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Designing game-inspired applications to increase daily PA for people with ID

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Abstract. People with **intellectual disabilities** are less likely to meet the recommended daily levels of **physical activity**. Meeting these requirements can lower the risk of serious health problems and life threatening diseases. To address this **problem**, the **idea** is to exploit mobile applications designed specifically to help increase daily levels of physical activity.

The **results** are: **guidelines** developed by a **literature review** and lessons learned during the development of a **prototype** application. **Evaluation** issues are based on focus group and usability test.

Keywords: Physical activity · Intellectual disabilities · Mobile Applications · Gamification · e-Health.

1 Introduction

Cognition is the "mental action or process of acquiring knowledge and understanding through thought, experience, and the senses" [?]. Intellectual disabilities (ID) falls under the term cognitive disabilities, but there is no international standard to what it means to have an ID. The Diagnostic and Statistical Manual of Mental Disorders (5th edition) says intellectual disability means a significant deficit in adaptive skills and carrying out age-appropriate daily tasks[?]. The World Health Organization (WHO) uses IQ and defines intellectual disability as having an IQ under 70, although meeting this requirement is not enough for a diagnosis. A diagnosis requires further tests in motor and social skills, language and social interaction and the handling of everyday tasks[?].

Among people with IDs, studies has discovered very low levels of physical activity [?][?][?] with only a small percentage meeting recommended levels of physical activities set by both global and national health organizations [?][?]. According to the World Health Organization (WHO), all adults between the age of 18-64 years old have the same recommendation for minimal level of physical activities per week;*at least 150 minutes of moderate-intensity aerobic physical activity throughout the week or do at least 75 minutes of vigorous-intensity aerobic physical activity throughout the week*[?]. Evidence shows that meeting these requirements can result in an overall lower rate of life-threatening diseases such

as coronary heart disease, high blood pressure, stroke, different types of cancer and depression. Physical activity will also help reduce the risk of becoming overweight and the increased health risks that brings[?].

Among technologies used to create and support solutions for health benefits (eHealth) the use of mobile technology is growing fast[?][?]. The term mHealth (mobile health) covers *The use of mobile and wireless technologies to support the achievement of health objectives*[?]. Mobile phones are a potential platform for serious games, which in recent years have become an increasingly valid medium for solving challenges in the fields of education and healthcare[?][?]. Serious games have been used to support rehabilitation, to promote healthy lifestyles and have shown effectiveness as a training program[?]. *The practice of making activities more like games in order to make them more interesting or enjoyable* is called gamification[?]. Mechanics from gamification used in eHealth are for example rewards, feedback and socialisation[?].

2 Related work

In this section we are going to present the most relevant academic work that address the problem of physical activity of people with ID.

2.1 Related research

As people with IDs are more sedentary than people without IDs, several studies have examined the motivators and barriers for physical activity in this population [?][?][?][?][?]. These factors are very individual and varied, but certain common motivators and barriers has been identified and should be considered; **Motivators;** Social interaction, working towards a goal, feeling healthy, having work that requires PA & competition

Barriers; Lack of facilities for PA, lack of support from key support persons, cost of activities, enjoying unhealthy food and activities & lack of guidance.

The Web Accessibility Initiative (WAI)[?] have some examples on potential barriers for people with cognitive disabilities when using technology. Their guidelines WCAG 2.0 (Web Content Accessibility Guidelines)[?] have several requirements to fulfill in order to create an accessible application.

When designing applications for people with disabilities, accessibility (i.e operating the application, perception of events and requirements of use) needs to be considered[?]. Another point to keep in mind should be that when designing applications for adults, one should avoid designing the application as if it is intended for children[?].

The Diagnostic and Statistical Manual of Mental Disorders (5th edition)[?] describes different levels of intellectual disabilities and the impact on conceptual, social and practical domain. Understanding written communication and abstract ideas can be difficult in varying degrees for people with IDs, meaning abstract thinking and executive function is impaired.

Information for all[?] is an European standard helping anyone trying to communicate information to make it accessible to everyone. The standards are describing how to use words, sentences, fonts and images. As many can find it hard to read text, the standards suggests the use of images to support the information trying to be communicated.

3 Proposal

3.1 Suggested guidelines

Based on the review of related works, the authors suggest to keep the following guidelines in mind when designing game-inspired mobile applications for the user group.

Functionality The functionality of the applications should focus on supporting the motivators and counteracting the barriers outlined in section 2.1. By having the option to interact with family and friends, social interaction and competition can be achieved. At the same time strengthening the support and guidance from key support persons. Rewards in the form of medals or achievements is also encouraged to further promote social interaction and working towards a goal. Where possible, developers should attempt to limit the required hardware to devices the users already have access to, in order to decrease the cost of activities. The level of customizability should also be considered. Having key support persons be able to suggest or decide what activities are available to the disabled user, could have a positive impact on the daily level of physical activity as they are performing activities they enjoy.

Design The design of the applications should focus on conveying clear, unambiguous information to the users. Information should be presented in limited quantities per view, considering font size, color-use and contrast, as discussed in section 2.1 and outlined by WCAG [?].

Communication The *European standards for making information easy to read and understand*[?], provides a high number of rules to consider. Many of which can be directly included into development of applications designed for people with IDs. Highlighting a selection of them, it is suggested to keep sentences short and to use simple words. Larger numbers and percentages should be avoided. Images are a good way of conveying information, either alongside text, or alone.

3.2 Initial prototype

Figure 1, 2 and 3, illustrates the main flow of an early prototype application utilizing the guidelines proposed in 3.1.

Figure 1 shows the screen that would greet the user before the daily activity goal is reached. As suggested by WAI[?], the amount of information provided is limited in order to make the main objectives of the view clear. The available activities are described using a single word, accompanied by an image as suggested in *Information for all*[?].

Instead of using a step-counter or progress-bar, the progress of the daily activity is symbolized using a flower that blooms as you get closer to the daily activity goal. Figure 3 shows the flower in full bloom, symbolizing that you have met your daily goal.

Figure 2 is displayed while the user is active and shows the flower changing, in order to motivate them to keep going. The data is also displayed in a similar way throughout the application in order to make it easier to understand.



Fig. 1: Before activity Fig. 2: During activity Fig. 3: After activity

4 Evaluation and future work

The prototype and the guidelines will be evaluated using a focus group, and later tested with a selection from the user group.

4.1 Focus group

The guidelines purposed in section 3.1 will be discussed in a focus group containing experts from different fields. These include people with experience in working with the user group as well as people with experience in development of mobile applications and games.

4.2 Prototype game

The prototype game will be further developed based on the feedback of the focus group. The improved prototype will then be tested with a selection of the user group. The results and observations gathered from this test will be the basis of data in the larger project, that will attempt to answer the question of whether or not such applications can be a motivating factor towards an increased level of daily physical activity in the user group.

4.3 Ethics

In order to complete the suggested usability test, temporary storage and analysis of personal data is required. The necessary applications has been made and approved by both NSD (Norwegian Center for Research Data) and REK (Regional Committees for Medical and Health Research Ethics)

Conflict of Interest The authors declare no conflicts of interest

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