A study on usability criteria regarding interfaces for children

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ABSTRACT

Building an application's interface is always an attempt to match the software functions with the users' mental model. This task is complicated enough when an adult is designing the interface to other adults. When the users are children, the challenge is harder still. How can the users' mental model be predicted? This communication deals with a study that aims to answer this question, going from the characteristics of the children cognitive thought to the discovery of efficient design guidelines for interfaces.

Keywords

Interfaces, usability, cognitivism

INTRODUCTION

This project's goal is to produce a set of guidelines for the construction of software interfaces for children aged from 5 to 7 years old. These guidelines will be tested with the children, by means of small packages of software created purposefully for the tests.

There has been research in this area, and there are sets of guidelines (for example [2] and [3]) available. However, most of these guidelines arise from empirical testing and direct observation. The novelty in this project's approach lies in the way the guidelines will be reached. The main purpose is not in finding out what children can or can not do in an interface, but in understanding the reasons why children can perform or not, and in doing so lending a technique for other investigations to follow.

The project we have in hand has its roots in Jean Piaget's work on cognitive psychology. Beginning with the studies of Jean Piaget and the scientists that worked after him, we'll try to find the connection between cognitive development and what shall (or not) work in an interface built for children.

So, this work has a two-fold purpose: to discover whether it is possible to define guidelines for the construction of software interfaces based on the features of the children's thought; to develop a method capable of identifying these guidelines.

Piaget divided child development in 4 stages [4]: sensori-motor (from birth to 2 years), preoperatory (2 to 6/7 years), concrete operations (6/7 to 12 years) and formal thought (12 years on). The subjects on this research are at the end of the second stage and their thought's characteristics are described below.

FEATURES OF PREOPERATORY THOUGHT

Piaget's work discovered eight main features of preoperational thought [1,4]:

a. Egocentrism: children tend to center their thought process on their own point of view, and sometimes don't even consider the possibility of different ones;

b. Transductive thought: children always try to find a reason for everything, frequently establishing cause-effect relations. Sometimes these relations happen to link unrelated facts. This occurs when children try to deduce the relationship without the proper knowledge or experience to do it correctly. This type of thinking mechanism is known as transductive thought;

c. Reversibility: children normally can only perceive the present. They aren't capable of mentally reversing an action and doing it again;

d. Centration: centration is the inability to consider multiple aspects or characteristics in a given situation. Children tend to concentrate on an one single aspect, which is most important to them, and forget about every other one;

e. Intuition: children often judge things based on their exterior aspect. If the facts recorded by their senses are not adjusted by their mental processes, they often can not appraise the situation correctly;

f. Syncretism: syncretism is a model of thought that takes a part for the whole. It shows when children are not able to separate different aspects or parts of an object or situation and act based on their unique characteristics;

g. Difficulties with classes: children often have difficulties organizing and relating classes of objects or situations;

h. Difficulties with series: children often have trouble ordering or making series.

QUESTIONS

Piaget was criticized because he did not exactly describe what children could actually do. Most of his conclusions

were about what children can not accomplish. It is difficult to translate his conclusions directly to features in the interfaces. So our first job was to accommodate the features listed above into questions. The set of questions we reached was used both to help us consider different aspects of the interfaces and also to provide a direct link to one or more guidelines. So, for instance, if we ask "can children use the keyboard?", and we find out the answer is "no", we have one guideline ready for use: "do not use keyboard input".

This set of questions is by no means exhaustive. In a way we were testing the questions themselves. In other words, the test was also created to validate this method of uncovering guidelines. Further research will provide many other sets of questions and guidelines.

1. Are children capable of recognizing an image link or is a link with text and image more efficient?

Interfaces tend to associate ideas with images or symbols. This association is only understood if the user can understand the connection.

2. Are children capable of using the keyboard within an application?

All the keys in the keyboard are capitals. If children are not proficient using capital and non-capital letters, trouble may occur.

3. Must the interface be random or allow the learning of a sequence of events?

If the interface tries to teach something, the focus must be on the knowledge itself, not on the manipulation of the interface. The cause-effect relationship must not induce incorrect learning or simple memorization.

4. Can children correctly associate images with the actions that will occur?

This question evolves from question1. If an icon starts a series of actions, it is crucial that the child understands which actions will be taken and what is their effects.

5. Are children capable of recognizing when an action must be undone?

To do so, the child must understand the "application's" point of view, and comprehend the effects of reversing the last actions.

6. Are children capable of repeating successful actions within the interface?

Like the question before, re-doing an action requires the children to adopt the mental model of the person who designed the interface.

7. Are children capable of doing a task that needs several independent actions?

To achieve this, mobility of thought and the ability to order the actions are required.

8. Are children capable of using a help link, or must the help be readily available on the interface?

To use a link, children must recognize the need for help. Again, to do so they must understand the application's point of view. Besides, they have to find the link.

9. Must the number of interactive controls be minimized?

Children must overcome egocentrism and understand the program as a whole to know that some controls have nothing to do with the task that is being done.

10. Can children understand an interface divided in categories?

Only if they can classify and order their actions.

The next table (table 1) is an attempt to link the questions to the features of preoperational thought. For instance, egocentrism (feature a.) suggests children may have trouble linking symbols to concepts and abstract ideas (questions 1 and 4) and understanding the designer's point of view (questions 5, 6, 8, and 9).

This table was intended as a quick summary for the interfaces described below. It made sure every question and every feature was covered upon a simple glance.

		Features of preoperational though							
		a	b	c	d	e	f	G	h
Questions	1	X	X			X			
	2				X	X			
	3		X	X					
	4	X	X			X	X	X	
	5	X		X	X		X		
	6	X		X	X		X		
	7			X	X				X
	8	X				X	X		
	9	X					X		
	10							X	X

Table 1

INTERFACES

This section aims to establish the relationship between the questions and the actual interfaces that will be shown to the children in the study. The main goal of the project is to assert whether that relationship exists.

Each interface has been created to emphasize one or two aspects of the questions in the previous section. However, the nature of man-machine interaction will inevitably lead to other features being highlighted. So the description below must be taken as a starting point or a working plan to create the interfaces.

It is obvious that the interfaces have been planned with flaws. Building "correct" interfaces from the user's point of view would not be the best way to find out where the

difficulties would occur in everyday use. But much planning took place to ensure that the "flaws" in the test-interfaces have the same nature of the ones found on real websites and programs.

Interface 1

Description: Each image is presented with some words next to it (picture 1). The child is asked to choose which word best represents the image.

Purpose: Try to figure how to child links an image to an idea. Corresponds to questions 1, 4 and 6.

Registered results: the words chosen and time spent.

Image 1.

Interface 2

Description: To child is asked to copy the word being shown. (image 2) The words are taken from a data base at random and have either capital or non-capital letters.

Purpose: Try to figure if children can effectively use the keyboard (question 2).

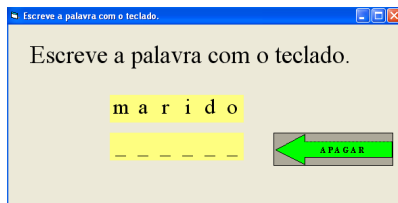**Results registered:** the words shown, the keys the child used and time spent.

Image 2.

Interface 3

Description: To answer each question ("Discover the (capital / population / language) of (Portugal / Spain / France)", the child must choose one of the yellow icons shown (image 3).

Purpose: Try to figure if the child understands different classes or categories within the same interface (question 10).

Results registered: every user's choice.

Interface 4

Description: The child is asked to combine geometrical shapes and colors to words several times (image 4).
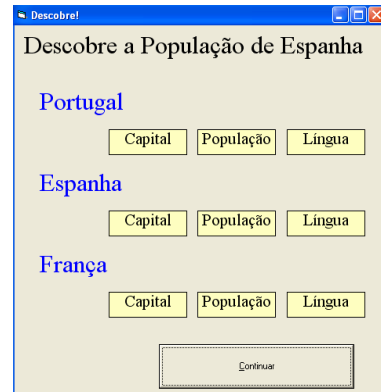

Image 3.

After doing the same combination a number of times, the combination is slightly changed to find if the children has memorized the combination or is reacting to the needs of the actual interface.

Purpose: See if the children link the image to the shape or color (question 1) and figure out if they tend to learn the sequence of events or the task (question 3).
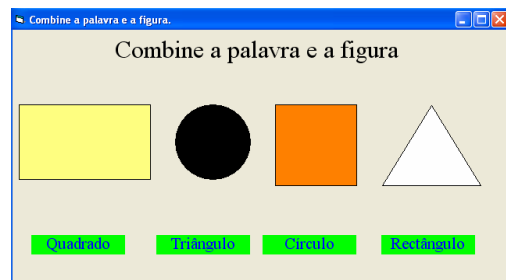
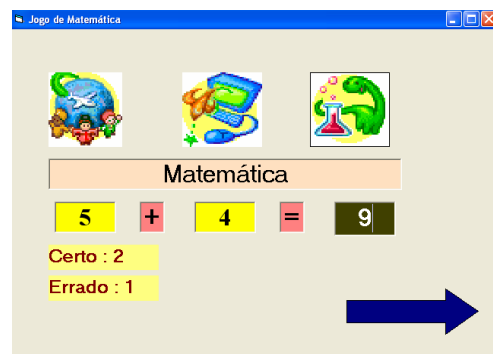**Results registered:** every user's choice.

Image 4.

Image 5.

Interface 5

Description: The child is asked to solve a simple arithmetic problem (image 5). The screen has 3 scintillating icons on top which have nothing to do with the problem.

To advance to the next problem, the child must click the blue arrow.

Purpose: Verify if the children understand that the arrow can only be clicked after they solved the problem

(question4); verify if the children tries interactive icons, even if they have nothing to do with the task (question 9); verify if the children associate the blue arrow with the idea of moving forward (question 1); verify if the children can undo an action, if they click on the interactive icons (question 5); verify if the children can use the numbers on the keyboard (question 2).

Results registered: every action taken.

Interface 6

Description: This is a little game that asks the child to find an animal (image 6).

Purpose: Try to figure if the children understand the concept of navigation and are capable of going back and forth between the screens (questions 5, 6 and 7).

Results registered: every action taken.

Image 6 (main screen).

TESTS

The tests were conducted during May, 2005 on two primary schools in the city of Braga, Portugal. The children were gathered from 1st and 2nd grade classes.

Two different situations were created: in the first, the children were brought to the computer laboratory in groups of 4, to simulate a "classroom" situation; in the second, the children did the test individually, as if they were at home.

In the "classroom" situation, the children would interact with each other, and could ask for guidance if they got stuck. Some indication would be given to ensure progress and every child was asked to stay until they completed the test. We were able to finish 38 tests this way.

Ten 1st graders took part in the individual tests. Children were given as little guidance as possible (enough only to make sure they could complete the tests and not get discouraged by any difficulties). They were told to only ask for help after they have exhausted their ability to solve the problems on their own.

The contexts were created to resemble the ways educational software can be experimented with. It is very common for children to first contact with software at school, and if they really enjoy it, it's likely they will ask their parents to buy it.

Some early conclusions may be drawn from the observation of the situations. In the "classroom" situation, children were much prone to imitation and were influenced by their peers. When solving a problem, some kids would announce their choices aloud, resulting in one or more of their colleagues imitating them, even in some cases when the problems were similar, but not equal. Also, some kids didn't want to be "left behind". If they perceived that others were going faster, they would rush their responses, trying to catch up. Finally, some shy kids did not cope well interacting with others, and were reluctant to express doubt or confusion, leading to a lot of guessing in the answers, or simply to paralysis. All of these problems did not occur when children were tested alone.

CONCLUSIONS

As stated above, this project is an attempt to draw some design guidelines based on a firm theoretical basis, rather than an empirical one. But what do we expect to gain from this approach?

Typically, when empirical testing is employed, results are the most important (as seen in [2,3]). Testers are not particularly worried about the reasons why some designs work while others don't. However, if it is possible to know in advance which interfaces must serve the users better and why, testing can be performed more efficiently and the results can be discussed with experts in the field of children' education, like teachers and psychologists, more naturally and in a language they can understand.

The latter conclusion has already proven useful. Before the tests took place, we had to obtain permission from the teachers and parents. We only had to mention the theory roots of the work to get them interested.

The software itself took care of recording the users' actions within the interface. These results are now being processed, and shall be ready for analysis soon. Further research and testing should take place to validate both the guidelines and the method used.

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