SAAC Usability Model and pictographic systems for people with disabilities

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# Introducción

Augmentative and Alternative Communication (AAC) is widely used in people with oral communication difficulties and refers to tools that complement people's natural speech [1]. They usually include symbol systems, which can be graphics or gestures, corresponding to the most used, pictograms and sign language [2]. There are AACs with help (eg SAAC) and without help (eg gestures), and their domain of use will depend on the context in which a person operates [1]. The AAC with help, can be complex systems such as pictographic, since they allow communication from a basic level to an advanced level [2], this article addresses the pictographic SAAC.

The Augmentative and Alternative Communication Systems (SAAC) are "a form of expression other than oral language that compensate for the communication and language difficulties of many people with or without disabilities" [3]. These are constituted as image-based expression tools designed to augment (support speech) or compensate (replace spoken language) for communication and language deficits. They are also suitable for people with a disorder such as the autism spectrum, multiple sclerosis or for people with communication problems to communicate with their environment more effectively, with special emphasis on use in childhood [4].

SAACs are tailored to the needs of people with different ages and motor, cognitive and linguistic abilities. These assistive products include non-technology resources such as printed pictograms and technology such as artificial voice communicators. Non-technological SAACs have a basic and functional implementation, however, they present limitations such as the number of pictograms that people can carry in their daily lives [4]. This problem is solved by the technological SAAC, since it complements it through the use of smart mobile devices and specialized software. These technological resources increase the number of pictograms, add functionalities such as audio synchronized with the pictograms, and reduce the need for external support. Thus, technological SAACs improve the quality of life of people with some type of communication disability [4].

At present there are a series of technological solutions that allow users to communicate through pictograms. Some of these are: Araboard Constructor [5], Talk up! [6], Soyvisual [7], SPQR [8], Dictapicto [9]. Despite the benefits of these systems, they do not follow quality standards, therefore, they do not guarantee that users obtain the highest therapeutic adherence or satisfaction when interacting with these systems [10]. Thus arises the need for a method of evaluation of use to know if these systems satisfy the usability needs of end users, using a series of metrics [3]; in order to measure, understand, predict and improve software development [11].

In computer science, to evaluate the level of satisfaction with the use of software, software quality models are used. These models interpret the degree to which software meets user requirements, providing a level of value to their activities [12]. Besides being a tool that provides standards and parameters, as well as specific steps to manage or validate an IT project [13]. These models have various characteristics to evaluate, such as Reliability, Reliability, Security, among others [6]. However, this article focuses on Usability, which is understood as the ability of the software to be understood, learned and used, being attractive to the user, when used under certain conditions [12]. With all the above, this article proposes a quality model in use, which refers to the user's opinion about the quality of the software product when it is used in a specific environment, that is, if the user can use the product. to achieve their goal [14]. According to [13], quality in use can be approached from the perspective of quality at the product level, which seeks to specify and evaluate the fulfillment of a product's criteria, which is why this article is built as a quality model to product level, with an emphasis on quality in use, for which certain characteristics, sub-characteristics and metrics may overlap in concept.

The evaluation of the usability of the SAAC will be approached around a quality model based on the ISO / IEC 25010 standard. This model considers a set of characteristics which allow knowing the quality of the product by evaluating the properties of the SAAC [12]. In addition, the ISO 14915-1 quality standard will be used that addresses important concepts of user interfaces for applications that incorporate, integrate and synchronize different static and dynamic media, such as text and interactive multimedia (images, videos, audio) directly related to the sensory modalities [15]. Finally, to address aspects of planning and design management focused on human ergonomics, ISO 9241-210 will be used, this ISO will allow to establish characteristics, sub-characteristics and metrics for SAAC using the HCI design guides for interactive systems [16].

Thus, Section 2 establishes similarities and differences of the models and standards mentioned above. This stage sets or discards properties to establish a quality model and its appropriate evaluation method for pictographic systems. In Section 3, the proposed quality model is specified, analyzing the properties, characteristics, sub-characteristics, metrics and heuristics chosen and its approach in the framework of evaluating the usability of SAACs. Continuing with Section 4, Implementation of the Usability Model for pictographic systems in SAAC, which breaks down the selected measurement tools and evaluates the definition models and is the basis for measurements in controlled environments [13]. This section likewise establishes the results and how they are interpreted in the domain of this document. Finally, Section 5 records the conclusions and recommendations obtained from the model based on the tests performed.

# Related Works

This section details several articles, under which the present article establishes different important points of the central theme; specifies various standards used to measure product quality and in use. These standards raise the issue of quality in a generic way, the contribution of this article lies in configuring several of these characteristics, sub-characteristics and metrics to the domain of SAAC in people with disabilities. There are several quality standards, such as those shown in TABLE 1, that allow customizing the usability quality model for pictographic systems.

1. MODELS AND QUALITY STANDARDS FOCUSED ON THE LEVEL OF PRODUCT QUALITY

| Quality level | Quality Model | Quality Standard |
| --- | --- | --- |
| Product | Gilb, GQM, McCall, FURPS, BOHEM, SATC, Dromey, C-QM, SQA, Web EQM | ISO 9126-1, ISO 9126-4, ISO 25010, IEEE 1061-1998, ISO 9241-210, ISO 9126-2, ISO 9126-3 |

Among the standards chosen from TABLE 1, for the purposes of this article, are ISO 9126-1 [17], ISO 25010 [12] and ISO 9241-210 [16]. It is important to specify that ISO 25000 including ISO 25010, are an evolution of ISO 9126, which develop the same concepts, however, they differ in how to measure quality in use, and in the category in which it is designated [17]. While in ISO 9126, quality in use is a characteristic with attributes such as Efficiency, Productivity, Safety and Satisfaction; ISO 25010 the obvious one as characteristic, and its attributes become characteristics [12]. TABLE 2 indicates the differences in characteristics of each ISO.

1. FEATURE OF THE QUALITY STANDARDS ANALYZED

| FEATURE | ISO 25010 | ISO 9126 | ISO 9241 |
| --- | --- | --- | --- |
| Effectiveness | No | No | Yes |
| Efficiency | No | No | Yes |
| Satisfaction | No | No | Yes |
| Functional Adequacy | Yes | Yes | No |
| Reliability | Yes | Yes | No |
| Usability | Yes | Yes | No |
| Efficiency | Yes | Yes | No |
| Maintainability | Yes | Yes | No |
| Portability | Yes | Yes | No |
| Compatibility | Yes | No | No |
| Security | Yes | No | No |

Thus, starting from these differences at the level of characteristics, Usability is addressed as the main characteristic. This comparison is carried out using the standards in TABLE 2 and a usability quality model of [1]. In the same way as the overlap of the characteristics, there is some overlap between attributes, such is the case of attribute 8 and 17 of TABLE 3, of ISO 9126 and 9241, respectively. Like this one, there are other overlaps, which, although they may provide redundancy with respect to the proposed model, have been proposed in a way that allows establishing a global vision of these, applied to the needs of the CAA.

1. SUB FEATURE OF THE QUALITY STANDARDS ANALYZED

| N° | SUB FEATURE | ISO 25010 | ISO 9126 | ISO 9241 | USABILITY MODEL |
| --- | --- | --- | --- | --- | --- |
| 1 | Ability to recognize its adequacy | Yes | No | No | No |
| 2 | Learning capacity | Yes | No | No | No |
| 3 | Ability to be used | Yes | No | No | No |
| 4 | Protection against user errors | Yes | No | No | No |
| 5 | User interface aesthetics | Yes | No | No | No |
| 6 | Accessibility | No | Yes | No | No |
| 7 | Operability | No | Yes | No | No |
| 8 | Context Comfort | No | Yes | No | No |
| 9 | Context extension in use | No | Yes | No | No |
| 10 | Satisfaction in use | No | Yes | No | No |
| 11 | Efficiency in use | No | Yes | No | No |
| 12 | Effectiveness in use | No | Yes | No | No |
| 13 | Understandability | No | No | No | Yes |
| 14 | Attractiveness | No | No | Yes | No |
| 15 | Personalization | No | No | Yes | No |
| 16 | Navigability | No | No | Yes | No |
| 17 | Accordance | No | No | Yes | No |

The standards [12] [16] and quality models [1] mentioned are different from the one presented in this work because it allows establishing the appropriate measurement tools with respect to the selected SAAC software. Establishing a direct link between quality in use-product and an applied case. The proposed model provides quantitative results of specific characteristics and attributes of both product quality and quality in the use of the software that implements the pictographic systems.

# USABILITY MODEL FOR PICTOGRAPHIC SYSTEMS IN SAAC

In this section, the proposed usability model for pictographic systems in SAAC is specified along with a brief description of the sub-characteristics, attributes and metrics. It describes the most relevant attributes of each subcharacteristic, but not its totality of sub feature.

# IMPLEMENTATION OF THE USABILITY MODEL FOR PICTOGRAPHIC SYSTEMS IN SAAC

This section details the tools used for the implementation and evaluation of the proposed model. The applications selected for evaluation using the proposed model are: Talk up! [6][5] and Soyvisual [7]. The choice of these applications is mainly due to the level of existing documentation and the maintainability through updates that are given in electronic stores.

# CONCLUSIONS AND FUTURE WORK

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