Navigation in children's educational software: the influence of multimedia elements

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Abstract

This study carried out an exploratory investigation which objective was to collect preliminary information about children user's mental effort in the use of a certain educational software, considering the organization of information and its representation, under a cognitive ergonomics approach. A case study of the *Bright Little Rabbit/second grade* was undertaken to observe a group of five eight years old children, in the same school level and understanding the system studied. These children were invited to play individually on the computer with the software, being asked to complete the tasks proposed in the system's activities. Thus it was possible to observe the navigation performance of each child in fulfilling the software's objective.

Keywords: field study, children, cognition, human computer interaction, research in design

1. Introduction

In hypertext systems the user's behavior and achievement of objectives are a consequence of cognitive associations influenced by the design of the system's interface. In such interface the physical representations of the elements which signal hypertext areas should make it possible for the user to complete his tasks without having to make excessive mental efforts in learning situations and data recovery. In other words, the user will not be able to understand how the system for navigation is structured and will have the sensation of being lost. Such facts also occur in the child's universe. Not always are the educational and game playing objectives of children's software satisfactory. In these cases the design is shown to be confusing, containing elements that do not sign the navigation of the software, thus interfering with the interaction for the completion of those tasks planned by the child user.

According Bedny *et al.* [1], an action includes the interconnection between cognition and human behavior. For the authors, the user's activity relates to the coherent system that involves the motivations, the external behaviors and the internal mental processes, which are combined and organized by mechanisms of the proper regulation to obtain a conscientious objective. In agreement with the authors, this principle detaches the need to considerer the external behavior in the study of human-computer interaction, showing that the human behavior does not have to be studied only of the point of view of the relation of the stimulation-reply, but also from cognitive relation with the external behavior.

When we consider the cognition as directly linked with the external behavior, the interface design is seen as the main responsible for the user's activity to be compatible with the model elaborated by the system's

developers. The interface's design is composed for graphical representations that influence the cognitive process. According to Puntambeakar *et al.* [2], these representations help emphasizing important informative characteristics and make the order of relations more accessible to the user. The graphical representations of the areas that signs the hypertext presents linked ideas, forming the nodes of a net of meanings and showing the user the options that will be learned in the system. Thus, the system's model, elaborated by the developers, could be similar to the user's mental model for the better interaction with the system.

Norman [3] defines the mental model as our particular conceptual model of the way as an object functions, events happen or people behave, that results in our trend to give explanations to the things.

In other words, the physical representations must be correctly associated to the mental representations. Otherwise, the user will not be able to understand how the navigation of the system is structuralized and will have the sensation to being lost. This concern must be present in the development of an interactive system, conception according to which is marked by the ergonomics cognitive approach.

According to Moraes and Mont'Alvão [4], in the category and taxonomy of the ergonomic problems of the system man-task-machine, the cognitive problems are characterized by decoding, learning and memorization difficulty, in face of logical inconsistencies and of navigation of the communicative subsystem, the cognitive strategies, problem-solving and decision-makings.

2. Cognition and learning

The cognitive questions in hypertext environments are also considered in the infantile universe, where the increasing of interactive products with educative content is known. With the expansion of computer basis, these products are being used more and more in schools and residences. At home, parents acquire these products to stimulate the learning and development of their children.

During the last decade, the education processes are being modified and amplified. Well as other knowledge areas, the digital media is spread in the learning process in different rhythms. Part of this process is the use of educative software for children in their residences (through their personal computer) and in schools (in computer laboratories). The use of this software may assist and stimulate an autonomous learning of the content in tune with the age group, and raises motivation and pleasure emphasized by entertainment and games environments. As other activities in infancy, this kind of system has an educative potential to contribute and interfere with the children's development and may help them comprehend how the world functions. Software used by children collaborates for a better quality in education, standing out the necessary adjustment of the interface projects to its possible interpretations. For this matter, it is essential to know how the children use and understand this technology, and its mental models in relation to the projected systems.

Puntambeakar et al. [2] affirms that hypertext environments are each time more present in education. However, the flexibility and non-linearity of the hypertext systems (attributes that seem to be a great promise, have been seen as the cause confusion and disorientation, showing problems to indicate where the users are and where they must go.) Still according to the authors, in hypertext systems and hypermedia, the users are stimulated to interact actively with integrated blocks of information presented as alternatives of representations and contexts. To deal with specific constraint of non-linear presentation, the hypertext users need to acquire specific strategies, as the knowledge of where they are, deciding which will be the next step, and constructing a cognitive representation of the content structure in the net. Thus, the interface features, as the graphical representations in hypertext areas, show a structuralized information context, which main function is to help navigation. Therefore, the user can understand the conceptual model of the system, and make the learning of navigation easier.

Another question is the increase of users with different levels of experience in learning these systems for these young users. The increasing number of users with different social and cultural conditions indicates an urgent attention in the development of interfaces for products that allows easy learning of these systems. So, in order to this software be used by children with varied experience levels it is necessary that the graphical elements that constitute its interfaces (as they represent the navigation) be well understood by them, avoiding constraints in its use.

Rocha and Baranauskas [5] ratify that the system has to be easy, allowing the user to interact quickly. According to the authors, when the learning easiness is

analyzed, is necessary to have in mind that, generally, the user does not learn the entire interface before starting to use it. On the contrary, the learning occurs during the use. Therefore, this factor is evaluated considering the time that the user delays to reach an enough degree of proficiency in its tasks.

In this context, when the model of the system is easily learned, it is possible to involve people with different levels of experience in technology. Interface design, as the main contact with the user, can make the software able to reach an ampler group of children, promoting its learning.

3. Aspects of the children

The studied question is delineated from the interference in cognitive processes caused by the unknown in children mental models. Druin [6] detaches that children have distinct levels of curiosity, enjoyment and needs in comparison with his parents, professors and professionals who elaborates products for them. The children cognitive model must be foreseen in different ways when an interactive environment is planned.

According to Mumtaz [7], it became extensively accepted that children develop ideas and beliefs on the natural world before their formal learning, and the importance of these concepts for the learning is relevant in education area. According to the author, even the ideas of children could be linked and seem to be coherent for them, frequently this relation do not represent the same coherence for the adults.

Moreover, the use of children software is something new for many of them. Attitudes, during the use, will only depend on the understanding of what is being presented, and it deserves attention during the design process.

According to Makpoulos and Bekker [8], the relation between entertainment, games and learning is based in the reasoning that amusement contributes for the motivation to seek for an activity and influences the learning. The authors present the following evidences on children's relation with technology: a) children are not a homogeneous group, which a simple practical theory can be recommended; b) abilities, needs, knowledge and their relation with the computational technology changes with the growth; c) design can be oriented for children, however, the success of the interaction between computers and children requires the understanding of intention and context of each child, and consideration of their needs; d) the agreement and learning are crucial for children.

Therefore, in development of interactive systems for children, the inquiry of the cognitive processes generated by the delineation of the external behavior in the navigation is a basic need for the product success.

4. Exploratory investigation

Before the previous considerations, a starting point for the work was established: to investigate the navigation in hypertext environments of infantile software, taking in consideration the adequacy of design of the interfaces to the user's mental models. This question considers the graphical representations for hypertext areas that they signal the navigation of software and the interaction with the user. The importance to understand the children's cognitive processes is perceived before these representations and the generated activities, that is, the external behavior in the software's navigation.

The exploratory investigation objectified to collect preliminary information on a child user's mental effort in the use of a certain children's educational software, focusing on the representation of the information. A case study of the *Bright Little Rabbit/second grade* was undertaken by means of observing a group of five children. These children were invited to play individually on the computer with the software.

5. General characteristics of investigated software

The *Bright Little Rabbit/second grade* is a software commercialized in physical media (CD-ROM), classified as educative (in relation to the purpose) and for proper learning (related to the type of educative relation). It is not treated, therefore, of a software of support to present education or the long-distance education. The indicated age for its users is between six and nine years old.

The software's activities are divided in stages, within environments with distinct scenes as it turns into a story with animated characters. To each stage, the child has to carry through some tasks to obtain points enough to pass to the following stage. For this paper, three consecutive screens of software had been analyzed, moreover, the child has to pass obligatorily for the three ones to follow to the most advanced

activities.

5.1. Screen 1 - Registration

Fig. 1: First interactive screen of the software.

To start the game, the child must type his/her name on a register screen (see Fig.1), the "*Guest book*". On this screen, the user can create a new player or continue where he/she stopped in the last time he/she played, choosing one of the names that was already registered in the book.

5.2. Screen 2 – Hall

Fig. 2: Second interactive screen of the software.

After that, the child visualizes a hall of a castle… screen (see Fig.2). This is the first section to arrive at environments for the accomplishment of the tasks. The scenario is a hall with some entrances and objects, without any indication where the user must go to. Each time the child reaches certain punctuation, he/she returns to the "*Hall of the Castle*" to restart the game in a more difficult level. After fulfilling three difficult levels, the child reaches the end of the game.

5.3. Screen 3 – "Section of knowing"

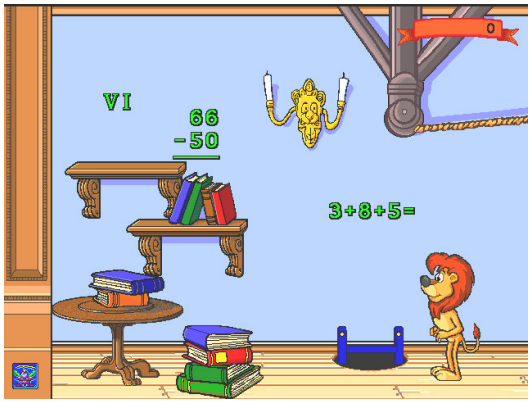

Fig. 3: First environment of activities of the software.

The first environment, in which the activities are developed, is the "Section of knowing/knowledge??". In this part, the user needs to capture everything that corresponds to what he/she was requested and some flying objects that supply extra points. The requests are of Portuguese knowledge, as to recognize words syllables, knowledge on sciences, like distinguishing mammals animals, and mathematics contents, as arithmetical operations. This part is composed of some scenarios that alternate for the activity. These scenarios are characterized as halls and corridors in the castle, where the elements to be caught by the child are spread around.

6. Assystematic observation

Based on the objective of the study, a script was elaborated to reveal and register the greatest number of occurrences of interest to the investigation, that is, the attempt to identify problems related to the structure and to the representation of information. The script followed the following topics in relation to the children's behavior during the use of the software: a) understanding of what was requested by the software; b) achievement of the game's objective; c) satisfaction and motivation to play the game.

All five participants were eight years old and in the same school level, therefore, experts on the

pedagogical contents in the program. But in relation to the experience with software and computers they differentiated themselves:

- P and **A** were experienced in software.

- L and **Y** were not experienced in software and they were not used to playing with software.

- G was not experienced in software, but he played frequently with infantile software.

Each participant was observed individually. To keep the child tranquil/at ease, it was made explicit that he/she could stop playing with *Bright Little Rabbit* at any time and the observer was writing information about the program and not about their performances.

The following problems were observed:

6.1. Screen 1 - Registration

At first the users **A**, **L** and **Y** had difficulties to register and initiate the game. The user **A**, the most experienced one, did not remember how to type his name and could not see the "New Player" button.

L and **Y** did not understand what they needed to do to register themselves. They clicked several times on the lateral arrows of the registered players list. They also did not see the "New Player" button, needing help to create the field to enter their names in the register book. They did not understand the yellow band on the book's page as a field to type their names in. "*Where do I type my name*?" (User **A**)

It was noticed that the great difficulty of the two children without experience in software in relation to the buttons to register and initiate the game was due to the fact that they could not understand the meaning of these graphical representations.

6.2. Screen 2 – Hall

All the children had difficulties in the "Hall of the Castle". The most experienced delayed some minutes to find the door for the activities section, experiencing a discomfort sensation. "It's d*ifficult! Now I'll look for an exit!*"(User **P**)

L and **Y** covered the whole scene without knowing what to do and asked the observer for help. When they returned to the hall of the Castle, after reaching the first level of the game, the users also had difficulties to log off. The doors they selected were always the wrong ones to ascent to the second tower. "*Wow! I can't log off! All the doors are closed* " (User **A**)

6.3. Screen 3 – "Section of knowing"

It was noticed that in some scenarios of the "Knowledge section", the participants could not catch all the words and objects requested because they returned several times to the same place, without finding the exit. In one of these scenarios, one of the options to continue was to make the character pass through a hidden door in a bookshelf by the wall. None of them noticed that door.

Another problem observed in this section is that the children did not understand the function of the flying objects. "*I don't know what it is, but I don't care. It doesn't matter*." (Using **P**)

The participants without experience **L** and **Y** had many difficulties: they did not understand the command instructions to catch objects and requested words. They did not perceive that, in the scenario, the character must eventually go up and down stairs, ropes, etc. They did not visualize some obstacles, as a wall, for example: they insisted on exceeding it without understanding that it was a wall. Consequently, many times they needed help to leave the section? "*How do I get out of here*?" (User **Y**)

User **L**, in despite of the instructions told by one of the game's characters, the child did not understand that he had to click the door to start the activity. The user G was some times locked up and did not want to leave by the door that contained the "Exit" sign, assuming that he would leave the game and not only the section he was in.

6.4. General comments

Before finishing their activities the children became tired and asked what was needed to finish faster. *"What is necessary to finish this sooner?"* (User **A**)

Moreover, the two inexperienced participants didn't know how to leave the game without the observer's help, when they wanted to stop to playing. Only one participant (user P) reached the end of the game, after one hour and forty minutes. The other ones did not want to finish it.

From the results, one notes that the objective of the game and the means of achieving it were not clear to the participants and in the case of those children with less experience these facts were more frequent.

7. Conclusion

Based on this observation one may consider that the multimedia elements of the interface of children's software, such as graphic elements, animation and sound, influence the user's cognitive system. The attitudes and behavior, along with the pleasure and motivation, are directed by the understanding of information. However, in the case of the *Bright Little Rabbit/second grade* software and within the limits of observation of only five children, it is confirmed that in situations of learning and fact recovery the participating children needed a bigger memory and mental effort than they were capable of. It was noted difficulties in navigation and performance of the pedagogical activities.

According to Sedig *et al.* [9], navigation involves moving on something by means of a representation. That is, navigation mentions the displacement in a determined surrounding, whose form and limits are unknown, being necessary references points. The work showed that some representations of these references points had caused a bigger mental effort of the user to interact with the program.

Frequently, educators and parents have difficulties to select softwares that will be more adjusted to its educational objectives. This happens due to the different variety of software available in the market. And, in many occasions, the problems are caused by design of its interfaces. In these cases, the design of these interfaces is not clearly, demanding a bigger mental effort than expected in the model defined in the project. Consequently, the user feels not motivated and frustrated for not achieving his objectives in the system.

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