies for the dynamic teaching-learning process, through operational efficiency. It proved to be a useful and instant tool for providing information to support clinical decision making in Dentistry.

Keywords: Mobile Applications; Telemedicine; Pediatric Dentistry; Orthodontics.

Introduction

The innovation process in education, when well-structured, can fill gaps that could only be previously filled by traditional and linear teaching methods, thus enabling to improve communication, creation, and learning [1]. Technological tools and devices have been playing an increasingly fundamental role in health sciences, being able to contribute to the dynamic process of teaching-learning and act as a method of social and educational transformation, compatible with current prospects and with the evolving profile of the population [1,2].

The use of Information and Communication Technology (ICT) for modeling the teaching-learning process through educational audiovisual contents has proved to efficiently interact, collaborate and develop new forms of knowledge, increasing the autonomy of users and enabling them to play an active role in their learning process [2-4].

In Dentistry, the increasing use of smartphone applications has enhanced the diagnosis and clinical decision-making process, through instant access to digital platforms [5,6]. Several studies have demonstrated the development and effectiveness of mobile applications in different areas, such as in oral health education [7,8], in the diagnosis of oral cancer [9], endodontic complications [5], and as a training tool for oral and maxillofacial surgery [6].

Although throughout their university degree, students may identify deficiencies in the diagnosis of certain pathologies and their respective therapeutic approaches in pediatric patients [10], the availability of digital tools in the area of child dental care is still scarce. With this in mind, this study aimed to develop an educational mobile application, OdontoPed-Helpbox®, as a dynamic platform provided free of charge, including the main clinical and laboratory protocols for acquiring a multitude of skills in both structuring axes of child dental care: Pediatric Dentistry and Orthodontics.

Material and Methods

Study Location

The mobile application OdontoPed-Helpbox® was developed in the Faculty of Dentistry of the Federal University of Alagoas, in the city of Maceió, Brazil. The content selected for its development included clinical and laboratory protocols on the subject of child dental care, consisting of Pediatric Dentistry and Orthodontics.

Pilot Study

The prototype was developed in a structured manner, according to the following steps: content development, software selection, layout format, insertion of features, applicability and acceptability tests of the operational system, indexation, and free availability on the Play Store® application store.

Content Development

The selection of subjects to be included in the application preferably comprised contents regarding the clinical routine of ambulatory care in the field of child dental care. Therefore, the following subjects were explored: restorative dentistry in pediatric dentistry, radiographic techniques with pediatric patients, pulp therapy in deciduous teeth, traumatic injuries in the primary dentition, as well as preventive and interceptive orthodontics. Besides, topics related to the production of preventive and interceptive orthodontic appliances

were also developed. All protocols were established according to systematic reviews of international guidelines based on high-level scientific evidence [11-17].

Each subject was assessed in conceptual and creative terms to reach an ideal educational content for each type of protocol. Therefore, different image and video processing techniques were explored, such as the use of slides, videos, hybrid images, and stop motion, as well as slow-motion and fast-motion videos. It was idealized that each produced media had a short period of execution, and a neutral and dark background was selected for their production. All photographs and videos were edited using Adobe Photoshop® and Adobe Premiere® software, respectively.

Layout Format and Inclusion of Features

The layout of the application was developed using Adobe Illustrator® software. The logo, brand, objects, and shapes of the mobile application were designed so to enable to resize of the images without any loss of quality, due to the wide range of scales available in current smartphones.

The application was developed in native Android, using Java (back-end) and XML (front-end) as the programming language. The program used was Android Studio®. YouTube® (video reproduction) and Firebase® (database) were used as external APIs (Application Programming Interfaces).

The layout was based on the educational classification of the constituting axes of the subject of child dental care, i.e., Pediatric Dentistry and Orthodontics. The respective subjects were subsequently listed in tabs containing the protocols in the formats of videos and texts, to enable on-line or off-line access. Moreover, links were also added to the layout, enabling the user to mark the content as favorite and access the media content in the search area.

Applicability Tests of the Operational System

Functionality and acceptability tests were carried out in the mobile application. Until its final version, all structuring and functional elements were duly tested until an acceptable version was obtained, without any predicted instabilities, such as tab, resize and/or interface inefficiencies. Therefore, cyclical usability testing was performed based on system error codes. For this purpose, each feature was tested on the system layout and interface with Youtube® and Firebase®. Also, possible mistakes on the layout were verified using different smartphone screen sizes.

App Indexing

The OdontoPed-Helpbox® application, in its 1.0 version, was finalized and indexed on Play Store®, available free of charge (<https://play.google.com/store/apps/details?id=sam.gurio.odontoapp>).

Results

The OdontoPed-Helpbox® application proved to be a tool capable of storing and providing data using audiovisual media contents on clinical and laboratory subjects of child dental care, being indexed on Play Store®. Table 1 shows the contents developed regarding each specialization involved in child dental care. The layout and operational system of the mobile application are shown in Figure 1.

The content was reproduced using the most suitable audiovisual formats, considering the particularities of each procedure, and aiming at better visualizing and understanding each technique. Figure 2

shows the clinical protocol of pulpectomy in deciduous teeth, according to the instrumentation technique. Figure 3 illustrates a Nance appliance produced in the laboratory for mixed dentition.

Table 1. Specialization, procedure and duration of media content produced.

Specialization	Procedure	Duration
Restorative Dentistry	Rubber dam isolation	1:47
	Sealants	1:13
	Biological restoration	2:41
	Stainless steel crown	2:56
Radiology	Radiographic techniques	6:11
Endodontics	Coronary opening of incisor, canine, upper and lower molar deciduous teeth	5:13
	Indirect pulp capping	0:32
	Direct pulp capping	0:54
	Pulpectomy with MTA/CH	0:57
	Pulpectomy with formocresol	0:54
	Pulpectomy with CH	1:59
	Pulpectomy with CTZ	0:53
Traumatic Injuries in the Primary Dentition	Trauma to the soft tissues	3:07
	Trauma to the supporting tissues	5:10
Preventive and Interceptive Orthodontics	Band and loop	5:13
	Nance appliance	3:56
	Orthodontic retainer	9:42
	Button or clints	1:33
	Inclined plane	2:25

MTA: Mineral Trioxide Aggregate; CH: Calcium Hydroxide; CTZ: Chloramphenicol, Tetracycline, Zinc Oxide and Eugenol.

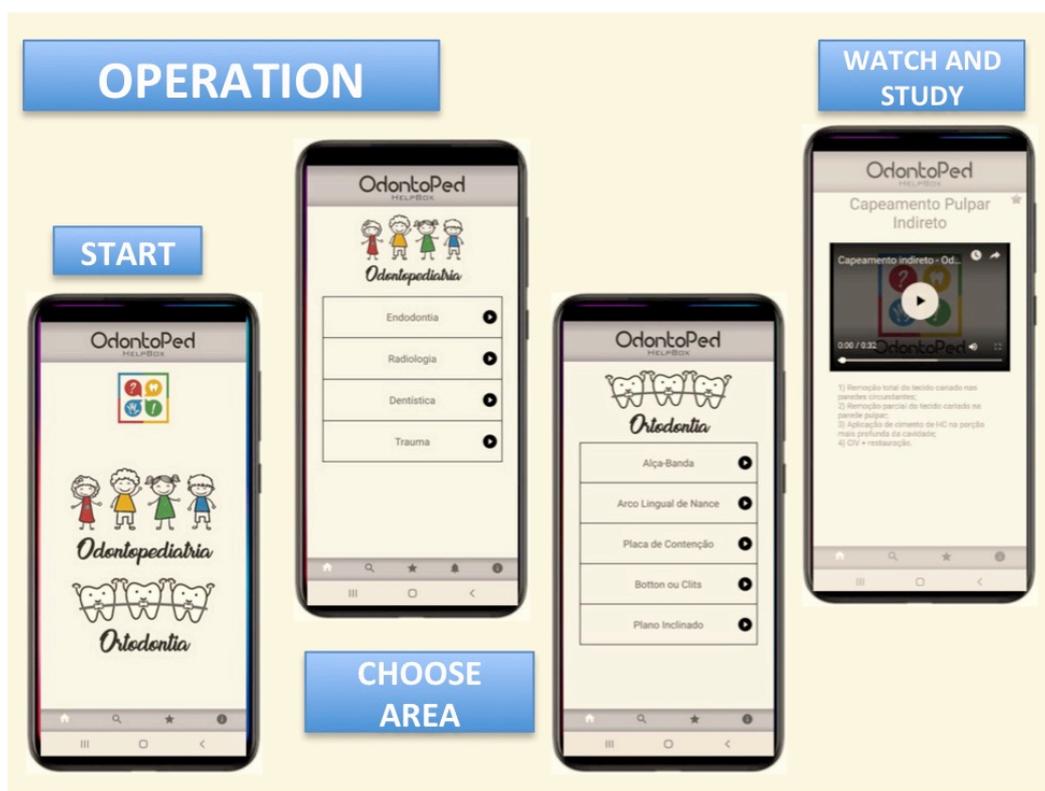


Figure 1. Layout and operational system of the OdontoPed-Helpbox® application.

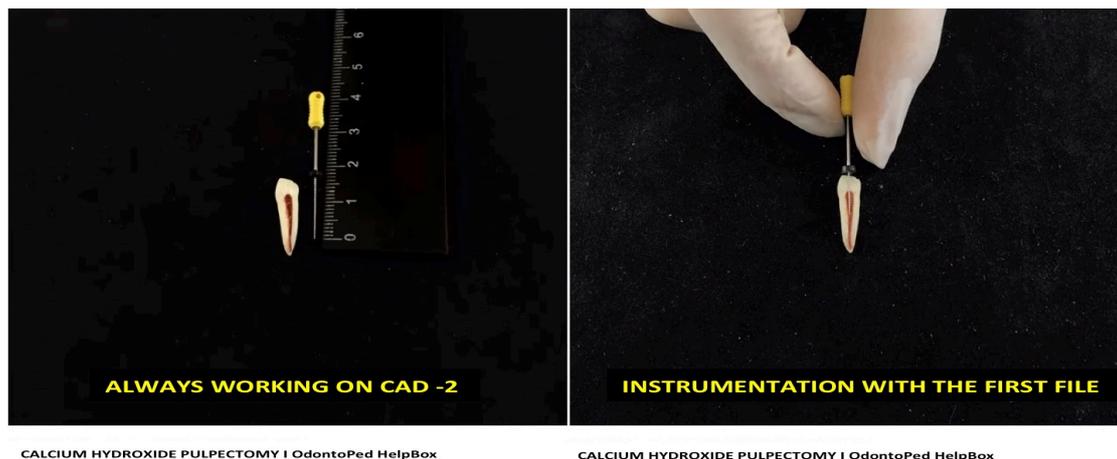


Figure 2. Video produced in stop motion for the technique of pulpectomy in deciduous teeth. CAD: Apparent Tooth Length; HC: Calcium Hydroxide.



Figure 3. Fast motion video to produce a Nance appliance in mixed dentition.

Discussion

This study enabled to adapt the educational content of the structuring axes of the subject of child dental care, Pediatric Dentistry and Orthodontics, to the current Information and Communication Technologies (ICT), exploring the use of mobile applications for smartphones. The results found demonstrated dynamic and educational media resources for easy access to the clinical and laboratory contents of the discipline.

Studies carried out with undergraduate students have shown the difficulties found by students in obtaining theoretical and practical content related to child dental care [10,18]. The constant biological development to which the child is subject and the particularities inherent to the pediatric physiological and anatomical constitution seem to be related to the barriers encountered by the students in the better visualization and understanding of the approaches directed at the infant patient [10].

The longevity of the acquired knowledge is significantly affected according to the learning process with which it is related [10]. Mobile learning comes from the interrelation between portable technology (use of mobile communication devices) and e-learning (learning facilitated and mediated by computing information

and communication) [19], and has shown promising results as support in the transmission of knowledge in health sciences [3-9,20].

In the present study, the sequenced simulation of the clinical and laboratory protocols of child dental care demonstrated; as a result, dynamic and educational media resources with a short reproduction period, based on current international guidelines with high scientific evidence [11-17]. In the field of oral and maxillofacial surgery, previously developed applications have shown effectiveness in their reach through the quick and easy availability of protocols and therapeutics pertinent to their use, as well as guidelines to technical approaches and better visualization of the biological structures involved [6], characteristics displayed in this pediatric tool developed.

Besides, in this study, it was possible to address aspects related to traumatic injuries in supporting and soft dental tissues of primary teeth, according to the guidelines established by the International Association of Dental Traumatology (IADT) [16]. For each type of traumatic injury, it was combined its simulation in a model, descriptions relevant to the related clinical and radiographic findings, clinical case in high definition of the lesion, the respective treatment, follow-up procedures, and outcome. In a recent study, the use of mobile applications as support tools for clinical decision-making in dental trauma demonstrated effectiveness for dentistry students and experienced pediatric dentists [20].

However, since clinical interventions for dental trauma require prompt performance by the professional, the difficulty of handling the applications currently available for the topic can act to impair the accuracy of emergency care [20]. Also, visual pollution from commercial advertisements and the insufficient amount of information on the diagnosis and treatment of traumatic injuries have been reported as harmful to the functionality of such applications, leading to the installation of various mobile applications by the user [21]. In order to avoid such disturbances, the mobile application developed in this study offers fast and practical access to the user, as well as content relevant to the main clinical themes that involve the care of infant patients. In addition, the OdontoPed-Helpbox® tool was developed for exclusively academic purposes, thus excluding any possibility of pop-ups that may harm the transmission of content to the user.

The incorporation of methods that have proven to benefit learning in educational technologies for the continuous development of health professionals consists of one of the essential pillars, based on evidence, for the effectiveness of the ICT applied [3]. Considering this, the use of audiovisual resources has been widely explored due to its wide teaching capacity, resulting from the ability to retain the individual's attention [22]. The mobile application developed in this study offers the user the possibility to move back, forward, and pause the chosen media, save screen images, highlight, and search the contents, favoring the repetition of their access and reproduction. This type of handheld technology has not only demonstrated to be a successful learning support tool, but it has also shown the potential of transforming how individuals can learn and interpret the knowledge acquired [23].

Some limitations can be identified regarding the present study. Since specific platforms for child dental care are scarce in the scientific literature, the comparative analysis regarding the development of this mobile application with other available tools has not been verified. The indexing of OdontoPed-Helpbox® to only one mobile application store makes its access exclusive to Android® smartphone users, which, although covers a large part of the population, does not reach all potential users. Thus, it is suggested that future versions of the application include a greater variety of virtual stores, in order to democratize the acquisition of the platform. Besides, future studies that assess the impact of the tool on the acquisition or improvement of knowledge are necessary, aiming at optimizing the theoretical and/or practical evolution of its future versions.

Conclusion

The OdontoPed-Helpbox[®] demonstrated to be able to reach new strategies for the dynamic teaching-learning process through operational efficiency. It proved to be a useful and instant tool for providing information to support clinical decision making in Dentistry.

Authors' Contributions

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All authors declare that they contributed to critical review of intellectual content and approval of the final version to be published.

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Conflict of Interest

The authors declare no conflicts of interest.

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