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Article

The MOSCA model as a strategy for the evaluation of educational software: SOLVE ELECv2.5 case study

El modelo MOSCA como estrategia para la evaluación de software educativo: estudio de caso SOLVE ELECv2.5

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Abstract

This research work makes an approach to the evaluation of educational software through the case study of the application of the SOLVE ELECv2.5 software tool in higher education; it bases its development on the implementation of its own model based on usability and criteria established in the software evaluation model under a systemic approach to quality (MOSCA), as well as the ISO/IEC standard. It performs the usability evaluation based on the application of instruments designed for technical personnel specialized in software development and actors of the teaching-learning process: students and teachers. As a result, the use of the SOLVE ELECv2.5 tool in the subjects related to the area of electrical and electronic circuits is effective for the consolidation of knowledge.

Keywords: MOSCA, software evaluation, model, usability.

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Resumen

Este trabajo de investigación hace un abordaje a la evaluación de software educativo mediante el estudio de caso de aplicación de la herramienta informática SOLVE ELECv2.5 en la educación superior; el mismo que fundamenta su desarrollo en la implementación de un modelo propio en función de usabilidad y criterios establecidos en el modelo de evaluación del software bajo un enfoque sistémico de calidad (MOSCA), así como de la norma ISO/IEC. Realiza la valoración de la usabilidad a razón de la aplicación de instrumentos diseñados para personal técnico especializado en el desarrollo del software y actores del proceso enseñanza-aprendizaje: estudiantes y docentes. Se obtiene como resultado la efectividad para la consolidación del conocimiento el empleo de la herramienta SOLVE ELECv2.5 en las asignaturas vinculadas al área de circuitos eléctricos y electrónicos.

Palabras clave: MOSCA, evaluación de software, modelo, usabilidad

Introduction

The changes in education due to the health emergency from the year 2020, have been of transcendental importance, this evidenced the need to provide continuity to the teaching-learning processes through alternative means with the vision of maintaining academic training at all levels. Higher education is no exception, hence the insertion of digital tools arises as a complement in order to minimize the impact of non-presence.

Virtuality gains space and becomes a palliative resource at the moment of interaction: teacher - student. The boom in the use of videoconferencing platforms is accentuated, and at the same time, the need to have elements that contribute to meaningful learning drives the inclusion of educational software in curricular planning, primarily in the subjects, where the development of practical activities or the use of laboratories is inherent.

Society, exposed to the vertiginous changes of the new normality, where the reiterative use of computer resources is common, has had to adapt and experience new environments for the development of its activities. This society demands innovative ways of teaching and learning, and it is there where information and communication

technologies provide the motivating and creative space in which students, under the guidance of the teacher and through educational software, apply science and develop skills that favor the construction of knowledge and meaningful learning.

However, as stated by Sánchez et al. (2020), university teachers, upon leaving the traditional classrooms, face a reinvention process as a result of the obligatory nature of confinement; in addition to the economic, health and emotional implications, the fact of becoming users of technological tools, for many of them new and unknown, becomes a challenge faced with responsibility in order to maintain the continuity of the processes for the professionalization of students.

When talking about the teaching work that involves several generic skills, systemic, instrumental, social and citizenship competencies, planning in teaching strategies, design of support material, design and use of monitoring and evaluation strategies, it is essential to evaluate the software as a didactic tool in the teaching-learning process; one more task that the teacher must perform, regardless of whether or not he/she has sufficient knowledge of the models, methodologies, techniques and tools that allow him/her to perform this activity (Aburto, 2020).

Based on these premises, the present work is proposed as a case study of the application of the educational software evaluation model under a systemic approach to quality (MOSCA), as a contribution from the teaching experience and based on the concepts of total systemic quality, which according to Mendoza et. al (2005), software quality does not depend on a single characteristic in particular, but on the congruence of all its components, namely: internal and contextual aspects of the product and the process, in addition to the points of view of the customer and the user.

Materials and methods

The Systemic Model of Software Quality [MOSCA] is developed by the Laboratory of Information and Information Systems of the Simon Bolivar University [LISIUSB], supported by the principles of total systemic quality that proposes "to quantify quality evaluation metrics based on three categories: Functionality, Usability and Reliability, and thus identify whether the educational software is of basic, intermediate or advanced quality" (Callaos, 1994:33).

The application of this model, as stated by Díaz-Antón (2002), involves a series of questionnaires to ponder the quality perspective from the point of view of the teacher, computer specialists and students. This will lead to the application of pre-selection techniques and final selection methodologies either for the acquisition or the performance of field studies for the evaluation of educational software through tests in standardized formats, depending on the interest in the commercial acquisition of the software evaluated as a final product or, through the evaluation if it is in the development process.

The proposal of the evaluation model for educational software established by Díaz-Antón (2002) reduces the six categories proposed in the original MOSCA model: functionality, usability, reliability, efficiency, maintainability and portability to four.

The present work is a case study of the adaptation of Diaz-Anton's MOSCA model to evaluate the development processes during the implementation of the SOLVE ELECv2.5 educational software in the electrical circuits department. For this purpose, a quality model is considered under a systemic approach focused on usability, in that an educational software must motivate learning, the educational material must be attractive and easy to use, it must generate interactive activities that motivate and maintain attention, and at the same time they must be varied and respond to the different learning styles.

For the generation of the proposal of the systemic quality model focused on usability, the international standards are considered, which within the pertinent establishes: "usability is the ability of the software product to be understood, learned, used and be attractive to the user, when used under certain conditions" (ISO/IEC 25000, 2021:1), it is complemented with the Software Ergonomics Standard for Multimedia User Interfaces, where requirements and recommendations for the ergonomic design of software, of application in professional or learning activities are framed (ISO 14915-1:2002, 2014:7). The proposed model, at the level of factors considers the parameters established in the ISO/IEC 25000 standard for usability, in terms of criteria the considered characteristics are based on ergonomics and privacy, accessibility and serviceability policies are included as a complement, finally the contribution with the estimated contribution of each criterion to the final usability is discussed.

Solve Elec 2.5

The Solve Elec 2.5 tool, a free distribution electrical circuit simulation software, presents a series of active and passive elements

within a DC and AC configuration context. It has a graphical interface for the development of electrical diagrams in which it is enough to drag and drop the components to start the diagramming, the programming logic of the software allows to obtain instantaneous calculations of solutions and functions, at the same time easy to navigate graphical representations to investigate the responses to voltage pulses, current circulation among others.

The particularities of Solve Elec 2.5, described above, are part of the qualities that must be tested through a software evaluation process in order to establish, through a proposed model, the contributions or detriments to the teaching-learning process in the field of electrical circuits as an application course.

Design of the specific evaluation model for educational software

After reviewing the documentation according to international standards and the systemic model of software evaluation, the proposal for the evaluation of educational software is generated, considering general, didactic and technical aspects in relation to the participation in the collection of information from teachers, students and experts, the applicable evaluation instrument (questionnaires) is designed, using LÍKERT and DICOTÓMICAS scales with metrics according to the pre-established contribution to each criterion, with a maximum accumulated evaluation of 100 points.

Comprehensibility and operability characteristics associated with the general assessment aspects, the capabilities developed by the software tool, the motivation for learning and the contribution to the content of the subject are considered as characteristics of the didactic aspect; finally, from the technical point of view, criteria such as documentation, support, design and security level of the educational software object of this study are defined.

From each of the characteristics associated with the various aspects to be evaluated, sub-characteristics are defined to complement the study, and the percentage weights are distributed in relation to the contribution associated with the evaluation criteria.

Documentation of the specific evaluation model

Level: General

Feature: Comprehensibility

Sub-features:
- Readability: Determines if it is pleasant to read.
- ✓ Software Evaluation: Students and Teachers
- Compatibility: Adaptation level with more than one system

✓ Software Evaluation: Experts

Feature: Operability

Sub-features:
o Accessibility: Properties suitable for the inclusion of people with special abilities.
✓ Software Evaluation: Teachers and experts
o Flexibility: Multiplicity of ways in which the user and the system exchange information.
✓ Software Evaluation: Students, teachers and experts

Level: Didactic

Characteristic: Capabilities developed

Sub-features:
o Level of Learning: Facility for the development of competencies based on the BLOOM Taxonomy.
✓ Software Evaluation: Teachers
o Predictive: The knowledge acquired by the user is sufficient to be able to determine the results of future interactions.
✓ Software Evaluation: Students and Teachers

Characteristic: Motivation

Sub-features:
o Ease of Learning: The extent to which the novice user understands how to initially use the system and how to build on this to reach a maximum level of knowledge and use of the system.
✓ Software Evaluation: Students and Teachers
o Learning Outcomes: The software contributes to the curriculum objectives.
✓ Software Evaluation: Students and Teachers

Feature: Content

Sub-features:
o Curricular Design: The software complies with the content of the academic program.
✓ Software Evaluation: Teachers
o Complexity: It presents levels of difficulty according to the student.
✓ Software Evaluation: Students and Teachers

Level: Technical

Feature: Documentation

Sub-features:

o Manual: Availability of a physical or digital guide for the installation and use of the system.
✓ Software Evaluation: Students, teachers and experts
o Help Tools: Possibility of consulting help at any time without leaving the application.
✓ Software Evaluation: Students, teachers and experts

Feature: Support

Sub-features:
o Technical Support: On-line support for updates and/or bug fixes
✓ Software Evaluation: Students, teachers and experts
o COST: SW acquisition level - price
✓ Software Evaluation: Students, Teachers and Experts

Feature: Design

Sub-features:
o User-friendly interface: Clear, attractive screen design without excessive text.
✓ Software Evaluation: Students, teachers and experts
o Discovery and Exploration: Technical and Aesthetic Quality - Audiovisual Environment
✓ Software Evaluation: Students, teachers and experts

Feature: Safety

Sub-features:
o Authentication: Access validation for multiple users
✓ Software Evaluation: Students, teachers and experts
o Program Protection: Ability of the SW product to achieve acceptable levels of risk.
✓ Software Evaluation: Experts

The implemented Model preserves the principle of category satisfaction, as established in the MOSCA model and emphasized by Grimán (2004), "in a category, if at least seventy-five percent (75%) of the associated metrics are within the optimal values for each of the characteristics immersed in the evaluated categories, then it can be stated that such characteristic has been satisfied". (p. 195)

Results

Once the evaluation instrument has been applied, the results of the technical test, evaluated by an expert, the evaluation of students and teachers are presented, and tabulations are presented outlining the scores obtained and expected parameterized according to the metrics established according to the level of contribution or significance of

the model developed. The results of the evaluation carried out by qualified technical personnel, teachers and students, where the scores of the characteristics and sub-characteristics of the model are shown, the differences obtained 3.1; 7.67; 10.9 respectively, allow to have an approach towards the usability of the software under study, however, it is necessary in order to elucidate with a robust argument that supports the applicability of the tool in the classroom, to consolidate the data according to technical, didactic and general criteria. Finally, based on the principle established for the characteristics of the MOSCA model, regarding the minimum compliance to ensure the usability of a tool "75%", the data of the evaluated aspects are consolidated, and the corresponding percentage ratio is generated, thus it is noticed in Table 1, that all the evaluated Technical, Didactic and General aspects comply with the proposed task, it can then be inferred that the usability of the SOLVEELECTv2.5 in the classroom will generate the expected results in relation to the skills and competencies that the student is expected to develop as a complement to the classroom training.

Table 1. *Level of compliance by evaluated aspect*

ASPECTS	% OF COMPLIANCE
TECHNICIANS	**76%**
DIDACTICS	**82%**
GENERAL	**75%**

Source: Prepared by the author.

Discussion

The versatility of the Systematic Model of evaluation of educational software provides the freedom to outline a prototype of assessment according to the needs experienced by the teacher in the classroom, beyond the curricular planning, the fact of having a tool that allows identifying the effectiveness of a software as a complement for the teaching-learning process, generates the confidence to implement activities that strengthen the theoretical knowledge through practice. The application of the proposed model, based on usability as a principle of quality assessment, in relation to generalities, technical and didactic aspects from the perspective of teachers, students and

experts in the area of software development, contributes to the identification, assessment and estimation according to established characteristics: ease of use, user appeal, help documentation, friendly interface, among others, the benefits and contribution in the educational environment; as a case study the proposed model is applied in the software SOLVE ELECv2.5 software, which, according to the established metrics and the evaluation obtained, allows identifying the tool as highly satisfactory in relation to the usability criteria, therefore, in the learning environment of study: Electrical Circuits, it is recommended the use of this tool as a complement for learning.

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