



## Towards a participative approach for adapting multimodal digital books for deaf and hard of hearing people



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### ABSTRACT

Participatory designs for the development of technologies have advanced considerably to incorporate children in the process of design and development. However, significant challenges remain for developers, specially regarding levels of continuous involvement by children, communication aspects with young children and the incorporation of children from minorities. In the present article the results of a systematized experience for adapting three multimodal digital books for deaf and hard of hearing (D/HH) children are presented and discussed. Four phases and corresponding methods are described. Level of involvement, impact of participation in development and relations between children and adults are presented and analyzed considering how participation changes depending on the phase, activities and project progress and constrains. Results are discussed using the concepts of epistemology, values of the research team, results and stakeholders.

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### 1. Introduction

Learning to read is an essential skill for participation in today's society [1]. It has an impact on the cognitive development of children [2] and increases their chances of academic success [3]. However, many deaf and hard of hearing people (D/HH) do not manage to develop a sufficient command of written and spoken language upon graduating from secondary school [4,1,5–7]. This may be due to a number of factors, with the academic community intensely debating the effectiveness of different learning environments for language acquisition, such as the visual language model through the use of sign language [e.g. [8,9]] and the use of technologies like Cochlear Implants (CI) from an early age [e.g. [10,11]]. Among these, the bilingual perspective proposes that, for most D/HH people, written texts represent a code that belongs to a second language. This perspective suggests that, when exposed to it constantly and at an early age, many deaf people acquire a visual language (sign language) as their primary or natural language, and, based on it, a second written, and maybe, oral language [7], what has been known as the Cummin's linguistic interdependence hypothesis [12]. This suggests that proficiency in a language can be transferred to another if there is sufficient

exposure and motivation to acquire it [5]. In this regard, in the case of D/HH people, the teaching of a sign language should result in better general language skills and, therefore, in better written language skills [5]. However, studies on the transference of sign language skills to written/oral languages have yielded mixed evidence of its effectiveness [e.g. [13,14]]; thus, good first language skills may be a necessary but insufficient condition for learning to read in a second language [5]. In this context is necessary to ask, to what tools and devices have teachers access to promote reading among their D/HH students?

Children's books are an important literacy teaching resource, both because of their socializing role [15,16] and their contribution to the promotion of language skills [17]. However, for the majority of deaf students, children's books represent an encounter with a language different from their natural language [5]. Therefore, in order to benefit from this literacy teaching method, the texts used must be, foremost, accessible [1,18] and mediated by teachers or parents that know how to bridge sign language and written text [16,19].

Such mediation can be supported by technology, which has changed our traditional concept of reading [20]. Electronic books make it possible to incorporate multimedia material [21]; this, in the case of deaf people, involves the potential to include videos in sign language alongside pictures and text, thus allowing them to access information via several formats [22]. The inclusion of multimedia resources has been shown to have a positive

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impact on the reading comprehension of deaf children, especially through the combination of text and images only when these are carefully constructed [23,24]. This puts special pressure on the design and development process which usually is carried on in interdisciplinary groups of researchers and developers. Nowadays, however, the design of many digital resources considers the participation of final users, whether because it allows to develop more pertinent technology [25] or as an empowerment tool, especially in the case of people with disabilities [26]. However, this participation is not devoid of difficulties, because tension may arise between the development team and the final users during the process [27].

In this context Participative Design (PD) can be understood as a set of theories, practices, and methods that make it easier for individuals to take part in the design process of technological devices or services [26]. There are several types of PD, some of which focus on work with children, specifically with children with disabilities [28]. Within this framework one essential concept is participation, which involves the relationship between the development/research team and the children/users. The level of involvement in this process can be defined in connection with the transference of power, according to which the participants' perspectives influence decisions; being aware of this can lead to empowerment [29].

In this article, the incorporation of participation to an adaptation process of three digital books for D/HH children is critically revised considering two main aspects: the children's degree of involvement and the relationships established between them and the work team. With this purpose the development phases are described and through it analysis we expect to contribute to the need of provide details about the participation process of children with disabilities in the design of technological resources [28] and the difficulties of working with children that communicate differently than the research team.

## 2. Method

### 2.1. Deaf education in Chile

In Chile, traditionally, public policies orienting the education of deaf people have been based on the Oral Model. Nevertheless, efforts have been made to progress towards an Intercultural Bilingual Model (IBM) [30], which proposes the appreciation of cultural diversity in the school. In this context, deaf students are regarded as members of a different culture, whose first language is Chilean Sign Language (ChSL). The teaching of oral and written Spanish is addressed as the acquisition of a second language, a process that must consider the participation of deaf adults, ChSL natives, as linguistic and cultural models for students [31].

### 2.2. Center for the development of inclusion technologies

The digital books were developed at Pontificia Universidad Católica de Chile's Center for the Development of Inclusion Technologies [Centro de Desarrollo de Tecnologías de Inclusión, CEDETi UC], between 2013 and 2016. The team is comprised by psychologists, educators, designers, illustrators, programmers, and an audiovisual producer. Historically, the products developed by the Center have been informed by the scientific literature, following the definition by [26] of non-participative approaches to technology design, in which systems are informed by theories, better practices, or previous experiences. However, the books discussed in this study involved the participation of the deaf community and associated professionals, which generated a change in the traditional way of developing technology in this academic setting.

### 2.3. The adapted books

The first book, "Papelucho", is an adaptation of the original by author Marcela Paz, which is regarded as a classic of Chilean children's literature. The second adaptation experience, "The Three Little Pigs at the Circus", is based on the traditional story of "The Three Little Pigs". Finally, "The Little Prince", a classic of world literature by Antoine de Saint Exupéry, was adapted recently. All books are available for free at <http://www.cedeti.cl/recursos-tecnologicos/libros-inclusivos/>.

### 2.4. Participants

#### 2.4.1. Adult participants

The research team worked with deaf culture experts, some of them deaf and some normally hearing. Defining these "experts" is quite difficult, because several educators, psychologists, and ChSL interpreters were involved. Two deaf teachers participated actively in two of the projects, while one deaf professional and a deaf university student participated in the creation of the third book. In total, around 5 deaf adults collaborated in a recurrent basis for the projects.

#### 2.4.2. Child participants

The children who participated in this project have a documented hearing loss certified through their affiliation to the Chilean Disability Service [Servicio Nacional de la Discapacidad], have been diagnosed by medical professionals, use hearing aids or CIs, and attend two of the main deaf education institutions in Santiago de Chile. It must be noted that both institutions serve children from socially vulnerable contexts and adhere to the IBM, therefore they use ChSL at different levels of expertise. The children were contacted through their schools. Their participation was supervised by the University's Social Sciences, Arts, and Humanities Ethical-Scientific Committee. After being authorized by the school principal, we contacted the teachers of the classes that matched the age groups that the books intended. Parents were requested to sign an informed consent form, while students signed an informed assent form. In total, 20 different children took part in different phases of the three projects, although work was carried out with 8 children simultaneously at most. A ChSL interpreter was present in all sessions. In some cases, the children traveled to the Center, but most times the researchers went to the participating schools.

### 2.5. Technology developed

All the books were developed for digital platforms, either online or as downloadable software for the Windows operating system.

### 2.6. Book adaptation process

The books were developed following the IBM in order to support the reading comprehension process of deaf students who use ChSL and foster their motivation and interest in reading. The process can be seen in Fig. 1.

## 3. Results

### 3.1. Description of the phases of the book adaptation process

The three projects comprise the same phases, although they differ regarding some specific activities (see Table 1). This section briefly describes each phase, the activities belonging to it, and its associated materials and procedures. Table 2 summarizes the phases, activities, participants, results, and methods used.

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