Use of visual metaphors in virtual environments for teaching and learning: the user point of view.

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ABSTRACT

This paper aims to discuss the use of visual metaphors in the development of System Interfaces for Distance Education about the differences between two scholars concerning Human-Computer Interaction: Donald Norman and Jakob Nielsen, whether or not to use the metaphors. The possibility of networking, both as a framework for access and processing of information, and as a framework for exchange and collaborative activity is the high quality of emerging technologies. These techniques allow structures to implement new and more complexes forms of social interaction, arising the possibility of immediate exchange of information and content in cyberspace. Hence, the individuals become at the same time, transmitters and receivers, producers and consumers of the message. Therefore, communication is no longer linear and one way to become multilingual, polycentric and polysemic. In this context, the interfaces through which individuals will interact should be designed towards their needs in a fast, effective, efficient and satisfactory way. A powerful tool used to achieve these goals is the use of visual metaphors (icons, graphics, layout of visual elements in the interface) that exploits the users' previous knowledge and repertoire to facilitate the communication process, leveraging prior knowledge   to define computational interactions difficult to articulate. If in one hand this association is interesting, on the other hand new mental models cease to be created and exploited, often delaying the development of a language of its own in such systems. In Virtual Environments for Teaching and Learning such use is widespread, which may end by emphasizing similarities, by omitting important differences between the model that uses (something known) and the system that is drawn from it (something new). In this sense, we have tested two groups of students: one that is used to the environment which the metaphors are installed and the other that uses a different LMS (Learning Management System).Thus, we shall show that in Virtual Environments for Teaching and Learning, as well as in other interfaces that use the Web environment, the user will have to improve the conceptual model of the object in every interaction, because, for as close as they can be, the virtual world is different from the real world.

KEYWORDS

Metaphors, Learning Management Systems, Usability, icons, digital interfaces

INTRODUCTION

Moran (2002) defines distance education as a teaching-learning process mediated by technology, where teachers and students are separated spatially and/or temporally.

However, Litwin (2001) pointed out that EAD is no more characterized by the distance, since the virtual meeting allows more effective than possible in fact education. For the author, the distinguishing feature of this mode is the mediation of relations between teachers and students.

In this sense, the possibility of networking, both as a framework for access and processing of information, and as a framework for exchange and collaborative activity is the high quality of emerging technologies. If the network structure, of many complexities, is the new computer technologies, the network activity is as old as humankind, only restrained by the space-temporal conditions and the technical limitations of the available devices.

To improve formal distance education were developed systems called Learning Management Systems (LMS) that are softwares applications or Web-based technologies used to plan, implement, and assess a specific learning process. Typically, a learning management system provides an instructor with a way to create and deliver content, monitor student participation, and assess student performance. A LMS may also provide students with the ability to use interactive features such as threaded discussions, discussion forums and chats. In such environments, more and more tools are available to promote a richer process of teaching and learning.

The success and the efficiency of a Virtual Environment for Teaching and Learning (also called LMS) lays in the quality of services it offers and in the way it offers, and not only in its aesthetics (Albertin, 1999). Users communicate with the sites to perform their tasks and access the services of sites through the user interfaces, a fundamental part of the Information Systems (Ferreira, 2003).

According to Levy (2003), new media raises new and different types of knowledge. Hence, by experimenting interfaces and devices that enable a high degree of interactivity, the individuals come to learn different ways, which ultimately remove the technologies and strategies of traditional education of the learner's reality.

In this sense ,the interfaces should be designed aiming the users' needs and expectations, allowing them to target their attention to the objects they work directly with (Roberts, 1998), in a fast, effective, efficient and satisfactory way, which means, the design should be user-centered.

The use of visual metaphors (icons, graphics, layout of visual elements in the interface) may exploit the users' previous knowledge and repertoire to facilitate the communication process, leveraging prior knowledge changing the mechanical learning in meaningful learning (Ausubel, 1968) and hence allowing the definition of computational interactions usually difficult to be articulated by no experienced user.

Developed from the best known figure of speech, the visual metaphor is, as the metonymy, a figure which the desired effect is given by a word game (and images) that is made in the sentence construction or in the interfaces.

The metaphor is to draw an idea of its conventional context (denotative) and move it to a new field of meaning (connotative), through an implicit comparison from a similarity between the two. (Corbett & Connors, 1999)

In this sense, metaphors allow understanding and experimenting a kind of thing in terms of other, widely used in everyday life. They can also be used in the interfaces design to leverage the users' previous knowledge and to define computational interactions difficult to articulate (Preece, Rogers & Sharp, 2005)

However, the inappropriate use of metaphors, as well as of other figures of speech, may hinder the interaction. The metaphors emphasize similarities between two things, but can also omit differences (Lakoff, 1980) and (Blackwell, 2006). If the use of figures of speech is not carefully done, the user can be induced to believe that the system has some attributes that it certainly does not.

Due to these characteristics, there are different opinions among some scholars in the Human-Computer Interaction (HCI) as to whether or not use the metaphors in interfaces. These differing points of view led to this research. Hence, this paper aims to discuss the different points of view of the use of visual metaphors in the development of System Interfaces for Distance Education between two scholars concerning Human-Computer Interaction: Donald Norman and Jakob Nielsen.

This paper is part of an earlier investigation, which proposed an analysis of the visual metaphors used in Moodle in Mackenzie Presbyterian University based on the research and on the classification proposed by Lakoff (1980). His intention is to analyze these metaphors from the user's impressions and perception. Therefore, teachers and students users were analyzed. They were divided into two groups, those who were already familiarized with Moodle, and those who were not. As a testing methodology, it was used the Nielsen's proposition (2000), with a limited number of users.

INITIAL CONSIDERATIONS

To be able to develop the research, it was of paramount importance to contextualize the reader concerning the beginning of this work.

So, it is necessary to trace an overview of both Ausubel's and Vygotsky's basic researches in learning theories, cognition and the use of visual elements and interfaces of visual elements.

Vygotsky's Social Interactionism and Ausubel's Meaningful Learning.

In Psychology as in Education there are different approaches explaining the learning process. Among them are Vygotsky's Social Interactionism and Ausubel's Meaningful Learning theories.

Lev Vygotsky's studies claim the dialectic of children's interaction with their peers and with the environment they live in, as a trigger of the cognitive and social development. For him, development is driven by the learner's own language and learning process that generates and promotes the development of higher mental structures. (Pacheco and Kfouri, 2012)

A central point of his theory is the concept of Zone of Proximal Development (ZPD), which ensures that learning happens between the actual knowledge and the potential knowledge. In this sense, formal education should act in this area, encouraging the acquisition of the potential knowledge from the learner's ZPD. When the potential knowledge is reached, it becomes a real knowledge, and the ZPD is redefined from the new potential.

"...the zone of proximal development. It is the distance between the actual development level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers." (Vygotsky, 1984:86)

To Vygotsky, the interactions are crucial and decisive, to define the real knowledge. He states the importance of knowing what the subject is able to do by himself, and the potential of what he can do with the help of someone else. According to him, the richest the interactions are the most sophisticated the development will be.

In Anusubel's Meaningful Learning Theory, to have meaningful learning two conditions are required: firstly, the student must have the willingness to learn, secondly, the school contents to be learned must be potentially significant. For that, the contents must be logically and psychologically significant: the logical meaning depends on the nature of the content, and the psychological meaning depends on the individual experiences. According to Ausubel (1968), a student filters the contents that are meaningful or not for himself.

Note that for Ausubel, as for Vygotsky, it is strongly required to consider the repertoire of the learner's prior knowledge so that new concepts are assimilated.

Cognition and the use of visual elements

Beck and Alford (2000) define cognition as "function that involves inferences about our experiences and about the occurrence and control of future events" or "the process of identifying and predicting complex relationships between events to facilitate the adaptation to environments liable to change. "

So, it can be said that the cognitive load refers to the demands of the learner working memory during ones instruction. Specifically in computer-based instruction or Web-based instruction, the term covers both the mental method required to access and explain the screens, icons and objects, such as the cognitive procedures dedicated to process the actual content of instruction.

In this sense, the cognitive load is a factor that should always be considerate during the digital interfaces design process, because each of the elements or objects used need to be interpreted by the user that, consequently, involves using the users' mental energy. A complex or unconventional design has generally a high procedural or functional cognitive load because each component needs to be perceived, interpreted and understood by the learner.

Intending to reduce the cognitive overload, a possible way is to use symbolic standards widely accepted to screen elements, and labels or explicit icons associated with choices or tasks. Therefore, the users should not think about their actions, but simply respond in an intuitive way.

THE VISUAL ELEMENTS AND THE INTERFACES

In graphic design and information, pictograms are understood as graphic symbols, often figurative, visually representing objects, actions or concepts, preferably without using verbal language. The term 'icon' is often used in the same direction (Westendorp & van der Waarde 2001:91), and this is more recurrent in design for digital media (Caplin, 2001). In some cases, pictograms and icons are described as a type of diagram (Bounford 2000: 24-29), others as a kind of symbol (McLaren 2000, Brigham 2001).

When a digital system is designed, the designer develops a conceptual model of such a system, called "design model". The development of this model is based on a particular set of users, the particular context of use. It includes things like what features perform which tasks, the navigational structure of the system, and how do the parts of the system report to one another. (Moknkern, 1997).

This model is based on the development of a particular group of users, and a singular context of use. It contains things such as what features perform which tasks, the navigational framework of system, and how the parts of the system are related to one another. (Moknkern, 1997)

As a person uses the system, he forms a "user model", and develops his own concept of what the system's is and how it works, based on his experience with the system. The "user model" can whether or not be an accurate model of the system. The designer's target is to communicate the model to the user. One's only resource of communication, however, is the system image itself. If a system is successfully designed, the "user model" will be equivalent to the design model.

Both metaphors and mental models have been proposed as basis for user interface design. Some researchers point out that user interfaces should "closely match the way a user thinks of a task." (Hollan, Hutchins & Weitzman, 1984). Others believe that familiar, daily, metaphors like desktops should be the starting point for interface design, because users can explain the interface based on their previous knowledge of the source of the metaphor. (Apple Human Interface Guidelines, 1987)

The Metaphors: features and classifications

The term metaphor used in interface design differs a little from the same term used in literature. In literature it means "an implied comparison between two things of unlike nature that yet have something in common" (Corbett & Connors, 1999). Both things are known and the weight of metaphor is in a distinctively or amazingly pairing. With the pairing it is possible to find out something surprising about what one thought one already knew. In a computer interface, one of the two elements is knew and unknown. The weight of the metaphor is in making a new system looks like and acts like an already known system. Interface metaphors give the user a user model directly.

Physical objects, just by their appearance and physical properties, provide a specific set of functions, a long straight stick has a number of potential uses poking soft ground support in rough terrain, the result of hitting a branch. However, screen displays have not inherent features, and program functionalities have no inherent appearance. For example, an abstract function may need to be beseeched by having the user clicks the mouse pointer in a particular location. A clickable spot can be indicated by a colored group of pixels or a highly rendered image of a lifelike button. In the latter case, one uses a metaphor of a physical button that has the function and the appearance that the user is already familiar with, when someone addresses a metaphor that applies he takes on its function and appearance to the screen.

Relating a model of a known system and its functions to an unknown program via metaphor permits the user to apply what he knows about that system to a new one. This connection applies the user model of the known system to that of the unknown system. Users then make certain suppositions about the new system. For example, they may

assume that the folders of the Macintosh Finder can be opened and the items (files and other folders) can be placed inside of them or removed from them.

On the other hand, the choice of metaphor has a lot to do with the way people think about things. Computer-based systems differ from physical systems. Thus, modeling one after a physical analogue is sure to bring up inconsistencies and inadequacies. There is no one-to-one representation between the system and the real world analogue. The metaphor indicates at the same time too much and too little about the system.

Interface metaphor indicates that the system has certain attributes that it really does not. For example, people are inclined to think of e-mail as a private, sealed message to be read only by the addressee, as the mail sent through the postal system. However, there are no laws protecting e-mail the same way as physical mail. Actually, it's easy, and not uncommon for companies to archive and manage e-mail of their employees. Only few companies have taken steps to declare personal e-mail a private correspondence between two people. The metaphor implies that e-mail has the quality of private life that it really does not.

There are several classifications for metaphors. For example, they can be classified according to linguistic terms, according to relationships involved in the association, in respect to time of their adoption, among others.

According to Peirce's semiotics, for example, they correspond to instantiated icons of habits, conventions or laws. By the logic of the categories that rules such theory according to which categories at higher levels of generality assume those at lower levels, the 'metaphors' (hypo-icons more general, abstract) depend on some internal diagrammatic coherence to assume its status of icons, convention or law (Farias, 2002). Among the studied classifications, some were identified as appropriate metaphors for Web. Of these, two stand out: one is to classify metaphors according to the type of relationship between the two elements involved in the association and the other is to classify metaphors according to their time of existence (Lakoff, 1980) and (Moknkern, 2004).

1. Classification as a Relationship Function: this type of classification involves metaphors that relate one thing to another. The relationships involved can lead to:

 A. Structural Metaphors: are used to compare a concept to everyday concepts (Moknkern, 2004). They characterize the structure concept compared to the structure of another process; the concept involved in this process can be of various types: as an abstraction, as a real object, as an activity, and other types metaphorically structured. (Lakoff, 1980)

 B. Spatial Guiding Metaphors: transmit the concept of spatial orientation (up, down), it means, a concept explained in terms of space. They organize a whole system of concepts in a way to become possible to relate a concept to a spatial relation. (Lakoff, 1980)

 C. Ontological Metaphors: relate concepts in terms of basic categories of existence as objects or as substances. The understanding of experiences in terms of objects or substances allows to select parts of the experience and treat them as discrete entities or substances of a uniform type, the experiments can then be categorized, grouped and quantified. (Lakoff, 1980)

2.   Classification as a Function of Existence: relates to how the people receive the metaphors relating one thing to another: involves an already known and familiar relationship or brings a new conception of relationship that shows a new concept.

A. Conventional Metaphors: are those already used intuitively by the people. In Web environment, it can be considered traditional those already existed as digital graphical interfaces before the popularization of the Internet.

B. New Metaphors: are those not yet used intuitively by the people. In this case, the structure of the metaphor must be previously established. (Moknkern, 2004).

USABILITY: CONCEPTS AND TESTS

The user interfaces are components which are gaining more and more importance in the computer systems development. With the popularization of computers more systems are available for larger groups of users who perform a great variety of tasks. Currently, video games and other equipment and devices showed the users that they can expect something more pleasant and intuitive on interfaces, which made them more critical about products of complicated operation. (Nielsen, 2003)

So, it needs to emphasize that an important part of the development of digital systems , especially the Learning Management Systems, is the analysis of usability. According to Nielsen (1993) the global acceptability of a system is divide into social acceptability and practical acceptability. The first is characterized by the users' acceptance of the need and relevance of the social role proposed by a particular system. The second points to issues such as cost, reliability, security, compatibility, flexibility and quality of use (which considers the easeness of interaction between user and system).

Usability aims the development of interfaces that allow easy, pleasant, effective and efficient interaction. It should permit the creation of transparent interfaces so as not to hinder the process, allowing the user's full control of the environment without turning to an obstacle during the interaction.

The usability can be divided into five basic criteria (Nielsen, 1993):

• Learnability - The system must facilitate the use allowing that even an inexperienced user could produce some satisfactorily work.

• Efficiency - The system must be efficient in its performance presenting a high level of productivity.

• Memorability - Its screens should provide easy memorization allowing infrequent users being able to use it even after a long period of time.

• Errors - The number of errors of the system should be as minimum as possible, plus it must present ease and fast solutions even for beginner users. It cannot occur serious or unsolved errors.

• Satisfaction – For beginners as for advanced users, the system must be appealing, promoting a pleasant interaction.

The most common way of evaluate the usability of a software is watching its interaction with the user. This can be done in a laboratory with a representative amount of users for which the system was developed or in the work environment where the system will be deployed. The most important thing in the evaluation of this process is that, as ever as

possible, one should use the proper user for the proper tasks to obtain the maximum evaluation as possible.

The test with 5 users

According to Nielsen (2000), "the best results come from testing no more than five users and running the many small tests as you can afford."

As the author says, when the first user is tested, about a third of the usability and of the design problems are already solved. And many things are repeated and new ones are added. This number of innovations will decrease, and, from the sixth user on anything important is detected.

Therefore, "there is no real need to keep in observing the same thing multiple times" because "after the fifth user, you are wasting your time observing the same findings repeatedly but not learning much new." (Nielsen, 2000)

Also according to the author, to discover all the usability problems in an application it should be tested only 15 users.

METAPHORS IN LMSs: The Moodle Case

In Virtual Environments for Teaching and Learning the use of metaphors is widespread. In such environments, the main function of these elements is to facilitate navigation of the learner and the teacher, enabling access, interaction and content editing interactively and immediately.

To analyze the use of metaphors in such environments, this research considered the most popular LMS in Brazil: Moodle.

As it is a platform developed collaboratively, many developers around the world create their own themes (graphical user interfaces suitable for the architecture of Moodle). These themes tend to use visual elements from existing libraries of icons or develop its own family of graphics elements. But one way or another, many of them start from associations commonly seen at the interfaces of the Linux operating system, which is designed similarly to the LMS in question. (Pacheco, Kfouri, 2012)

To analyze metaphorical imagery elements, the standard icons tool and those presented in the skin of Mackenzie University (Sao Paulo - Brazil) in its personal atmosphere were analyzed.

Icons belonging to all categories presented by Moknkern (2004) and Lakoff (1980) were found.

Analysis of visual metaphors according to user's perception

Starting from the premises so that the use of visual metaphors is of paramount importance in the use of interfaces learner's cognitive overload can appear and the user's mental model must be respected at this moment to propose the metaphorical associations. Testing with users started for the second part of our research.

In order to collect presised data, users were divided into two groups: students who have not yet had contact with the platform (01) and students who have already had contact with the platform (02).

The groups of students, are the ones that interest the most to the research for the virtual environments for teaching and learning should have, as pointed out in the present

study, an interaction interface which provides an intuitive and transparent commands to boost the learner's energy spending in the knowledge to be learned.

The efficiency of visual metaphors was tested from an online questionnaire answered by the user's groups.

This questionnaire has four groups of questions: the user's profile, open-ended questions in which the user should associate the images presented to a concept (action / task / application area), multiple choice questions in which users should associate the presented image to one of the concepts provided and to free associations in which the user should associate an image (his head) to presented concepts.

15 students in each group were tested based on Nielsen's (2000) methodology, it was possible to detected that 100% of students.

Analysis of the results:

The group 01 consists of 15 university students who, although use a LMS in the institution they are studying, it is not Moodle so, they are not familiarized with the presented visual metaphors.

The first group of metaphors to analyze was presented as open questions. The student should associate each image displayed to an action, task or application area, as in the image bellow:
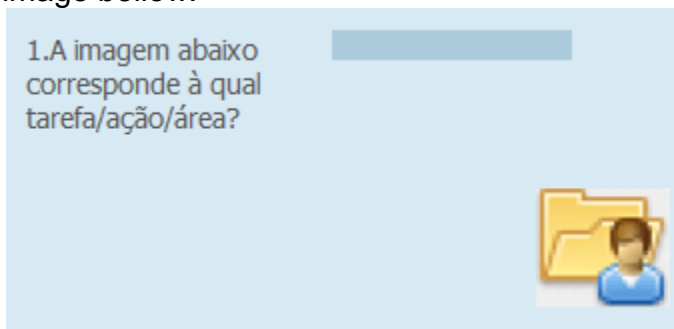

Figura 1: example of open question

The next set of questions some options were presented and the respondents were warned that these were LMS visual elements, as the following image.
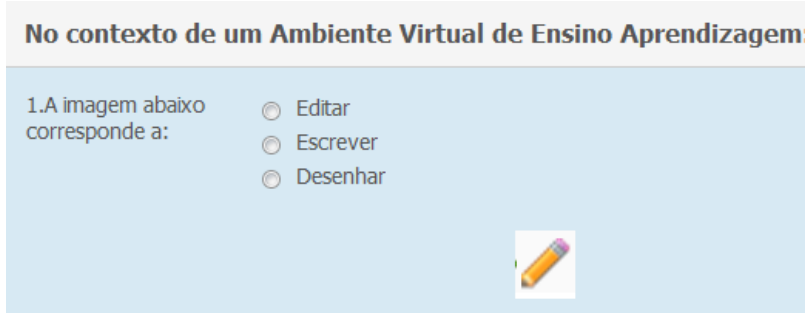

Figura 2: second group of questions.

Propositions of association were made as following:

Faça a associação de uma imagem às palavras apresentadas abaixo:

Mensagem:

Figura 3: last group of questions: associations.

FINAL CONSIDERATIONS

The analysis revealed that although the metaphors can make the user feel more comfortable in dealing with familiar concepts and ideas, they do not cause an object to behave exactly like the other. During the interaction, the user will have to improve the conceptual pattern, because as close as they can be the computer world is different from the real one, so it was concluded that the metaphors can be used, but cautiously and judiciously.

In cognitive terms, the analog procedures rely on concepts more concrete and closer to the experience of the users. Therefore, they can extend their understanding to more complex and abstract levels of knowledge and apprehension of the reality. This procedure is highly productive in the expansion and renovation of the vocabulary of a language.

Although traditionally viewed as an eminently semantic process, it actually operates with pragmatic rules. If understood only at the semantic level, metaphorical analogy may not be fully decoded by the receiver. The inferences are not deductible from pragmatic meanings of logical rules, but from conversational rules, that are true or relevant from the contextual relationships.

The evaluation of metaphors with students showed that the familiarity with the system actually solves some associative problems, whereas there is the learning of metaphorical visual elements, however, if these elements are analyze out of the association context they can be presented as truncated and incipient .
In these cases, the cognitive overload is very high which suggests the use of text,and not the use of visual metaphors. If these are used, it is essential that the text appears along with the image.
As aextention of this research, it is intended to an intensive semoitics analyze of such elements to verify if there are any connections between the semiotic symbol used with metaphorical function, and the right comprehension of the tasks, activities or locations in digital systems.

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