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### ► To cite this version:

Yosra Mourali, Benoit Barathon, Maxime Bourgois Colin, Sondes Chaabane, Raja Fassi, et al.. Design and Prototyping of a Serious Game on Interactive Tabletop with Tangible Objects for Disability Awareness in Companies. 17th International Conference of the Association for the Advancement of Assistive Technology in Europe, AAATE 2023, Aug 2023, Aubervilliers, France. pp.318-325, <10.3233/SHTI230638>. <hal-05363755>

**HAL Id: hal-05363755**

**<https://uphf.hal.science/hal-05363755v1>**

Submitted on 10 Jan 2026

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# Design and prototyping of a serious game on interactive tabletop with tangible objects for disability awareness in companies

Yosra MOURALI<sup>1</sup>, Benoit BARATHON<sup>2</sup>, Maxime BOURGOIS COLIN<sup>3</sup>, Sondes CHAABANE<sup>1</sup>, Raja FASSI<sup>3</sup>, Alice FERRAI<sup>4</sup>, Yohan GUERRIER<sup>1</sup>, Dorothée GUILAIN<sup>4</sup>, Christophe KOLSKI<sup>1</sup>, Yoann LEBRUN<sup>5</sup>, Sophie LEPREUX<sup>1</sup>, Philippe PUDLO<sup>1</sup>, Jason SAUVE<sup>6</sup>

<sup>1</sup> *Univ. Polytechnique Hauts-de-France, CNRS, UMR 8201 – LAMIH, 59313 Valenciennes, France*

<sup>2</sup> *Emploi et Handicap Grand Lille, 23 chemin du Moulin Delmar, 59708 Marcq en Baroeul cedex, France*

<sup>3</sup> *HandiexpeRh, 40, rue Eugène Jacquet, 59708 Marcq en Baroeul, France*

<sup>4</sup> *Handyn'Action, 12 Boulevard Froissart, 59300 Valenciennes, France*

<sup>5</sup> *Serre numérique, 2 rue Pécelet, Parc des Rives Créatives, BP 80577, 59 308 Valenciennes Cedex, France*

<sup>6</sup> *ARACT Hauts-de-France, 197, Rue Nationale, 59000 Lille, France*

ORCID ID: Yosra Mourali <https://orcid.org/0000-0002-1337-8892>, Maxime Bourgois Colin <https://orcid.org/0000-0002-3117-464X>, Sondes CHAABANE <https://orcid.org/0000-0002-6306-6192>, Yohan GUERRIER <https://orcid.org/0000-0003-1040-0799>, Christophe KOLSKI <https://orcid.org/0000-0002-7881-6435>, Yoann LEBRUN <https://orcid.org/0000-0002-2376-8915>, Sophie LEPREUX <https://orcid.org/0000-0002-0582-7993>, Philippe PUDLO <https://orcid.org/0000-0002-0339-7336>

**Abstract.** This paper presents elements of user-centered design and prototyping of a serious game. Produced within the framework of the SG-HANDI project, the serious game aims to raise awareness about integration, prevention of professional displacement and job retention of people with disabilities. This serious game is developed on an interactive RFID tabletop with tangible objects. It is intended to be used in a collective context involving one or more facilitators specialized in employment and disability, as well as the company's stakeholders to be made aware of the issue.

**Keywords.** Serious game, Disability, Accessibility, Employment, Interactive tabletop, User-Centered Design, Tangible interaction, RFID

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<sup>1</sup> Corresponding Author: Yosra Mourali, Yosra.Mourali@uphf.fr.

## **1. Introduction**

Because work and employment are essential for the inclusion of people with disabilities in society, a collective was created in 2021 to launch the SG-HANDI project (Serious Game (SG) to raise awareness of integration, prevention of professional disinsertion and retention in employment of people with HANDIcap). Supported by Agefiph, this project is carried out by ARACT Hauts-De-France in partnership with LAMIH-UMR CNRS 8201 laboratory, Serre Numérique (CCI Grand Hainaut), Handyn'Action association, Emploi et Handicap Grand Lille association and HandiExpeRh consulting firm. In order to raise awareness of disability among company's stakeholders (directors, managers and employees, both able-bodied and disabled), this project proposes a user-centered design of a serious game. The serious game is developed on an interactive RFID tabletop associated with tangible objects to encourage company's stakeholders think together about the challenges faced by people with disabilities and find solutions to promote their integration and job retention [1]. A first prototype is realized and will be presented below.

The rest of the paper is structured as follows: Section 2 presents a state of the art on serious games developed for disability awareness. Section 3 describes the methodological approach followed in the project. Section 4 is devoted to the implementation of the SG-HANDI serious game prototype. Finally, this paper is ended by a conclusion and perspectives.

## **2. State of the art**

Serious games have experienced a boom in educational settings and professional training. They have, furthermore, demonstrated their effectiveness as tools that can increase awareness of social and environmental issues [2]. This state of the art presents earlier research in order to portray how serious games can be useful to raise awareness about disabilities.

Search terms selected are: serious game, disability, awareness, management and governance. Papers identified generally cover education sector. Some focus on serious games supporting people with disabilities in their learning [3] [4] [5] [6]. Others cover the topic of protecting people with disabilities from aggression and bullying especially at school. Among these serious games, we describe: Stop bullying now [7], Conectado [8] and The world of Empa [9].

“Stop bullying now” [7] is a serious game designed to help parents, caregivers and teachers to respond in a supportive manner to their children or students to bullying incidents. The game lasts approximately 30 minutes and can be played from any location at any time. It is structured in six levels. Each level presents a character with disability/disabilities in a certain situation where different bullying behaviors take place. The player is required to take the perspective of the character and the carer. Questions are prompted after each situation (short clip). Points are awarded if the player answers correctly. For incorrect answers, points are deducted and feedback is also offered. Authors test and show the effectiveness of the serious game in promoting autonomy-supporting strategies for adults with disabilities at high risk for bullying.

Conectado [8], is a serious game initiated by the e-UCM research group of the Complutense University of Madrid, Spain. The game is designed for youths between the ages of 12 and 17 to raise awareness against bullying and cyberbullying. The player is put in the situation of a student who suffers from bullying and cyberbullying in a daily basis after arriving in a new school. Conectado has been developed to provide a common experience to students, placing them in the role of victims. It is intended to be used in class as a tool for teachers, allowing them to motivate a controlled discussion and make students reflect on the problems of bullying and cyberbullying. Researchers experimented the game with 257 students in three different schools. A previous and a subsequent test composed of 18 questions were proposed to students to measure the impact of the game on their perception of harassment and cyberbullying. Promising results were obtained.

The world of Empa [9] targets students in order to increase their empathy and mitigate prejudices towards people with special needs. First, the player encounters a number of characters, namely a blind boy, a girl with multiple disabilities, a father, a mother, a baby, and a boy without disabilities. Over six levels, questions are asked about the main educational and interactional challenges encountered by the characters in different situations. Several answers are provided. If players answer by choosing an option that reflects an empathic and sensitive attitude, they will be rewarded with points and move on to the next level. Otherwise, they will lose points and have to retry to complete the level. Throughout the game, players can see their score. Once the game is completed, players receive feedback on their measure of sensitivity, empathy, and reactivity.

People's inappropriate behavior and lack of sympathy can have serious consequences on the mental and physical health of people with disabilities, as well as on their ability to participate fully in social, economic and cultural life. Works cited in the state of the art are centered on awareness people about the impact of bullying and the promotion of a tolerance culture to facilitate the social integration of people with disabilities. We think that paying attention to the psychological aspect is extremely important, but not enough for the social and economic integration of people with disability. In this research work we are particularly interested by these two research questions:

QR1: How to use a serious game to promote the integration and the maintain of people with disabilities in companies?

QR2: How a serious game can help company's stakeholders think together about the challenges faced by people with disabilities and find solutions to promote their integration and job retention?

Our contribution consists of proposing a serious game developed on an interactive tabletop associated with tangible objects to let aiming to raise awareness about integration, prevention of professional displacement and job retention of people with disabilities. The rest of the paper is devoted to the description of the tool and its evaluation.

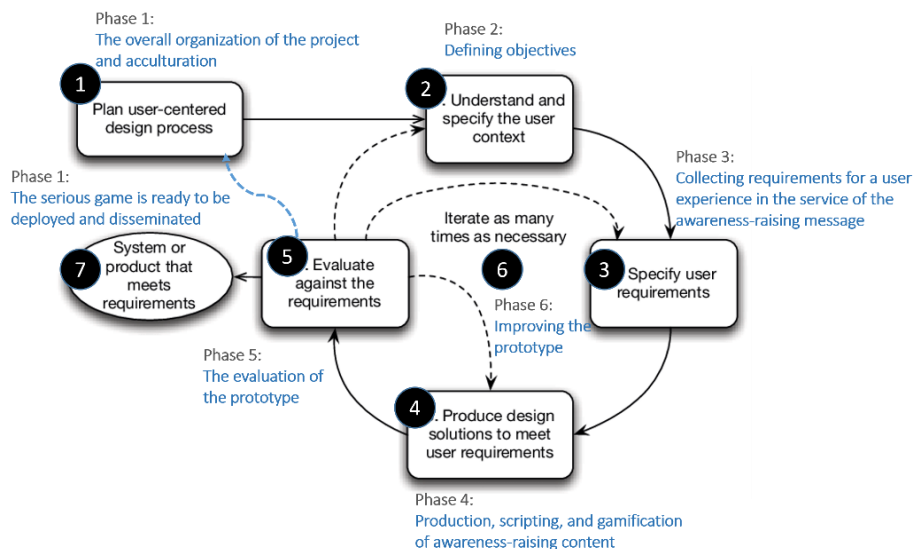
### **3. Methodology**

The SG-HANDI objective is to make employers, employees and company decision-makers aware of the obstacles faced by people with disabilities in the workplace, using

a fun and interactive tool: a serious game. The initial thoughts around the SG-HANDI serious game explored various avenues. Initially, a decision-making tool was considered. One possible direction was to allow company's stakeholders to think together about possible solutions and thereby secure the work situation over time by avoiding risks of inaptitude. The partners, then, turned towards creating awareness-raising actions for company's stakeholders. Actions intend to involve them simultaneously around an interactive tabletop with tangible objects. Through this tabletop, pedagogical content is provided. It allows for prior imagining of compensation or accommodation needs in companies, whether they be technical or organizational.

In its current version, the SG-HANDI game is designed to be used in the context of an awareness session involving one or more facilitators and people from the company to be sensitized. The serious game is developed in an interactive RFID tabletop with tangible objects (inspired by previous works [10] [11] [12]). This proposition concerns the first research question (RQ1). It suggests a set of challenges (quiz, drag-and-drop, betting pieces, scenes, etc.) to be solved as a team. These challenges cover several facets of the disability field: basic concepts, legislation, company resources, professional disinsertion, compensation, etc. Members of each team (company's stakeholders) have to discuss, reflect and collaborate together to succeed challenges and get points. A facilitator specialized in employment and disability is present throughout the game to moderate discussions and debrief players.

Referring to ISO 9241-20, a design process centered on facilitators specialized in employment and disability was followed as shown in Figure 1. This process consists of seven phases, beginning with (1) the overall organization of the project and acculturation, followed by (2) defining objectives and (3) collecting requirements for a user experience in the service of the awareness-raising message. Later on, there is the (4) production, scripting, and gamification of awareness-raising content. Then, (5) the evaluation of the prototype is necessary in order to (6) improve it. Finally, (7) the serious game is ready to be deployed and disseminated.



**Figure 1.** User-centered design approach inspired by the ISO 9241-20 standard for the serious game SG-HANDI.

## 4. Implementation

In this section, the basic principles of the serious game SG-HANDI are presented. A description of the prototype is also provided.

### 4.1. Basic principles

The SG-HANDI is designed to be used in disability awareness session in companies. A facilitator (or team of facilitators) presents the serious game, and the game begins as illustrated in Figure 2. Around the TangiSense interactive tabletop (produced by the Rfidees company), two or three teams are formed. Each team chooses its pawn (a tangible object in the form of a 3D-printed character equipped with an RFID tag) [11] [12].

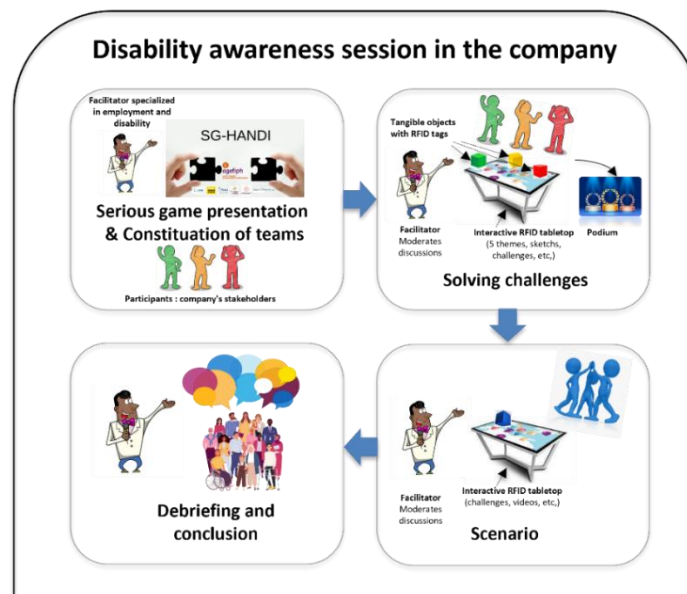


Figure 2. The SG-HANDI basic principles.

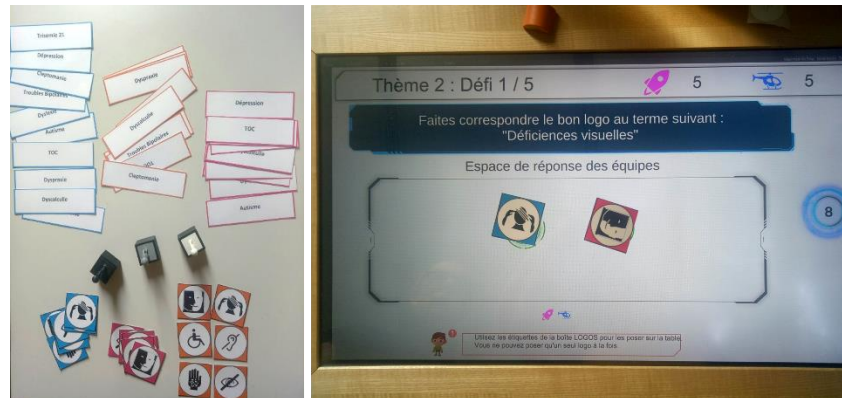
In the first phase, teams compete with each other in challenges with countdowns. In the second phase, players get together as one team. They collectively choose a sector of activity (logistics, commerce, or industry) and put themselves in the shoes of a company (human resource manager, service manager, etc.) looking to hire a new employee. To achieve this, the game proposes a set of playful and competitive challenges with disability considerations.

Throughout the game, the facilitator moderates discussions around themes and challenges. At the end, the facilitator proposes a debriefing and concludes the awareness-raising session.

#### 4.2. Description of the prototype

After preparing and evaluating paper and digital mockups, the serious game was developed using (1) a middleware layer in Java to collect data from the interactive tabletop (position and identification of RFID tags on different readers. These tags are stuck on tangible objects handled by the participants) and (2) an application layer developed using a real-time game engine (Unity).

The prototype proposes several challenges that stimulate intellectual cooperation to promote disability awareness in the workplace. These challenges are grouped into five themes: (1) situational disability, (2) disability typologies, (3) disability recognition, (4) compensation and (5) job displacement. For each theme, a set of tangible objects are provided to be used in the resolution of challenges. Figure 3(a) presents examples of SG-HANDI tangible objects: terms related to different types of disability, team pawns (3D-printed characters) and disability logos.



**Figure 3.** (a) Examples of tangible objects used in the serious game SG-HANDI, (b) example of page-screen. “Faites correspondre le bon logo au terme suivant : Déficiences visuelles” translated by: “Match the correct logo to the following term: Visual impairments”

Participants, then, attempt to apply what they have learned the challenges to a real-life scenario, such as hiring a new employee in the logistics, commerce, or industry sector. In order to achieve this goal, they get into one team and must complete six challenges: (1) Job description, (2) Job offer, (3) CV sorting, (4) The interview, (5) Communication and (6) Testimony.

#### 5. SG-HANDI evaluations

The SG-HANDI serious game prototype is nearing completion. It has undergone preliminary evaluations in laboratory and first on-site evaluations.

Preliminary evaluations in laboratory, shown in Figure 4, involved human-computer interaction specialists and business trainers (facilitators) specialized in employment and disability, who themselves are future users of the system. Overall, the prototype was appreciated by the evaluators. They found it fun and easy to use in collective contexts. A set of recommendations were also formulated with the aim of improving it. Among these recommendations can be cited: (1) reformulate certain instructions to remove

ambiguity and facilitate the resolution of challenges, (2) provide shorter texts, (3) provide shorter videos, etc.



**Figure 4.** SG-HANDI undergoing preliminary evaluations in laboratory.

First on-site evaluations were made in disability awareness sessions during the annual event "*Printemps du handicap*" (translated by "Spring of disability") which takes place in the north of France. Each awareness session involved a facilitator and participants from several companies and organizations (Figure 5). Globally, both facilitator and participants feedbacks were very encouraging.



**Figure 5.** SG-HANDI undergoing on-site evaluations.

## 6. Conclusion

This paper presented a user-centered design of the SG-HANDI serious game. This one is implemented on an interactive RFID tabletop with tangible objects. The objective of the serious game is to encourage company's stakeholders think together about the challenges faced by people with disabilities and find solutions to promote their integration and job retention. Globally, preliminary evaluations in laboratory and on-site evaluations (in real use) were positive. Actually, we are in the process of analyzing the

data collected from the on-site evaluations (linked to the second research question: RQ2). In the future work, details about analysis results will be provided.

## Acknowledgment

The authors are very grateful to Agefiph for the financial support provided to the SG-HANDI project. They thank also the facilitators and participants who were present at the awareness sessions.

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