

# Health Education in Brazil

## Assessment of the Understandability of Icons for the e-Books Store SAITE App

Eurides Florindo de Castro Jr.<sup>1</sup>, Edilson Thialison da Silva Reis<sup>1</sup>,  
Camila Santos de Castro e Lima<sup>1</sup>, Carla Galvão Spinillo<sup>2</sup>,  
and Ana Emilia Figueiredo de Oliveira<sup>1</sup>(✉)

<sup>1</sup> Federal University of Maranhão, São Luís, Brazil  
euridescastro@gmail.com, edilson.sreis@gmail.com,  
camilasclima@gmail.com, oliveira.anaemilia@gmail.com

<sup>2</sup> Federal University of Paraná, Curitiba, Brazil  
cgspin@gmail.com

**Abstract.** The communication role of computer icons is a relevant aspect in digital interfaces, as they promote efficiency and effectiveness in the interaction between users and computer systems. This paper presents the results of a study on comprehension of computer icons for the SAITE e-Book store app of the Brazilian Health System Open University (UNA-SUS). Nine out of 39 icons designed for SAITE were assessed through online questionnaire by 139 health professionals enrolled in the distance learning courses of UNA-SUS. The results showed that five icons reached high rates of understanding and three reached low rates. It was concluded that icons may succeed in representing abstract general concepts in the health field, and that users' familiarity with an icon's graphic representation affects message comprehension.

**Keywords:** Computer icons · Understandability · User centered design · Information design

## 1 Introduction

Health education is today part of social programs in several countries as it promotes the well-being of populations. It regards the learning experience of health related contents which can be addressed to individuals as well as professionals. Among the initiatives in health education, distance learning courses and apps have been widely made available to facilitate the access of training material to health professionals.

In 2008 the federal government of Brazil founded the UNA-SUS – the National Health System Open University to offer health education training courses mainly addressed to medical doctors and nurses. To facilitate the development, publication and distribution of the e-books of the UNA-SUS e-learning courses, a platform was designed for mobile devices (e.g., tablets, smart phones): the SAITE Store. It is a virtual store that offers interactive e-books categorized into several thematic areas of health (e.g., nephrology, pediatrics). The SAITE Store app also allows students to get their reading

material in places with limited Internet access by downloading the e-books to be read offline in their mobile devices.

E-books and apps produced for the SAITE Store employ visual resources in their digital interfaces, such as icons to represent the contents of the e-books. These are considered to aid effectiveness and efficiency in communicating content and enabling navigation in digital devices. Computer icons are valuable graphic representations of information content for both users with little familiarity with digital systems and experienced users [1, 2]. Thus, icons are important elements to design of information and interaction in GUIs-Graphic User Interfaces.

From a user centered approach, users should be involved in the design process of icons to ensure their understanding [3]. This may be at the initial stage of the process, providing inputs to make design decisions, and/or at the final stage, evaluating the designed icons. Nevertheless, there seems to be a lack of such approach to the design of computer icons. This is perhaps due to developers tending to verify the understandability of icons within their own team and/or with experts in the field, instead of with users [3]. According to Nielsen [4], the test with real users is essential to provide direct information on how people make use of and what problems they encountered when interacting with the tested interface.

By considering the relevance of users' comprehensibility of icons to the success of computer systems in health education apps, this paper presents a study on the understandability of the icons designed for the SAITE Store of the UNA-SUS (National Health System Open University) in Brazil. Before presenting the study, a literature on this topic is introduced, highlighting aspects of the graphic presentation of icons from an information design perspective.

## 2 Icons as a Graphic Representation of Messages

Icons are elements of graphic digital interfaces used to convey information. They directly affect the quality of interaction and user's performance. Icons represent computer system functions, what distinguishes them from other symbols/pictograms displayed on screen [5]. Moreover, icons may represent objects, pointers, controls, tools and status indicators of a computer system, and are employed to mediate user's interactions with software applications [5]. In this sense, icons are intended to convey ideas/concepts rather than spoken words in a prompt and universal manner [6]. They allow the transposition from digital and computer language to the visual language through synthetic representations accessible to people with little or no technological knowledge [2].

Thus, icons are pictorial schematic and compact representations that allow prompt visualizations of messages, and in this sense they can be said to be similar to pictograms [7, 8]. Based upon Dewar [7], the relation between an icon and its referent (things or/and concepts) can be said to be similar to those of pictograms, as follows: (a) Part – part relation in which the icon is associated to the referent through certain similar characteristics as for example a 'globe' to represent 'worldwide web'; (b) Part - whole relation in which the icon is associated to its referent through a specific characteristic, as for

a ‘bag’ to convey ‘shopping’; (c) Image-based relation in which the icon is the illustration of its referent, e.g., calculator; (d) Example-based relation, in which the icon is associated to its referent through a class of objects, as for example a ‘book’ to represent ‘library’; and (e) Concept based relation, in which the icon has no referent, then an arbitrary image is employed to convey the intended meaning, e.g., the symbol for power on/off.

Moreover, as for pictograms, icons can represent a message through one element, i.e., simple representation or through more than one element, i.e., compound representation [8]. The number of elements of an icon may increase its visual complexity, which may affect user’s perception and/or comprehension of the icon [8]. Regarding the advantages of using icons, as for pictograms [7, 8], they may be independent of words/labels if they are part of users’ visual repertoire. They also may allow the message visualization at a glance, and may be seen in adverse visual conditions, for example low resolution screens. Though, since icons are pictorial representations, they have limitations in conveying abstract concepts/ideas, but are suitable for depicting concrete/existing objects/things [9]. Furthermore, the interpretation of pictorial representation of abstract concepts are related to individuals’ familiarity with such representations, and with the graphic system to which they belong [10]. Thus, to represent computer functions and users’ actions (e.g., delete, send message, save) through icons, it may be necessary to employ resources of visual rhetoric. It is also necessary to take into account users’ visual repertoire, for instance, a computer disk to represent save file (visual metaphor). Thus, to know how to verify the effectiveness of icons to communicate messages seems to be a chief aspect in the design of useful icon. This is briefly presented next.

## 2.1 Understandability of Icons

Several testing methods and techniques are available in the literature for researchers to verify individuals’ reactions to icons and pictograms/symbols, whether in the domain of perception or comprehension [11, 12]. For the latter, [3] states that understandability test is one of the most important steps in the development of symbols for public information (as computer icons), as it aims to find their correct degree of understanding. She also advocates the qualitative approach to understandability tests, as this provides support to designers to decide for the most suitable variant of a symbol, i.e., the most comprehensible graphic representation of the message.

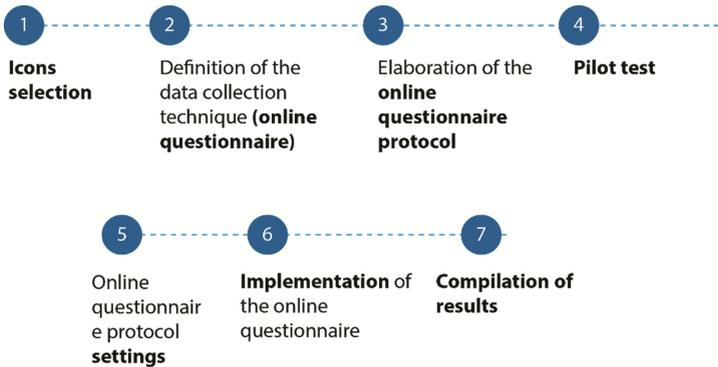
In the scope of health education in distance learning courses, the understanding of icons in GUIs seems to be a key issue to reach satisfactory training results. Misinterpretation of the icons’ meanings may make access to information difficult or even lead to unpleasant experiences in human-computer interaction by the health professional trainees. As an attempt to aid the design process of icons from a user centered design approach, [2] (2013) conducted a study on the assessment of icons of a telemedicine system interface in Brazil. As a result, the authors proposed guidelines and recommendations to develop useful icons based on the HCI literature.

Taking into account (a) the relevance of understandability tests to icons’ effectiveness to communicate messages, and (b) the literature recommendations for their design, a set of icons was designed to SAITE Store platform of the UNA-SUS e-books. These

were tested with health professionals to check whether the icons were properly conveying their function/role in the e-book GUIs. This is presented next.

### 3 The Evaluation of the Understanding of the SAITE Store Icons

The understandability test of icons of the SAITE Store was conducted in the following stages: (1) icons’ selection; (2) definition of the data collection technique (online questionnaire); (3) protocol elaboration; (4) pilot testing; (5) online protocols’ settings; (6) data collecting; and (7) results’ compilation (Fig. 1).



**Fig. 1.** Flowchart of production and application of understandability test of icons of the SAITE Store.

#### 3.1 The Icon Sample Tested

A total of 39 icons were developed for the SAITE Store. To select the sample to be tested, the understandability of the icons (without labels) was assessed by 10 volunteer participants who were not health professionals. The results showed that the most difficult icons to understand were those for: (a) Women’s Health; (b) Communicable Diseases; (c) Distance Learning; (d) Stork Network; (e) Health and Society; (f) Nephrology; (g) Health; (h) Aggravations in Health; and (i) Health Networks. Hence, the sample to be tested was composed of these nine icons, which is showed in Table 1.

#### 3.2 Methodological Procedures

The understandability of the sample of nine icons of the SAITE Store app was assessed through an online questionnaire. The questions were closed-ended and open-ended based on the understandability test proposed by Formiga [3]. The closed-ended questions provided different meanings to an icon, and the open-ended questions provided a field for writing the answers.

A pilot test was conducted with five participants as a trial run of the main study to validate the questionnaire protocol, ensuring the reliability of the results [13]. This led

**Table 1.** Sample of nine icons tested in the study

Icon Identification	Icon	Concept	Icon Identification	Icon	Concept
a		Women's Health	f		Nephrology
b		Communicable Diseases	g		Health
c		Distance Learning	h		Aggravations in Health
d		Stork Network	i		Health Networks
e		Health and Society			

to adjustments in the number of closed-ended response options to five choices for each icon, and in setting the terms provided to identify/label the icons.

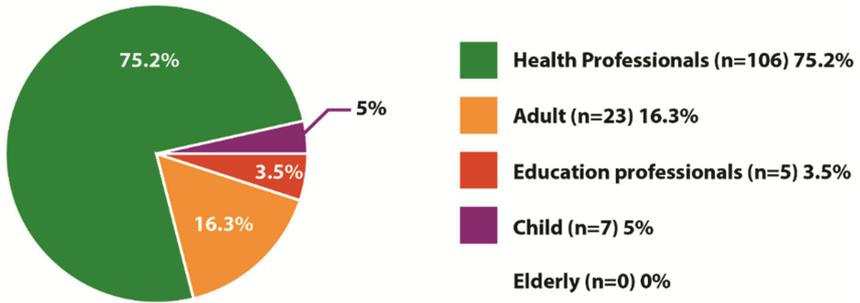
The adjusted online questionnaire was made available through the Google Forms platform to 847 students of the UNA-SUS/UFMA (Federal University of Maranhão), who voluntarily responded the questionnaire. They were asked to associate the meaning of each icon to a label, and to justify their answer. The results were analyzed quantitatively and qualitatively. However, for the purpose of this article, the results herein are discussed in a qualitative manner and figures are only used to indicate trends in the participants' responses.

### 3.3 Overall Results

From a universe of 847 students, a total of 139 students responded the questionnaire, and most of them were healthcare professionals (n = 86). When asked to whom the nine icons of SAITE Store were addressed, 75.2 % of the participants (n = 106) correctly responded that they were for healthcare professionals. The use of elements related to the medical field in the icons was given as the main reason by the participants. Only seven participants (n = 5 %) considered the tested icons to be addressed to children (Fig. 2).

The overall results showed that five out of the nine assessed icons were satisfactorily understood by the participants. These seem to be related to their acquaintance with the graphic representations employed [10], and to the relationship between the message and its referent [7]. Two icons obtained understandability index above 90 %: Stork Network 93.6 % (n = 132) and Nephrology 96.5 % (n = 136). The responses to the former seem to be due to the participants' familiarity with the national program for pregnancy, and with the symbols for health (the cross) and for delivering babies (the stork bird). This may have led participants to easily associate the icon graphic representation to its meaning. In a sense, that was a literal representation of the concept 'Stork Network'. Likewise, the representation of 'Nephrology' (branch of medicine concerned with the kidneys) by a kidney is literal, with both part-whole and image-based relations between

**In your opinion, the images above were developed for the public**



**Fig. 2.** Results of the kind of audience the tested icons of SAITE Store were intended to. Source: Google forms. (Color figure online)

the icon and its referent [7]. The former icons employed the symbols for health and breasts (a circle with two inner circles). On the other hand, the icon for Health Network used linked dots to convey the notion of networking in a concept based relation [7].

In contrast, low understandability occurred in the participants’ responses to the icons: Communicable Diseases 9.9 % (n = 14), Distance Education 28.4 % (n = 40), Health and Society, with 39.7 % (n = 56) and Aggravations in health, with 50.4 % (n = 71) as shown in Table 2.

**Table 2.** Results of the icons with low understandability. source: The authors

Concept	Icon	n	%
Communicable Diseases		14	9.9%
Distance Learning		40	28.4%
Health and Society		56	39.7%
Aggravations in Health		71	50.4%

Participants’ difficulties in associating the icons to their intended meaning may have been due to the abstract nature of their messages, allied to the absence of familiar symbols conveying the messages. This is demonstrated by most participants associating the Communicable Diseases icon to ‘Virus’ (83 %, n = 117), Health and Society icon

to Primary Healthcare (52.2 %, n = 74); and the Distance Education icon to ‘Archive Transfer’ (62.4 %, n = 88). The misinterpretation of the latter icon, however, was perhaps due to the image of ‘multiple pages’ being commonly associated to the semantic domain of ‘archive’ rather than of ‘distance learning’. As for the Aggravations in the ‘Health’ icon, its association to Hospital by 50.4 % (n = 71) of the participants, was probably because the cross is a symbol for hospital. Thus, the icon alone is not sufficient to represent the complexity of the concept. It is interesting to note that these icons were all in a concept-based relation to their messages, that is, they had no referent to rely on. Hence, the icons made use of visual rhetoric to represent their concepts, since images have limitations to convey abstract notions [8, 9].

## 4 Conclusions

Based upon the results of understandability of the icons of the e-book for the SAITE Store app, it is plausible to conclude that their success in communicating messages seem to be directly related to users’ familiarity with their graphic representation. If literal depiction of a referent and/or familiar symbols are not employed, labels should be used to make clear the icons’ meaning to their users, particularly when representing abstract/complex concepts. The study added empirical evidence to support the literature on the representational competence of the pictorial mode, through the results on understanding of the assessed icons. Finally, adjustments were made to the icons of the e-book for SAITE Store app according to the outcomes of this study.

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