

# Evaluation process based on user's need : ergonomic evaluation of multimedia games for visually impaired children

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## **Abstract**

The evolution of the design methods in order to create products answering of users needs, pass by the integration of the human sciences. These disciplines such as the ergonomics, the psychology, the sociology (...), allow better understanding of needs and human behaviours in front of product. The TiM project (Tactile Interactive Multimedia computer games for visually impaired children) intends to offer to young visually impaired children the possibility to play computer games in an autonomous way. The computer games must be adapted to users needs. To achieve this goal, this project integrates the human factor in this development process, namely during the evaluation process. Through this project, this paper suggests presenting ergonomic evaluation more specifically usability testing. of the computer games for young visually impaired children (3 to 10 years old). Traditional measures of usability such as productivity aren't appropriate to evaluate children's application. The indicators should be "challenge", "control" and "satisfaction". In order to improve and design new games, the results concern essentially the sound and tactile interfaces. The recommendations allow to the blind children to navigate and to localise easily in the game.

## **1. Introduction**

According to Rabardel [1] " the knowledge of human, of his behaviors, reasoning and representations, must be at the heart of design: in the process of design, the engineering must be centred on the human ". In the research, the ergonomics allow to better understand users' needs and human behaviors in order to improve the usability of a product. In the design process, the ergonomic analysis is realised during the extraction of the user's needs (to realise products' specifications) and during the product's evaluation. Through the TiM project (Tactile Interactive Multimedia computer games for visually impaired children) this paper will present the usability evaluation to design multimedia products: computer games for blind children and serve visually impaired children. This project intends to offer to young visually impaired children the possibility to play computer games in an autonomous way. The computer games must be adapted to users' needs. To achieve this goal, the team is multidisciplinary with different specialists working in human sciences (ergonomic specialists, therapists specialised in visually impaired children,...).

Traditional measures of usability such as productivity indices, speed and efficiency of task completion, are not generally appropriate to evaluate children's products [2]. Through examples of adapted games, we will present the objectives of the tests, some results and a adapted game.

## **2. Usability and Usability testing of computer games**

### **2.1 Usability and Usability testing**

A system is usable when it allows the user to realise its task with efficiency and satisfaction in a specified context [3]. “A thing is usable if we can use it to achieve what we want” [4]. Usability testing encompasses a range of methods for identifying how users actually interact with a prototype or a complete application. The idea is to write a usability specification early in the process, detailing measurable levels of usability that the final product must achieve. Usability can be measured in terms of efficiency (how long it takes to perform a test task), comprehensibility (how many errors the test user commits), satisfaction (Is the application pleasant to use?), the ease of learning and so on. Usability testing allows to observe directly the way that the users realise to use the application and identify the use’s problems which they encounter. The prototypes are tested with real users and representative tasks.

## **2.2 Usability testing and computer games**

A Microsoft study found that “the usability of computer game revealed dimensions of engagements such as “familiarity”, “control” and challenge (...) most importantly, that ease of use is a critical of engagement” [2]. Is it possible to speak about efficiency in the usability evaluation of a game? How do you measure engagement and challenge? Does productivity mean any thing for the game? To evaluate the usability of the computer games we have observed: Does application allow the children to realise the objective of the game: we observed the use of the functionalities and that the sound and tactile interfaces correspond to children’s needs...). Does the system allow the children to realise these objectives : “challenge”. The children want to be faster than the last time therefore the game must evolve with the children’s performance. We measured the children’s satisfaction which could show itself by a sentence “Yes, I want to play one more time” or by their quick loss of interest for the game. Game is an amusement if the children control and understand all that happens, in all the steps of the game [2]. We have observed the “control”, the ‘Understanding’ and the children’s satisfaction during the steps of the game following where the children evolve:

- Understand the game’s objective
- Navigate and find his way easily in the game’s environment
- Realise one or several scenes which will allow them to achieve the game’s objective

## **3. Computer games accessible for visually impaired children**

### **3.1 Why are computer games not accessible for visually impaired children?**

Currently, blind and severely visually impaired children cannot access multimedia games existing on the market independently because they cannot use the mouse and these games are based on a graphical interface. Moreover, the assistive technologies such as enlarging software or screen readers are incompatible with these games [5]. An accessible computer game for visually impaired children would be a game in which all the users could play in an equivalent way regardless of their access mode. This project proposes to develop an authoring tool, which allows to design computer games using different kinds of specific devices (tactile, audio, large scale screen displays). Currently, several games are adapted with different interfaces (sound, tactile, visual interfaces) and devices (joystick, keyboard, tactile board...).

### **3.2 Usability and computer games for visually impaired children**

In an accessible game, sound interface is very important. Indeed, visual information must be translated into sound information. The children should control the game essentially thanks to the sound. The sound gives feedback on the user's action, instructions about the game. Moreover, the sound should be used to create the environment of the game. "Therefore the challenge for the designer is to provide continuous information with sounds without disturbing the user"[6]. In addition, the children interact with the game thanks to standard peripherals (keyboard, joystick,..) or specific peripherals as tactile board.

#### **4. Some evaluation's results**

The recommendations result from the analysis of observations, therapists specialised in visually impaired children and we used some criteria allowing to evaluate the usability of an application : ergonomic principles to respect for the design of an ergonomic interface [7] [8] and heuristic evaluation of users interfaces [9]. In the adapted existing game, we evaluated the usability of the tactile board which allows the navigation and the sound interface which allows the localisation in the game. And we are tested several new game like "Mudsplat"(sound game presented in chapter 5).

##### **4.1 Children's control of the game**

The children must be aware of what happens, where they are in the game. For that reason, the usability of the information and feedback sound are very important. In order to control and navigate in the game, the player needs clear information. In the adapted game, the feedback sounds are used, for example, for the game's instructions. Music and "sound effects" (short sound) are used to reward the children or to indicate the beginning or the end of the game.... While in graphic interface natural sounds are rare, for the blind users it's of utmost importance to clearly specify an object or event by the sound. The study found that the game's instructions must not be omitted. All the used words must be common with the child's vocabulary. The sounds must be intuitive and real [10]. In cases for the blind children, the imagination of the world is based on the sounds they perceive. Therefore the learning effect is far higher if the sounds are real. The feedback after each user's action must be immediate. In a game accessible for visually impaired children, the high quality of the sounds is very important because the sound interface must replace the function of the visual interface. Moreover, there is an "environment sound" which gives an atmosphere to the game. This sound must not disturb the children, by hiding informative sounds. The children must control the game by these actions and only thanks to that. For example, in the navigation of the game, the children must be able to start or to stop the game when they want and by themselves. The shortcuts must exist for experienced children.

##### **4.2 Tactile board (focused on blind children)**

We will present some recommendations concerning the interaction by the tactile board. We use the interface for the young visually impaired children. In order to navigate easily on the tactile board, three criteria must be taken into account for the tactile board's design : localisation, texture, and shape. Use more than one indicator for one button to create redundancy, which helps the sense of control. E.g. a button is specified not only by its localisation on the board but also by its texture. For the young blind children, the texture is more important than the shape. For one interface it is important that the buttons are easy to identify from each other. There has to be a trade-off between objects that are easy to find on the board and surfaces that are easy to recognise one from the other. While the former is easier with big objects, discrimination is easier on a small surface, especially for young

children. The goal of the game was to get a player familiar with a computer interface. Therefore using computer symbols may be effective in helping them learning.

### 4.3 The learning of game's functionalities

This learning must be fast, otherwise the children can be discouraged and they are not interested in the game. The fact that the children are accustomed to use such or such peripheral, can allow them to learn and to understand more faster how the game works. In the design of the game, several kinds of interactions should be realised (keyboard, joystick,...). In some kind of game, as the games where the children have to move only in a sound environment, the joystick would be more suited because it would allow the child to perceive movement (There is a correspondence between the movement of the joystick and the body). To familiarise the children with a tactile interface, for the game "Reader Rabbit"(adapted mainstream game), we created a route so that the children can explore the board as well as the functionalities of the game.

## 5. Mudspat : accessible game

### 5.1 Presentation's game

This game has some similarities with the classic arcade game. It was designed to the children between 7 to 10 years old. They must defeat a bunch of monsters that they to throw mud at him. To protect himself the children can spurt water at the monsters. The children move thanks to the arrows keys and throw mud with the space bar. They have several lives and they reach different games levels by defeating a certain number of monsters. At the present, the game is composed by 3 worlds with 15 levels.



Fig.1. « Mudspat » game : the monster is at the top, the child is at the bottom.



This game is composed by several menu like "main menu" or "pause" with different functionalities like "new game", "save game",.... The children navigate in the menus thanks to the arrows keys. They can play with the keyboard or a joystick.

Fig.2. : Main Menu

### 5.2 Accessible game for visually impaired children

The children control the game and can navigate thanks to the feedback sounds. We will present several examples. When the children navigate in the different menus with the arrows' keys, they hear a sort sound (always the same). When they validate one functionality with the key "ENTER", they hear a specific sound. In this game, one sound is for a specific action and each action corresponds to a specific sound. The children hear all the functionalities thanks to the recorded sounds. Each monster has it own sound and the children can discriminate a little and a big monster.

## Conclusion

Whoever the children (sighted or blind children, more and less old) the computer game will stay an amusement if the children keep the control. Visually impaired children control the game thank to sound feedback and generally tactile interface. The usability of this interfaces must be them to navigate and to localise in the game. The article presented only ergonomics evaluation. These evaluations are completed by therapist's evaluations. For example, the studies found that for the children it would be helpful if their name is used in aural feedback when they entered it in the beginning. Re-inforcement is needed for e sense of confidence and motivation to keep going. The evaluations insert in an interative process of design. The future games and the future evaluation will improve thanks to the next experiences.

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