# Cognitive walkthroughs in the evaluation of user interfaces for children

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**Abstract**
*This paper describes a case-study, dealing with the application of the cognitive walkthrough as a method of evaluating an interface built for children. We performed the walkthrough and tested the interface with children aged between 5 and 7 years old. Given our goals and the scope of this study, the cognitive walkthrough proved as a reliable source of indications about usability problems on an interface aimed at children.*

**Keywords**
Child-computer interaction, usability, cognitive walkthrough,

## 1. INTRODUCTION

Every software project has to deal with an awkward situation: its designers are not the real, targeted users. That is why it is always mandatory to submit the project's interface to a rigorous scrutiny, which allows the finding of flaws and less-than-optimal features. To that effect, a number of analysis methods have been developed and used with considerable success [Desurvire92].

Software engineers usually resort to empirical usability methods to analyse their interfaces. When the project reaches a stage that allows testing, its behaviour is simulated for a group of human users. Starting with the observation of these users, along with interviews and inquiries, problems related to the interface are discovered and sorted out.

Testing children's interfaces though, is a different matter. Not only children are more reluctant to speak their opinions aloud, they are not "typical" users. Their needs and limitations make usability testing less straightforward than doing the same procedure with adults. Moreover, children are typically less experienced using computers and frequently are at a loss when describing their difficulties when experimenting with software.

This paper describes a case-study, dealing with the application of the cognitive walkthrough as a method of evaluation an interface built for children. The cognitive walkthrough seems like a perfect fit for children. After all, it aims to discover what can go wrong when the users have no previous knowledge of the system. In most cases, that's exactly the case with young children. They have little to no experience with the software they use at school or home, and frequently have to find their own way around it.

Oddly, to the authors knowledge, there are no published descriptions of studies that relate the findings of a cognitive walkthrough performed on an interface for children and the actual problems the children faced when using the software. This is the case here. We performed the walkthrough and tested the interface with children aged between 5 and 7 years old. Their results are compared and discussed.

## 2. THE COGNITIVE WALKTHROUGH METHOD

The cognitive walkthrough is an interface evaluation technique, which focuses on the support the interface offers to exploratory learning, i. e., usage with no previous training [Rieman95]. The method aims to verify how much can the system guide an untrained user, allowing the user to accomplish his goals.

This technique is based on Lewis and Polson CE+ theory of exploratory learning [Polson90]. The requirements for the application of the cognitive walkthrough are [Abowd95, Rieman95]:

1. A system description or prototype, detailed enough to allow for a complete navigation;
2. A set of representative tasks that an user can execute within the system;
3. The list of necessary actions to perform the tasks;
4. A description of the typical users, including their experience and expectations about the system.

After meeting these requirements, the cognitive walkthrough aims to simulate the steps taken by a user with no previous experience with the interface. During the execution of the tasks, the analyst registers the answers to the following questions [Abowd95]:

1) Will the users be trying to produce whatever effect the action has? – Ask whether an action appropriate to what the users would want to do at that point is available on the interface.
2) Will the users be able to notice that the correct action is available? – Ask whether the control that triggers the action is visible to the users when they need to use it.
3) Once users find the correct action at the interface, will they know that it is the right one for the effect they are trying to produce? – Ask whether the users will know that the control available is the one they need to complete the action.
4) After the action is taken, will users understand the feedback they get? – After the action is completed, ask whether the users will know the action is complete and what its effects are.

The answers provided by the walkthrough may lead to a set of flaws and possible improvements to the system interface. It is an asset that the analyst is familiar with the basic principles of interface design, as proposed by Lewis and Polson. These principles increase the chances that a user with no previous knowledge about the system will make correct choices through guessing.

## 3. BEFORE THE COGNITIVE WALKTHROUGH

The "História do dia" site ("Daily story", http://www.historiadodia.pt) was chosen for the test. This site was chosen for its popularity among Portuguese children. Besides, it is targeted to the same age group as this study.

The method used to validate the cognitive walkthrough on interfaces for children was broken up into 5 steps:

1. Performing the cognitive walkthrough on all the tasks available on the web site. (performed by first author)
2. Creating a list of typical tasks that children perform on the web site.
3. Getting 2 other analysts to perform the cognitive walkthrough on the list created on the previous step.
4. Testing the tasks with children, and recording their results.
5. Comparing the difficulties experienced by the children and the problems predicted on steps 1 and 3.

Therefore, a "percentage of predictable problems" can be calculated on step 5, and this percentage can be compared to other tests with adults. That way, it is possible to compare the cognitive walkthrough performance when applied to children.

It is important to note that the usability problems faced by children were always sub-sets of the problems found on the analysis. If the children had found some problems which had not been predicted, the "percentage of predictable problems" would have to be adjusted.

## 4. EXECUTING THE COGNITIVE WALKTHROUGH

The tasks chosen for the test were: Read the daily story; Vote on the daily story; Hear the daily story; Read a story from the archive. The first 3 tasks are the most typical on everyday use of the site (according to a primary school teacher). The last is one of the other ten tasks available on the home page.

Users: Children aged 5 to 7. Some skill using the mouse and keyboard is assumed, as well as basic knowledge of web navigation. Users can read at an appropriate level for their age.


**Figure 1. "História do dia" home page**

Starting Point: "História do dia" home page (figure 1).

Tasks and actions

Task 1: Read the daily story.

a. Click the picture associated with the story.
b. Click the  icon to start the story.
c. Click the  and  icons to navigate through the story.

Task 2: Hear the daily story.

a. Click the picture associated with the story.
b. Click the  icon to start the narration.

Task 3: Read a story from the archive.

a. Click the "Arquivo" icon.
b. Click the desired month.
c. Click on the period within the chosen month, in which the story was first made available.
d. Click the picture associated to the story.

Task 4: Vote on the daily story (includes task 1).

a. Click the "Votar" icon.
b. Choose how many stars will we awarded to the story.

As stated above, the first author went through the whole interface, and identified possible usability problems. However, the analysis of a single evaluator is typically not considered sufficient to uncover enough issues on any

given interface. Hence, a school psychologist, and a primary school teacher were asked to perform the walkthrough on the same tasks the children would be confronted with. Both were skilled computer users, and experienced web users. Moreover, they worked with children on a daily basis, and therefore knew what could be expected from them when the interface came to test. As they had no previous experience on the evaluation of interfaces, some guidance was provided, using [Mano04]. Their results were recorded using the same kind of tables the first author used. One of these tables is shown below as a sample. A "Y" (Yes) on the table represents a well defined action. A "N" (No) identifies a possible usability problem on the interface.

| | **Walkthrough questions** | | | |
|---|---|---|---|---|
| **Actions** | 1) | 2) | 3) | 4) |
| a) | Y | Y | Y | Y |
| b) | Y | N | N | Y |
| c) | Y | N | N | Y |

**Table 1. Execution of task 1 (read the daily story)**

So, on this particular task, 2 usability problems were identified, on actions b) and c), indicating children may have trouble performing the task.

A full account of the answers given can be found on [Mano05] and the walkthrough results are summarized on table 7.

## 5. TESTS

The subjects were asked to perform the tasks in this order: read the daily story; vote on the daily story; read a story from last week; hear the daily story.

As the test was not supposed to last more than 15 minutes, the tasks were always presented in the same order. If the test was meant to take longer, randomizing the sequence would be advisable [Hanna97].

The tests were made on a primary school library, during class time. Before starting the test, the children were asked some questions, to establish some background on their experience and knowledge using computers and the web. This was a homogeneous group regarding computer usage. Every child had some skill using the keyboard and mouse, and they knew what a web page was and how to navigate. None of them had ever used the "História do Dia" web site. The test was performed individually, and their teachers were asked to keep their pupils busy before and after the tests, so they could not tell each other what to do.

The results were recorded during the tests. For each action, the following classification was used: action not completed; action completed; action completed after request for help; action completed after one or more failed attempts; action not executed, because a previous failure prevented the attempt. Tables 2 to 5 show the results.

| | Action a | Action b | Action c |
|---|---|---|---|
| not completed | - | 2 | - |
| completed | 7 | 6 | 9 |
| with help | - | 1 | - |
| with failures | 3 | 1 | 1 |

**Tabel 2. Execution of task 1 (read the daily story)**

| | Action a | Action b |
|---|---|---|
| not completed | 4 | 5 |
| completed | 6 | 2 |
| with failures | - | 1 |
| previous failure | - | 2 |

**Table 3. Execution of task 2 (hear the daily story)**

| | Action a | Action b | Action c | Action d |
|---|---|---|---|---|
| not completed | 10 | - | 4 | 2 |
| completed | - | 6 | 2 | 3 |
| with failures | - | - | - | 2 |
| previous failure | - | 4 | 4 | 3 |

**Table 4. Execution of task 3 (read a story from archive)**

| | Action a | Action b |
|---|---|---|
| not completed | 1 | 2 |
| completed | 8 | 5 |
| with failures | 1 | 2 |
| previous failure | - | 1 |

**Table 5. Execution of task4 (vote on daily story)**

## 6. CONCLUSIONS

It is necessary to establish criteria to consider whether the action is correctly defined on the interface. Considering this is a web site for young children, and the study's goals, it was decided that a success rate below 70% indicated the action should be presented some other way. Therefore, test results can be compared to the cognitive walkthrough predictions, and this is shown on table 7, which relates successes (S) and failures (F) for each action. When the action could not be tried due to a previous failure, it was not taken into action for calculation.

For example, when evaluating action b) on task 1, we found that 6 children out of 10 completed the task with no failures and no help, so we awarded this action a 60% success rate, which in our study is not enough to indicate a successfully presented action. So, on table 7, the action was given an "F" on the test results.

| | Confirmed predictions | % |
|---|---|---|
| Author | 8 | 73% |
| Psychologist | 8 | 73% |
| Teacher | 7 | 64% |

**Table 6. Predictions confirmed on tests**

Table 6 shows how well the evaluators faired in terms of confirmed predictions. As 11 actions were tested, 8 correct predictions correspond to 73% accuracy. These prediction rates are higher than the ones obtained in a comparison between interface evaluation methods [Desurvire92], where they varied from 44% and 8%, using heuristic evaluation and 28% and 8% with the cognitive walkthrough. Obviously their testing was performed on more complex interfaces, but the results are encouraging.

Another good indicator that the cognitive walkthrough is a reliable evaluation method lies in the very fact that two inexperienced analyst's results came very close to those of the author himself, and, more importantly, to the results of the tests. This indicates that no great coaching or experience is necessary to get good results from the method.

As shown on table 7, the quality of analysis depends heavily on the analysts. While the author, psychologist and teacher reached similar percentages, only 4 tasks out of 11 had the same prediction. But the combined analysis identified every problem the children experienced. This confirms that using more than one analyst increases the method's reliability and allows for the discovery of a greater number of interface design problems. Besides, it doesn't require a large number of analysts to get a good analysis.

Given our goals and the scope of this study, the cognitive walkthrough proved as a reliable source of indications about usability problems on an interface aimed at children. Further research will validate these conclusions, using various software types and different subjects.

## 7. REFERÊNCIAS


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| Task | Action | Cognitive walkthrough prediction | | | Test results |
|---|---|---|---|---|---|
| | | Author | Psychologist | Teacher | |
| 1 | a) | S | S | S | S |
| | b) | F | F | F | F |
| | c) | F | S | S | S |
| 2 | a) | F | S | S | F |
| | b) | F | F | F | F |
| 3 | a) | F | S | S | F |
| | b) | S | S | S | S |
| | c) | S | F | F | F |
| | d) | S | F | S | S |
| 4 | a) | F | S | F | S |
| | b) | F | F | S | F |

**Table 7. Comparison between cognitive walkthrough and test results**