Evaluation of usability, perception of usefulness, and validation of a restorative dentistry study app

Edison Augusto Balreira Gomes[1,2]
0000-0001-9093-6037

Talyne Albuquerque Ximenes[2]
0009-0005-291-8798

Erick Ibraim Carlos da Costa[2]
0009-0001-6155-9882

Damile Pinheiro Machado[2]
0009-0000-5334-6599

Jéssica Pontes Cavalcante[2]
0000-0001-8568-0401

Paulo Goberlânio de Barros Silva[2]
0000-0002-1513-9027

Edgar Marçal de Barros Filho[3]
0000-0001-5037-2724

Juliana Paiva Marques Lima Rolim[2]
0000-0003-1299-0366

[1]Universidade de Fortaleza (UNIFOR), Fortaleza, Ceará, Brasil.
[2]Centro Universitário Christus (UNICHRISTUS), Fortaleza, Ceará, Brasil.
[3]Universidade Federal do Ceará (UFC), Fortaleza, Ceará, Brasil.

Correspondence:
Juliana Paiva Marques Lima Rolim
E-mail: julianapml@yahoo.com.br

Abstract The objective was to develop an application, evaluate its usability and perceived usefulness, in addition to validating it in different groups to identify which group is most targeted at. The "Restorative Procedures Clinical Study Guide" was developed by experts on Restorative Dentistry. The content is accessed through two tabs: "Materials Guide", which presents the materials and protocols, and "Dental Assessment", which directs the user to the degree of tooth involvement, pulp condition and directs them to a treatment protocol specific. The evaluation was carried out by 15 specialists in restorative dentistry using the System Utility Score (SUS) usability scale and the Technology Acceptance Model (TAM). It was validated by third, fifth and tenth semester undergraduate students, lato sensu postgraduate students in dentistry and primary care dentists in Fortaleza, Ceará, Brazil (n=15). Participants used and evaluated the application using the SUS and TAM questionnaires. The values obtained were compared using the Wilcoxon test and Spearman correlation. In the evaluation by a specialist, scores of 90.6 were obtained in the SUS and 68.0 in the TAM. In validation, overall scores of 87.7 and 91.2 were obtained for SUS and TAM, respectively. When comparing groups, scores were higher for undergraduate students compared to professionals, SUS (p=0.037) and TAM (p=0.031). The application provides clinical information support for the dental community, proving to be a potential study guide for professionals and students, being more targeted at undergraduate students.

Descriptors: Telemedicine. Education, Dental, Continuing. Dentistry, Operative.

Evaluación de usabilidad, percepción de utilidad y validación de aplicacíon de studio de odontología restauradora

Resumen El objetivo fue desarrollar una aplicación, evaluar su usabilidad y utilidad percibida, además de validarla en diferentes grupos para identificar a qué grupo está más dirigida. La "Guía de estudio clínico de procedimientos restaurativos" fue desarrollada por expertos en Odontología Restauradora. Se accede al contenido a través de dos pestañas: "Guía de Materiales", que presenta los materiales y protocolos, y "Evaluación Dental", que dirige al usuario al grado de afectación dental, estado pulpar y lo dirige a un protocolo de tratamiento específico. La evaluación fue realizada por 15 especialistas en odontología restauradora utilizando la escala de usabilidad System Utility Score (SUS) y el Modelo de Aceptación de Tecnología (TAM). Fue validado por estudiantes de tercer, quinto y décimo semestre de pregrado, estudiantes de posgrado lato sensu en odontología y odontólogos de atención primaria de Fortaleza, Ceará, Brasil (n=15). Los participantes utilizaron y evaluaron la aplicación mediante los cuestionarios SUS y TAM. Los valores obtenidos se compararon mediante la prueba de Wilcoxon y correlación de Spearman. En la evaluación por especialista se obtuvieron puntuaciones de 90.6 en el SUS y 68.0 en el TAM. En la validación se obtuvieron puntuaciones globales de 87.7 y 91.2 para el SUS y el TAM, respectivamente. Al comparar los grupos, los puntajes fueron mayores para los estudiantes de pregrado en comparación con los profesionales, SUS (p=0.037) y TAM (p=0.031). La aplicación brinda soporte de información clínica para la comunidad odontológica, demostrando ser una potencial guía de estudio para profesionales y estudiantes, estando más dirigida a estudiantes de pregrado.

Descriptores: Telemedicina. Educación Continua en Odontología. Operatoria Dental.

Avaliação da usabilidade, percepção da utilidade e validação de um aplicativo de estudo em dentística restauradora

Resumo O objetivo foi desenvolver um aplicativo, avaliar a usabilidade e a utilidade percebida, além de validá-lo em diferentes grupos para identificar qual grupo mais se direciona. O "Guia de Estudo Clínico de Procedimentos Restauradores" foi desenvolvido por *experts* em Odontologia Restauradora. O conteúdo é acessado por

meio de duas guias: "Guia de materiais", que apresenta os materiais e protocolos, e "Avaliação odontológica", que direciona o usuário para o grau de envolvimento dentário, condição pulpar e o encaminha para um protocolo de tratamento específico. A avaliação foi realizada por 15 especialistas em dentística restauradora usando a escala de usabilidade *System Utility Score* (SUS) e o Modelo de Aceitação de Tecnologia (TAM). Foi validado por alunos de graduação do terceiro, quinto e décimo semestre, alunos de pós-graduação *lato sensu* em Odontologia e dentistas da atenção primária de Fortaleza, Ceará, Brasil (n=15). Os participantes usaram e avaliaram o aplicativo usando os questionários SUS e TAM. Os valores obtidos foram comparados por meio do teste de Wilcoxon e da correlação de Spearman. Na avaliação por especialista, foram obtidas pontuações de 90.6 no SUS e 68.0 no TAM. Na validação, foram obtidas pontuações gerais de 87.7 e 91.2 para o SUS e o TAM, respectivamente. Na comparação entre os grupos, as pontuações foram mais altas para os alunos de graduação comparado aos profissionais, SUS (p=0.037) e TAM (p=0.031). O aplicativo fornece suporte de informações clínicas para a comunidade odontológica, mostrou-se um potencial guia de estudo para profissionais e estudantes, sendo mais direcionado para estudantes de graduação.

Descritores: Telemedicina. Educação Continuada em Odontologia. Dentística Operatória.

INTRODUCTION

The integration of mobile applications in the teaching of operative dentistry has gained significant traction in recent years, particularly as educational institutions adapt to the evolving technological landscape and the challenges posed by the COVID-19 pandemic The use of mobile apps and digital tools has been shown to enhance the learning experience for dental students by providing them with accessible, interactive and engaging resource the complement traditional teaching methods[1].

Based on biological foundations, biomaterials have evolved to preserve pulp vitality through conservative restorative dental procedures. The market has witnessed considerable advances in the materials that can be used[2]. Choosing which material would work best in each clinical scenario has made it challenging. These choices of materials and techniques must be evidenced in recent literature, as they are constantly advancing and changing, and updating knowledge can lead to a failure in clinical execution and the procedure's success. As a result, academics and professionals should use scientific evidence to follow the evolution of cariology in terms of diagnosis and treatment[3].

Considering technological advances, the mobile learning (m-learning) acts as a viable alternative for teaching and educational improvement combining multifunctionality, connectivity, personalization, flexibility and accessibility using digital resources such as apps, blogs, digital games, forums, and case-sharing networks[4]. Smartphones' m-learning capacity to capture and transmit information is growing progressively, attracting new audiences for contact with science and motivating them to interact and form communities in favor of the education and development of scientific information[5]. Therefore, through the use of m-learning tools it is possible for dentistry professionals to use these devices as a complementary way of information for their clinical decisions, and even collaborate with other clinicians to make diagnostic and treatment decisions about the best course and location of treatment for patients[6].

Due to their portability, ability to be updated, speed, and simplicity, smartphone apps are tools capable of providing practical assistance at the office level[7]. Some medical app services offer a wealth of information and resources to support clinical decision-making[8].

Look at digital resources in relation to other forms of traditional teaching, such as books and magazines. They can be used quickly and easily, with a lower cost and production time, allowing the user to use the content at their own pace. They are a more attractive form of teaching, respecting the plural learning capacity of each individual[9-11].

The effectiveness of mobile applications in enhancing learning outcomes has been supported by various studies Research has shown that students who utilized mobile learning tools demonstrated improved knowledge retention and skill acquisition compared to those who relied solely on traditional methods[12,13].

The purpose of this study was to develop, evaluate the usability, perceived usefulness, and validate an application for a portable device which will aim to guide dental surgeons and students in acquiring knowledge about Restorative Dentistry materials and procedures, being an innovative information platform that can provide accurate and quick access to the various clinical and procedural protocols, with a constantly updated interface.

METHODS

The study, approved by the Ethics and Research Committee, with documentation CAAE: 22519019.7.0000.5049 and Opinion: 3.766.879, comprised an analytical, cross-sectional, descriptive, and quantitative evaluation. Doctors of Dentistry and the team from the Technological Innovation Laboratory of the CHRISTUS University Center conceived the app development.

"Clinical Guide for restorative procedures" was defined in the Ideation and Prototyping stage having been prepared through the collaboration of a team expert in the field and IT professionals. During the prototyping stage, a prototype archive containing all the theoretical information and possible commands to the screen flow, was designed through Power Point® by the restorative dentistry specialists. Thus, the home screen was divided into 1. The "Materials Guide" tab briefly introduces the material of interest to the user and its usage protocol. The materials covered were Dental Adhesives (Universal Adhesive System, 3-step, 2-step, and Conventional Adhesive System, 2-step Self-Conditioning Adhesive System) and Dentin-Pulp Complex Protection protocols (Resin Restoration, Glass Ionomer Restoration, Resin + Glass Ionomer Restoration, Direct and indirect Pulp Capping) and 2. The "Dental Assessment" tab allows for selecting the degree of tooth involvement. The answer provided by the user on the "Degree of tooth involvement" tab will or will not direct specific questions about the "Pulp Condition" of the selected tooth, presenting the prerogatives of (presence of provoked pain, spontaneous pain on cold, spontaneous pain on heat, presence of pain relief with cold or pain on percussion), which will therefore help direct the suggestion for carrying out a given clinical protocol. At the end of the screens, directional buttons will provide the bibliographical references used to create the theoretical framework (Figure 1).

In the Execution and Completion stage, using all the prototype archive information an IT professionals team developed the app's digital interface, which was made in two versions: Android™ and iOS™[14,15].

Usability (SUS) and Utility (TAM) Tests (Restorative dentistry PHD's)

It is recommended that usability tests be carried out before marketing to identify possible problems in the interaction between the user and the interface. The potential of the interface to be understood by the user (effectiveness) through easy navigation (efficiency) and user-friendliness (satisfaction)[16].

During these evaluations, the sample consisted of 15 Restorative Dentistry PHDs. The number of participants considered the "magic number" stipulated by the creators of the SUS scale is 12 participants[17]. The sample size was 15 for possible losses. The professionals took part in the test by signing an informed consent form.

An evaluation questionnaire based on existing questionnaires was used to conduct the tests. The questionnaire was divided into four parts: Part 0, developed with components to obtain demographic information, academic background, and the experience of each participant with the use of mobile applications; Part 1, based on the questionnaire – SUS[18], validated in Portuguese in 2011[19], aims to collect information on the ease of use (Usability) of the application developed and the relative simplicity of learning to use it (Ease of Learning); Part 2 based on the Davis Technology Acceptance Model - TAM[20], aimed at identifying the level of usefulness of the system, perceived by users, perceived usefulness, during the use of the app; Part 3: Composed of two subjective questions, documenting participants' opinions regarding positive and negative points and suggestions related to the presented materials, content and described techniques.
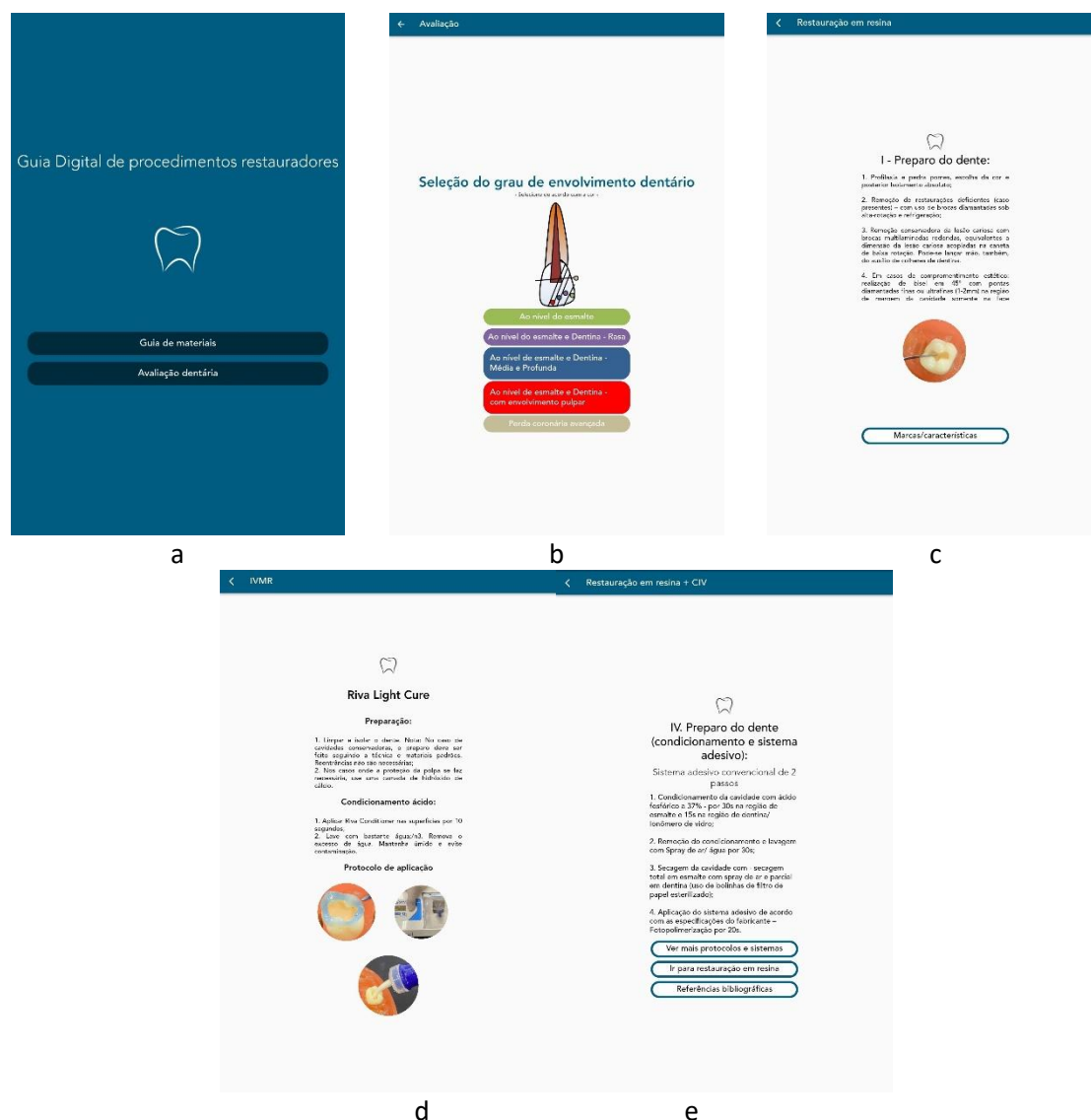
Figure 1. Interface of the application developed. a: Application home page. b: Dental assessment interface according to degree of dental involvement. c: Restoration of the dental element with composite resin. d: Procedural protocol for Riva Light Cure ® according to the manufacturer. e: Procedural protocol for the use of conventional two-step adhesive.

The same evaluator applied all the tests to minimize any bias. The data collected, containing suggestions and criticisms, acted as tools for improving the structure and content presented by the device developed[21,22].

Data analysis was carried out based on the responses to the evaluation instrument. Usability, ease of learning and usefulness perceived by dental specialists were analyzed.

Application validation (Usability (SUS) and Utility (TAM) Tests, students and dentist primary health care)

After assessment and adaptations suggested by the dental specialists in the previous stage, the app was used by undergraduate students at various stages of their studies (third (n=12), fifth (n=19), and tenth semesters (n=20), postgraduate students (n=18), and dentists in primary health care in Fortaleza city, Ceará, Brazil (n=13). The professionals took the test voluntarily and only after signing an informed consent form.

The same questionnaires (Part 0, part 1, part 2, part 3) used in the first phase of the study, with dental specialists, were used in this second phase. The data was tabulated in Microsoft Excel and exported to SPSS v.20 (IBM, Armonk, NY, USA), where the analyses were carried out using a 95% confidence level. The means and standard deviation were calculated and compared using the Wilcoxon test and Spearman's correlation after evaluation by Kolmogorov-Smirnov

normality test (p-values between <0.001 and p=0.032). Cronbach's **α** internal consistency coefficients were calculated for each questionnaire and each item, and after categorizing the SUS and TAM into up to 80 and >80, absolute and percentage frequencies were calculated and associated with other variables using Fisher's exact test or Pearson's chi-square test (variables: Have you ever used an app? Have you ever used a dental app? Have you ever used a dental app (frequency)? Operating system? Professional class?).

RESULTS

Usability Tests (SUS) and Perceived Usefulness Test (TAM) (Restorative Dentistry PHD's)

A summary of the analysis of the questions based on the SUS scale (Table 1) is shown. The results show an excellent usability rating (90.6, 95% confidence).

Table 1. Application usability description stratified by question – System Utility Score (SUS).

SUS	Mean ± SD
1	4.1± 0.9
2	1.3 ± 0.4
3	4.7 ± 0.4
4	1.2 ± 0.4
5	4.6 ± 0.5
6	1.4 ± 0.5
7	4.6 ± 0.5
8	1.2 ± 0.4
9	4.8 ± 0.4
10	1.3 ± 0.8
Total	90.6 ± 6.2

SD: standard deviation.

Average values are shown for the TAM questionnaire answers (Table 2). The results of each question show the aspect of the application's usefulness perceived by the participants. A score of 68.0 was achieved, demonstrating satisfactory values in the perception of usefulness[24].

Table 2. Descriptive of the perceived usefulness of the application stratified by question – TAM.

TAM	Mean ± SD
1 - I think it is a helpful technology for planning dentistry treatments	4.5 ± 0.5
2 - Standardization through a step-by-step process proposed by the app can help dental students and professionals learn how to plan restorative and rehabilitative procedures.	1.4 ± 0.5
3 - It helped me to understand better the concepts related to the indications for therapeutic and rehabilitative procedures:	3.8 ± 0.8
4 - You would use the app in your office routine.	3.8 ± 0.5
Total	68.0 ± 6.2

SD: standard deviation.

Analyzing the Bangor scale, Kortum and Miller (2009)[23] have strong interface validity for existing data. A score of 70 traditionally means approval, proposing a set of acceptability ranges that would help professionals determine whether an SUS score indicates an acceptable interface (Table 3). Using the Bangor, Kortum and Miller scale, the application falls into category A, corresponding to a "Best Imaginable" result. Sauro and Lewis (2012)[17] present a scale in which the application obtained an overall score of A+, which is the best level of usability classification according to this categorization (Table 3).

Table 3. Classification of the application's usability according to two different scales.

Guide to Restorative Dentistry	Score SUS	Classification Bangor, Kortum, and Mille Grade Range	Classification Sauro and Lewis Grade Range
General	90.6	(90 - 100) A (Best Imaginable)	(84.1 - 100) A+

Description in graphic form of the results compared to the responses to the SUS (90.6) and TAM (68.0) questionnaires from all dental specialists is shown in Figure 2. Highlighting the "excellent" and "satisfactory" classification of the application compared to the SUS and TAM, respectively using the Wilcoxon test (p=0.01) and Spearman's correlation.
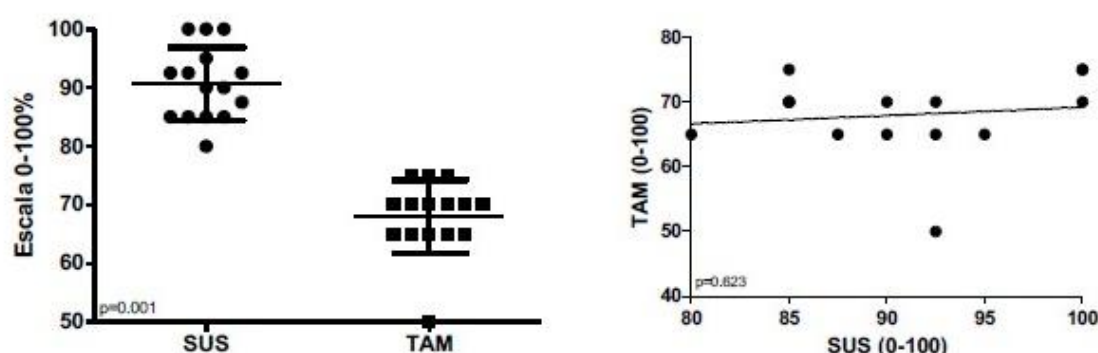

Figure 2. Graph comparing the results of the SUS and TAM questionnaires (experts).
p=0.001, Wilcoxon test (mean ± SD); p=0.623, Spearman correlation.

In Part 3, participants in the usability test had the opportunity to write down their impressions of the application. The positive responses were: *"Easy to use,"; "Quick to use,"; "Procedures described in detail,"; "Practical link between the topics presented,"; "Relevant to the clinician's routine,"; "Requires no instructions,"; "Step-by-step based on scientific evidence"; "Didactic"; "Self-explanatory"; "Good illustrations"; "Clarifies doubts quickly"; "Objective" and "Facilitates decisions on how to proceed*."

In the table of negative responses, 8 participants did not present any negative aspects. The reactions given by the others were: *"Need to improve the images used,"; "Use even more assertive language to reduce the risk of doubts,"* and *"Need spelling corrections."*

Usability Tests (SUS) and Perceived Usefulness Test (TAM) Validation (students and dentist primary health care)

This table summarizes the analysis of Part 0 of the evaluation questionnaire, which was designed to obtain socio demographic information, academic training, and the participants' experience with smartphone apps (Table 4). The results show that most had already used applications with various functions (92.7%). Still, concerning dental applications, it was clear that this practice was rare (58.5%) and was not used frequently (57.3%). The majority reported using the iOS operating system (75.6%).

Table 5 summarizes the analysis of Part 1 of the general questionnaire and each question on the SUS and TAM scale. The overall SUS score of 87.74 and the TAM score of 91.44 gave the app an excellent rating in the population analyzed.

Comparisons of the results obtained from the SUS and TAM questionnaires using the Wilcoxon test (p=0.001) and Spearman's correlation were placed on a graph showing the average uniformity of the response data (Figure 3).

Table 4. Description of applications and experience (part 0).

Variable	n (%)
Have you ever used an app	
No	6 (7.3%)
Yes	76 (92.7%)
Have you ever used a dental app?	
No	48 (58.5%)
Yes	34 (41.5%)
Have you ever used a dental app (frequency)?	
No	47 (57.3%)
Rarely	11 (13.4%)
Occasionally	8 (9.8%)
Often	9 (11.0%)
Daily	7 (8.5%)
Operating system	
Android	20 (24.4%)
iOS	62 (75.6%)
Professional class	
3rd-semester students	12 (14.6%)
5th-semester students	19 (23.2%)
10th-semester students	20 (24.4%)
Specializing in dentistry	18 (22.0%)
Graduated over four years ago	13 (15.9%)
SUS =>80	61 (74.4%)
TAM =>80	77 (93.9%)

Table 5. Description of the usability and usefulness.

Variable	Median and quartile range	α of Cronbach	Correlation with scale [c]	Likert scale [d]				
				1	2	3	4	5
SUS	90 (77.5-97.5)	0.775[a]						
Q1	5(4-5)	0.782[b]	$p<0.001$ (r=0.580)	0 (0.0%)	4 (4.9%)	3 (3.7%)	22 (26.8%)	53 (64.6%)
Q2	1(1-2)	0.504[b]	$p<0.001$ (r=-0.688)	55 (67.1%)	26 (31.7%)	1 (1.2%)	0 (0.0%)	0 (0.0%)
Q3	5(4-5)	0.704[b]	$p<0.001$ (r=0.716)	0 (0.0%)	0 (0.0%)	0 (0.0%)	26 (31.7%)	56 (68.3%)
Q4	1(1-2)	0.375[b]	$p<0.001$ (r=-0.690)	43 (52.4%)	31 (37.8%)	3 (3.7%)	3 (3.7%)	2 (2.4%)
Q5	4(4-5)	0.770[b]	$p<0.001$ (r=0.740)	1 (1.2%)	1 (1.2%)	3 (3.7%)	37 (45.1%)	40 (48.8%)
Q6	1(1-2)	0.529[b]	$p<0.001$ (r=-0.716)	43 (52.4%)	34 (41.5%)	2 (2.4%)	3 (3.7%)	0 (0.0%)
Q7	5(4-5)	0.723[b]	$p<0.001$ (r=0.730)	0 (0.0%)	0 (0.0%)	0 (0.0%)	31 (37.8%)	51 (62.2%)
Q8	1(1-2)	0.550[b]	$p<0.001$ (r=-0.710)	56 (68.3%)	25 (30.5%)	0 (0.0%)	0 (0.0%)	1 (1.2%)
Q9	5(4-5)	0.694[b]	$p<0.001$ (r=0.768)	0 (0.0%)	0 (0.0%)	6 (7.3%)	28 (34.1%)	48 (58.5%)
Q10	1(1-2)	0.618[b]	$p<0.001$ (r=-0.508)	46 (56.1%)	25 (30.5%)	2 (2.4%)	8 (9.8%)	1 (1.2%)
TAM	95 (85-100)	0.791[a]						
Q1	5(4-5)	0.749[b]	$p<0.001$ (r=0.841)	1 (1.2%)	1 (1.2%)	1 (1.2%)	27 (32.9%)	52 (63.4%)
Q2	5(5-5)	0.788[b]	$p<0.001$ (r=0.714)	0 (0.0%)	1 (1.2%)	1 (1.2%)	17 (20.7%)	63 (76.8%)
Q3	5(4-5)	0.708[b]	$p<0.001$ (r=0.871)	0 (0.0%)	1 (1.2%)	3 (3.7%)	35 (42.7%)	43 (52.4%)
Q4	5(4-5)	0.699[b]	$p<0.001$ (r=0.816)	0 (0.0%)	3 (3.7%)	3 (3.7%)	27 (32.9%)	49 (59.8%)

[a]α Cronbach's score of the questionnaire; [b]α Cronbach's for each questionnaire item; [c]Spearman correlation with the questionnaire; [d]Absolute and percentage frequency. The TAM average was significantly higher than the average SUS ($p<0.001$). Data expressed as median and quartile range.

The correlation of the results obtained with the SUS Questionnaire and TAM, according to the different groups, shows statistically significant differences with the values obtained in the correlation according to the variation between the academic and professional groups (Table 6).
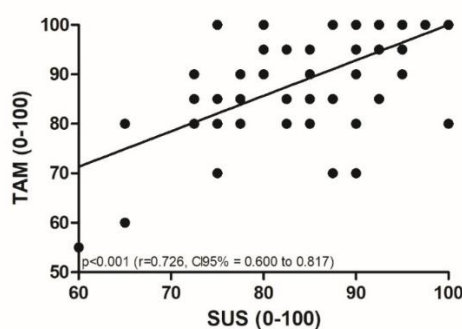
Figure 3. Graph comparing the results of the SUS and TAM questionnaires (students and dentist primary health care). Wilcoxon test and Spearman's correlation *p<0.001, Spearman's correlation.

Table 6. Descriptive comparison of the values obtained from the SUS and TAM questionnaires - time since graduation, dentistry specialization course, and primary health care dentist of the volunteers.

	SUS		p-Value	TAM		p-Value
	Up to 80	>80		Up to 80	>80	
Have you ever used an app						
No	3 (14.3%)	3 (4.9%)	0.155	1 (20.0%)	5 (6.5%)	0.261
Yes	18 (85.7%)	58 (95.1%)		4 (80.0%)	72 (93.5%)	
Have you ever used a dental app?						
No	15 (71.4%)	33 (54.1%)	0.164	3 (60.0%)	45 (58.4%)	0.945
Yes	6 (28.6%)	28 (45.9%)		2 (40.0%)	32 (41.6%)	
Have you ever used a dental app (frequency)?						
No	15 (71.4%)	32 (52.5%)	0.318	3 (60.0%)	44 (57.1%)	0.818
Rarely	2 (9.5%)	9 (14.8%)		1 (20.0%)	10 (13.0%)	
Occasionally	1 (4.8%)	7 (11.5%)		0 (0.0%)	8 (10.4%)	
Often	3 (14.3%)	6 (9.8%)		1 (20.0%)	8 (10.4%)	
Daily	0 (0.0%)	7 (11.5%)		0 (0.0%)	7 (9.1%)	
Operating system						
Android	5 (23.8%)	15 (24.6%)	0.943	1 (20.0%)	19 (24.7%)	0.814
iOS	16 (76.2%)	46 (75.4%)		4 (80.0%)	58 (75.3%)	
Professional class						
3rd-semester students	2 (9.5%)	10 (16.4%)*	0.037	0 (0.0%)	12 (15.6%)*	0.031
5th-semester students	2 (9.5%)	17 (27.9%)*		0 (0.0%)	19 (24.7%)*	
10th-semester students	3 (14.3%)	17 (27.9%)*		0 (0.0%)	20 (26.0%)*	
Specializing in dentistry	8 (38.1%)*	10 (16.4%)		2 (40.0%)*	16 (20.8%)	
Graduated over four years ago	6 (28.6%)*	7 (11.5%)		3 (60.0%)*	10 (13.0%)	

*p<0.05, Fisher's exact test or Pearson's chi-square (n, %).

DISCUSSION

The "clinical guide for restorative procedures" application was developed and considered by experts in the area of restorative dentistry as a digital platform with usable interfaces, with useful content for the dental community. The dental community in the segments analyzed also considered the application usable and useful, especially for undergraduate students.

The importance and effectiveness of associating the traditional teaching method with the new technologies available is demonstrated by using the development and use of applications and software to achieve knowledge of various subjects[25]. Using these current tools is seen as a facilitating complement to the conventional way of learning, offering dynamism, as it has an inciting character that will lead the user to explore their curiosity about the content. It also provides access to fast and often reliable information[26].

The increasing use of these mobile applications in the health area is highlighted, showing their application in dentistry in terms of education and care, facilitating the practice of the dental surgeon, whether manager, clinician, or researcher[27].

In contrast to the trend towards using new teaching technologies in dentistry, more studies are needed to focus on digital mobile platforms in restorative dentistry. One study reported the development of *software* capable of providing an accurate, objective, and systematic approach to determining the color of teeth, soft tissues, and dental materials, and was named *"Smileshade®."* However, it does not present clinical protocols for materials, is only available in English, and can only be used with an intraoral scanner[28].

The second app identified, not in studies but in a digital store, is called Dentistry Protocols®. It resembles a digital clinical guide as it contains different "step-by-step" clinical protocols. However, the literature did not study this platform before its development. There is no way of determining its usability or the validity of the information presented.

The study by Buijink *et al.* (2013)[29] addresses the lack of evidence and professional medical involvement in the design and development of mobile applications, raising questions about the reliability and accuracy of the content present in them and the consequences that can be generated for patient safety. Given the above, users should be aware that apps may have unreliable content, are not based on scientific evidence, and are not reviewed by qualified professionals.

During the process of developing mobile applications, it is essential to have an interdisciplinary team involved in the project, including health professionals allied with professionals responsible for the engineering and operation of the software, exposing their ideas and needs, thus generating a sharing of information from the professions involved, integrating content[30,31]. The "Clinical Guide to Restorative Procedures" app was created with the participation of dental professionals allied to information technology professionals and was developed using up-to-date scientific information. The app's innovative and updatable interface allows for corrections and modifications to the content as changes in the literature arise. It is important to emphasize that the app developed does not aim to teach Restorative Dentistry but rather to help clarify doubts about the various protocols and materials and to update previously acquired knowledge and skills.

For the first phase of the study, analysis was carried out with experts, the average score of 90.6 presented by the SUS test made it possible to affirm that this application is accessible for future users to use and access the content. The average values observed after applying the TAM questionnaire were 68.0, demonstrating a satisfactory value in the perception of usefulness and the volunteers' intention to continue using the application. The contrast between the excellence shown in the SUS score and the TAM may be based on the professional reality of the volunteers, all of whom have a doctorate in dentistry and are highly proficient in the content and protocols present." This reinforces the influence of professional reality, clinical routine, and academic training on the perceived usefulness of a proposed teaching tool, and there may be different values within the same professional class.

Another point that reinforced the change in the TAM score was the average number of lower scores answers to Question 02 of the Perception of Usefulness questionnaire: *I believe that the standardization through a step-by-step* process *proposed by the app can help dental students and professionals learn how to plan restorative and rehabilitative procedures*. The app's function is not a teaching tool to help with planning but rather to study and consult the concepts of the various restorative materials and protocols presented on screen. Since the planning of therapeutic approaches in dentistry can be considered super complex, there is only one path to understanding but several ways with their respective answers, questions, and conflicts. Thus, planning must be based on interdisciplinarity, involving prior and preferably up-to-date knowledge of other areas[32,33].

The volunteers' opinions presented as suggestions were vital, as they alerted the developers to the need to make improvements, making the app even more helpful and adapting to users' needs. The possibility of accessing the various therapeutic protocols that are relevant to clinical practice, as well as the presentation of materials that are sometimes unfamiliar or distant from the reality of future users, which make up the app, were points praised by the majority of volunteers, who justified the use of this option due to the agility of access provided and the didactic capacity of the tool.

App validation among different dental training groups, undergraduates in various stages, postgraduates, and primary care professionals scored highly on the SUS and TAM questionnaires for all participants, showing a higher rate of usability and usefulness among undergraduates than professionals. Notably, a large percentage of participants in all groups agreed that the app made it easier to obtain information. They also felt that the app was easy to use without requiring too much effort to understand.

One explanation for the difference between students and professionals may be that young people have greater access to and skill in using apps. The survey results reported that the percentage of professionals with health apps installed on their smartphones decreased with age. This corroborates the study by Payne et al. (2012)[34], which found that the time spent using apps daily is reduced among doctors compared to students, especially for educational activities during the medical course. This also aligns with research by Zhang et al. (2020)[35], in which young doctors were likelier to use medical apps than doctors with more training. It is also worth considering the environment where users are inserted, such as clinics and hospitals, where there is a busier routine with less time to use cell phones.

Another explanation for the results is that students need to obtain more information in the application than professionals, who are supposed to be more knowledgeable about the subject.

The study's limitation is that there are no previous studies to compare the results. Furthermore, the SUS and TAM tests are based on volunteers' opinions and may have overestimated and underestimated data.

CONCLUSION

Given the results, it is possible to state that the "Clinical Guide to Restorative Procedures" represents an innovative tool with promising potential as a study guide for dental professionals and students. The interface developed has the advantages of bringing the user closer to sometimes unfamiliar protocols, clarifying doubts, and providing access to information based on research and of relevance assessed by a panel of experts. Given the professional and academic reality of the evaluating public, its use is more targeted, and its exploitation among undergraduate dental students is more necessary.

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