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ORIGINAL ARTICLE

Evaluation of the usability of the Truedent dental system to improve the efficiency and quality of dental care

Evaluación de la usabilidad del sistema odontológico de Truedent para mejorar la eficiencia y calidad del cuidado dental

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ABSTRACT

The evaluation of dental system usability is of utmost importance to improve the efficiency and quality of dental care in dental clinics and dental offices. A dental system should be easy to use, consistent, flexible and provide adequate feedback, among other usability criteria. Evaluation of these criteria can be done through surveys of system users and analysis of their behavior in the application. Improving the usability of the dental system not only benefits dental professionals, but also patients seeking more efficient and higher quality treatment. In addition, a dental system that meets usability criteria can reduce data entry errors, improve communication between healthcare professionals and patients, and increase patient satisfaction.

Keywords: Information Systems; Usability; Software.

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RESUMEN

La evaluación de la usabilidad del sistema odontológico es de suma importancia para mejorar la eficiencia y calidad del cuidado dental en las clínicas y consultorios odontológicos. Un sistema odontológico debe ser fácil de usar, consistente, flexible y proporcionar retroalimentación adecuada, entre otros criterios de usabilidad. La evaluación de estos criterios puede realizarse a través de encuestas a los usuarios del sistema y análisis de su comportamiento en la aplicación. Mejorar la usabilidad del sistema odontológico no solo beneficia a los profesionales de la salud dental, sino también a los pacientes que buscan un tratamiento más eficiente y de mayor calidad. Además, un sistema odontológico que cumple con los criterios de usabilidad puede reducir los errores de entrada de datos, mejorar la comunicación entre los profesionales de la salud y los pacientes, y aumentar la satisfacción del paciente.

Palabras clave: Sistemas de Información; Usabilidad; Software.

INTRODUCTION

In previous research, the software developed in php for the TRUEDENT Dental Specialties Center was evaluated, in this way, on the one hand, navigation and user flow analysis was applied, this usability methodology involves the evaluation of how users interact and move through a website or application.(1)

Navigation analysis focuses on how users find and access content, and how information is organized on the website or application. This may include assessing the structure of information, the clarity of labels, and the navigation of the website or application.(2)

On the other hand, user flow analysis involves evaluating how users navigate through a website or application and how they move from one task to another. This can include tracking the steps users take to complete a task and identifying trouble spots where users may have difficulty.

In this way, navigation and user flow analysis is a usability methodology that helps designers understand how users interact with the content and functions of a website or application, allowing them to optimize the user experience and improve the effectiveness of the product or service.

On the other hand, by using usability testing which is responsible for evaluating the usability of a digital product or service and is based on direct observation of users as they perform specific tasks on the product or service.

Usability testing involves gathering a group of representative users and having them perform specific tasks on a website, mobile application or other digital product or service. During testing, the users' interaction with the product or service is recorded and information is collected on problems encountered, confusions and user satisfaction.

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Usability testing can be qualitative or quantitative, depending on the objectives of the evaluation. In qualitative testing, detailed information is collected on problems encountered by users and analysis of user comments and reactions is performed to identify patterns and trends in usability. In quantitative testing, specific variables are measured, such as user efficiency or effectiveness in completing tasks, and statistics are used to analyze the results.

Overall, usability testing is an effective tool for improving the usability and user experience of digital products and services. By providing direct feedback from users, usability testing allows designers to make specific and significant improvements to functionality and user experience.

The system was developed TypeScript as it is an extension of JavaScript intended to address this deficiency of JavaScript and specifically ExpressJs was used syntactically, TypeScript is a superset of EcmaScript 5, so every JavaScript program is a TypeScript program which has a module system, classes, interfaces and a static type system and this is intended to provide lightweight assistance to programmers, the module system and the type system are flexible and easy to use.[3,4]

It should be mentioned that MariaDb was used as the database and all the analysis used for the collection of information for the development of the system used the IEEE 830 standard; the software development methodology was established XP taking into account the need of the center to establish the correct use of the methodology.[5,6]

The Ministry of Public Health (MSP) of Ecuador is the governing body of the health sector in the country, responsible for guaranteeing universal, equitable and quality access to health services. Among its functions is the development and implementation of public health policies, regulation of health care and management of resources for the sector.

One of the fundamental tools for medical care in Ecuador are the medical records, which are the medical record of the interventions and procedures performed on each patient. The medical record is an important document that accompanies the patient throughout his or her treatment and serves as a valuable source of information for the diagnosis and treatment of diseases. (MSP, 2021).[7]

The MSP of Ecuador establishes standards and guidelines for the use of medical records, in order to ensure the quality of medical care and the protection of patients' rights. Among the established norms are the obligation to record all relevant patient information in the medical record, including medical history, family history, allergies, medications, examinations, and medical test results. (MSP, 2021) [7]

In addition, the MSP of Ecuador has implemented the use of electronic medical records in the public health system, which allows the integration of patient information in a centralized digital platform. This improves the efficiency of medical care, reduces errors and ensures the confidentiality of medical information.

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METHODOLOGY

The use of medical records in Ecuador and information systems are closely related, since the implementation of information technologies in the health sector, such as electronic medical records, has improved the quality of health services in the country.

In the care of a population of 5328, the medical record allows the collection of complete and updated medical information on each patient, which facilitates the diagnosis and treatment of diseases. In addition, the implementation of computerized systems for the management of medical records allows for greater efficiency in medical care and better coordination among health professionals.

The electronic medical record, in particular, allows the integration of patient information in a centralized digital platform, which reduces errors and improves the quality of medical care. It also guarantees the confidentiality of medical information and its access only by authorized professionals.

Qualitative methodology is based on the collection of non-numerical data, such as interviews, observations and document analysis, to understand complex phenomena. This methodology focuses on the exploration and understanding of human experience and seeks to reveal the subjectivity behind the data. Qualitative methodology is useful for investigating social, cultural and psychological issues.

On the other hand, quantitative methodology is based on the collection and analysis of numerical data, using statistical and mathematical tools to describe and explain phenomena. This methodology focuses on the measurement and analysis of variables and relationships to establish patterns and causal relationships. Quantitative methodology is useful for investigating scientific, medical and economic issues.

It is important to note that both methodologies have strengths and weaknesses and can complement each other in a mixed approach and that is why the authors used a dual approach to obtain the best results.

When usability is applied to a dental system, several criteria that directly affect the user experience can be evaluated, thus, the authors evaluated the following points.

1) Ease of use: the system should be easy for users to use, allowing them to perform the necessary tasks in a simple and uncomplicated manner.
2) Consistency: the system must be consistent in its design and functionality, so that users can understand and use all functions in a uniform manner.
3) Flexibility: the system should be flexible and adaptable to the needs of users, allowing them to customize information and settings according to their preferences.
4) Clarity: the information presented in the system must be clear, organized and easy to understand, so that users can access it quickly and efficiently.
5) Feedback: the system must provide feedback to users when they perform actions, so that they know that their action has been acknowledged by the system.
6) Efficiency: the system must be efficient in its operation, allowing users to perform tasks quickly and without unnecessary delays.
7) Error tolerance: the system must be error tolerant, allowing users to recover from errors and continue using the system without difficulty.

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8) Visual aesthetics: the system must have an attractive and well-designed interface, so that users feel comfortable and attracted to use it.

RESULTS

Based on the research carried out, the results obtained for each of the points mentioned in the previous section will be presented, knowing and reiterating that the documentation evaluated was evaluated for the work of dentists, nurses, as well as patients, and the following results were obtained. (Table 1)

Table 1. Results on Ease of use.

Criteria	Description	% of satisfied respondents
Navigation	Is it easy to move between the different sections of the system?	89
Interface design	Is the interface appealing and easy to understand?	83
Accessibility	Is the system easy to access and use?	76
Ease of registration	Is it easy to register in the system?	91
Ease of search	Is it easy to find the information you are looking for in the system?	85
Clarity of information	Is the information presented clear and easy to understand?	87
Help and support	Does the system provide sufficient help and support for users?	79
Loading speed	Does the system load quickly and respond without delays?	82

In summary, the Ease of Use criteria that were evaluated in the dental system, as well as the percentage of respondents who were satisfied with each criterion. It can be seen that the majority of respondents are satisfied with most of the criteria, with satisfaction percentages ranging from 76 % to 91 %. This suggests that the dental system in question is easy to use and has been designed with users' needs and preferences in mind. However, there are also some criteria that may need special attention to improve the user experience, such as loading speed and support.

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Table 2. Results on Coherence

Criteria	Description	% of satisfied respondents
Consistency in navigation	Is the navigation between sections and pages consistent?	88
Consistency in interface design	Does the interface have a consistent design across all sections?	84
Consistency in commands	Are commands to perform actions consistent throughout the system?	82
Consistency in terminology	Is the terminology used throughout the system consistent and easy to understand?	85
Consistency in data presentation	Is data presentation consistent across all sections and pages of the system?	83
Consistency in feedback	Is the feedback provided to the user consistent throughout the system?	87

Regarding the Consistency criteria that were evaluated in a dental system, as well as the percentage of respondents who were satisfied with each criterion. It can be seen that the majority of respondents are satisfied with most of the criteria, with satisfaction percentages ranging from 82 % to 88 %. This suggests that the dental system in question is consistent in its design and functionality, allowing users to use it uniformly and without confusion. However, there are also some criteria that may need special attention to improve the user experience, such as consistency in commands and data presentation. (Table 2)

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Table 3. Results on Flexibility

Criteria	Description	% of satisfied respondents
Interface customization	Does the system allow customization of the user interface according to the user's needs?	73
Adaptability to different devices	Is the system accessible from different devices, such as mobiles, tablets or computers?	81
Adaptable to different treatment needs	Is the system adaptable to different treatment needs, such as periodontics, endodontics, orthodontics, among others?	87
Personalization of information	Does the system allow personalization of patient information according to the user's needs?	76
Adaptable to different payment methods	Is the system adaptable to different payment methods such as cash, credit or debit card, among others?	82
Flexibility in appointment scheduling	Does the system allow for flexible appointment scheduling according to the availability of the patient and the dentist?	89

Flexibility was evaluated in the sample and it was found that they were satisfied with each criterion. It can be seen that the majority of respondents are satisfied with most of the criteria, with satisfaction percentages ranging from 73 % to 89 %. This suggests that the dental system in question is flexible and adaptable to different needs and situations, allowing users to customize the system and use it effectively. However, there are also some criteria that may need special attention to improve the user experience, such as interface customization and personalization of patient information. (Table 3)

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Table 4. Results on Clarity

Criteria	Description	% of satisfied respondents
Clear and understandable language	Does the system use language that is clear and understandable to the user?	87
Clear and precise instructions 85%	Does the system provide clear and precise instructions for performing different tasks?	85
Intuitive interface design	Is the interface design intuitive and user friendly?	80
Relevant and easy-to-find information	Does the system provide relevant and easy-to-find information for the user?	82
Use of clear icons and labels	Does the system use clear icons and labels to make information easy to understand?	76
Visibility of system status	Does the system provide clear information on system status, such as errors or technical problems?	79

The Clarity criteria that were evaluated in the dental system, as well as the percentage of respondents who were satisfied with each criterion. It can be seen that the majority of respondents are satisfied with most of the criteria, with satisfaction percentages ranging from 76 % to 87 %. This suggests that the dental system in question is clear and easy to use, with understandable language and an intuitive design that makes it easy to find and understand the information. However, some criteria, such as the use of clear icons and labels, and the visibility of system status, need special attention to improve the user experience and ensure greater clarity and understanding of the system. (Table 4)

Table 5. Results on Feedback

Criteria	Description	% of satisfied respondents
Quick response to user actions	Does the system respond quickly to user actions?	83
Clear and concise feedback	Does the system provide clear and concise feedback on the user's actions?	81
Confirmation of completion of an action	Does the system confirm completion of an action performed by the user?	78
Relevant and useful notifications	Does the system provide relevant and useful notifications to the user?	76
Real-time feedback	Does the system provide real-time feedback on user actions?	73

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The table 5 summarizes the Feedback criteria that were evaluated in the dental system, as well as the percentage of respondents who were satisfied with each criterion. It can be seen that the majority of respondents are satisfied with most of the criteria, with satisfaction percentages ranging from 73 % to 83 %. This suggests that the dental system in question provides adequate and useful feedback to the user, with quick responses and confirmation of completion of actions taken. However, some criteria, such as relevant notifications and real-time feedback, need special attention to improve the user experience and ensure greater interactivity and feedback in the system. Overall, it can be concluded that feedback is an important aspect of the usability of the dental system, which should be continuously evaluated and improved to optimize its efficiency and effectiveness.

Efficiency highlights the performance of all the components that converge to have a good performance within the system operation. Overall, it can be seen that the majority of respondents are satisfied with the efficiency of the system, with satisfaction percentages ranging from 71 % to 81 %. This suggests that the dental system in question is relatively fast and agile in its use, with acceptable loading speed and adequate ease of navigation. However, some criteria, such as speed of task execution and data retrieval, need special attention to improve the user experience and ensure greater efficiency and productivity in the system. Overall, it can be concluded that efficiency is an important aspect of the usability of the dental system, which should be continuously evaluated and improved to optimize its efficiency and effectiveness.

Table 6. Results on Error Tolerance.

Criteria	Description	% of satisfied respondents
Prevent common errors	Does the system prevent common errors in its use?	84
Error correction capability	Does the system allow for easy correction of errors?	81
Error recovery capability	Does the system allow to recover information lost due to errors?	78
Clear error messages	Does the system displays clear and useful messages to help the user correct errors?	75
Prevent serious errors	Does the system prevent serious errors in its use?	72

The Error Tolerance criteria that were evaluated in the dental system, as well as the percentage of respondents who were satisfied with each criterion. Overall, it can be seen that the majority of respondents are satisfied with the system's error tolerance, with satisfaction percentages ranging from 72 % to 84 %. This suggests that the dental system in question is relatively error tolerant and has effective mechanisms in place to prevent common errors and allow for error correction and recovery. (table 6)

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In addition, users value positively the ability of the system to display clear and useful messages to help them correct errors. However, some criteria, such as the ability to prevent serious errors, require further attention to improve system security and avoid major problems for users. Overall, it can be concluded that error tolerance is an important aspect of dental system usability, which should be continuously evaluated and improved to ensure a satisfactory user experience and minimize risks for patients and healthcare professionals.

As the last but most important criterion we have Visual Aesthetics, as well as the percentage of respondents who were satisfied with each criterion. Overall, it can be seen that the majority of respondents are satisfied with the visual aesthetics of the system, with satisfaction percentages ranging from 75 % to 87 %. This suggests that the dental system in question is visually appealing and uses a consistent design that makes the information easy to read and understand. In addition, users value positively the use of icons and symbols to enhance the comprehension and intuitiveness of the design. However, some criteria, such as the ease of reading the information, require further attention to improve the readability and accessibility of the system for different types of users. Overall, it can be concluded that visual aesthetics is an important aspect of the usability of the dental system, which should be continuously evaluated and improved to ensure a satisfactory and effective user experience in the communication of information.

DISCUSSION

While it is true, it can be observed that consistency and usability are closely related, as uniformity in system presentation and behavior can improve the ease with which users can perform tasks in the system. On the other hand, flexibility can improve user satisfaction by allowing the system to be tailored to their individual needs, which is why Ease of Use refers to the ease with which users can perform tasks in the system. According to author Norman,[8] ease of use is a combination of factors including ease of learning, efficiency of use and user satisfaction. On the other hand, author Nielsen,[9] highlights the importance of consistency in interface design to improve ease of use.

In other words, Consistency refers to the uniformity in the presentation and behavior of the system in different situations. According to author Shneiderman,[10] consistency is a key factor for the usability of a system, as it helps to reduce the user's cognitive load and facilitates the understanding of the system. Author Nielsen,[9] also highlights the importance of consistency in interface design, making Flexibility frames the system's ability to adapt to different situations and user needs. According to author Dix et al. ,[11] flexibility is important for the usability of a system, as it allows users to customize the system according to their needs. On the other hand, author Nielsen,[9] highlights the importance of simplicity in interface design to improve flexibility.

If we take into account that feedback is framed to the system's ability to provide information about the state of the user's actions and the system's responses, it is so Nielsen,[9] the feedback must be clear and consistent so that the user has an adequate understanding of the system's response.

Dix et al.,[11] note that feedback is important for system information feedback and confirmation of actions performed by the user. Efficiency: refers to the ability of the system to enable the user to perform tasks quickly and effectively. Nielsen,[9] states that efficiency is related to the time it takes a user to perform a task. Shneiderman,[10] highlights that efficiency is achieved through reducing the number of actions required by the user and simplifying the steps to perform a task.

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Error tolerance: refers to the system's ability to avoid errors and enable error recovery. Nielsen,[9] states that error tolerance is important to minimize the impact of errors and to enable error recovery. Shneiderman,[10] highlights that error tolerance is achieved through the design of clear error messages and the inclusion of safety features. Flexibility: refers to the ability of the system to adapt to different user needs and usage situations. Nielsen,[9] states that flexibility relates to the system's ability to adapt to different user preferences and habits.

Dix et al.,[11] note that flexibility is important to enable system customization and adaptation to different usage situations. Visual aesthetics: refers to the ability of the system to be visually appealing and to provide a pleasant user experience and they emphasize that visual aesthetics are important for user satisfaction and overall perception of system quality.

Preece, Rogers, & Sharp,[12] note that visual aesthetics can also affect usability, as an attractive interface can improve navigation and information comprehension. Regarding the relationships between these criteria, it is important to note that they are all interrelated and equally important to the usability of a system. For example, feedback is essential for efficiency and error tolerance, while visual aesthetics can affect feedback and efficiency. Therefore, it is essential to consider all of these criteria when designing a usability system.

CONCLUSION

By evaluating usability criteria, such as ease of use, consistency, flexibility, and feedback, dental health professionals can identify areas for improvement in the system and work to improve the user experience. Improving the usability of the dental system not only benefits dental health care professionals, but also patients, as an efficient, high-quality system can reduce errors and improve communication between health care professionals and patients, which in turn increases patient satisfaction. Changes in technology and processes can affect the usability of the system, so it is important for dental health professionals to be aware of any changes and perform periodic evaluations. In addition, collaboration between dental health professionals and software developers is essential to ensure that the system is easy to use and meets usability criteria. In summary, dental system usability evaluation is an ongoing process that must be addressed in order to improve the efficiency and quality of dental care.

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