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# A tangible interface approach to the codesign of a literacy platform for deaf users

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## Abstract
We report initial results of the codesign process of a software platform aimed to support the development of reading and writing skills among deaf students at the elementary level. This platform is one of the main outcomes set out for a broad multi-institutional, multi-disciplinary deaf literacy project. As one of the initial user research activities, we held a co-creation workshop with six deaf participants, one sign language interpreter, and four hearing researchers. In this workshop we explored the application of a design technique intended to enhance participation and communication by relying on low-tech tangible representations of interface components that can be combined to generate interaction designs. Through observation during the workshop and analysis of video recordings we have derived adaptations and adjustments to our approach for its application in upcoming codesign activities.

## Keywords:
Participatory design; Codesign; Sign language; Deaf culture; LSM.

## 1 Introduction
Designers regularly face the challenge of empathizing and understanding varied user contexts in order to propose transformations intended to positively impact the way user activities are carried out. Communication is critical to the success of user experience design. Various techniques exist to facilitate communication among participants in the design process. Most of these conventional techniques, however, do not consider the participation of users with disabilities. Designing the user experience for users who cannot hear, see, or have physical or mental disabilities, poses challenges that are not familiar to many professionals and researchers in the field [1]. We are interested in exploring novel design techniques that are inclusive and suited for codesigning assistive technologies.

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We have been working on the design of assistive technologies for deaf users. More specifically, we are designing the user experience for a software platform aimed to support the development of reading and writing skills among deaf students at the elementary level. Given the complexity of deaf literacy, the development of the platform follows a multi- and inter-disciplinary perspective in practically every stage: user research, content selection, information architecture, instructional design, and interface design. During the initial stages of our project, we are interested in proposing user interfaces that are natural and lead to their acceptance and appropriation by the user community. As with any human-centered design process, interfaces for deaf users should be derived through a process in which the participation of the deaf community is fundamental. The deaf community includes not only people who are deaf or hard of hearing, but also their families, teachers, close friends, sign language interpreters, and members of organizations that promote inclusion and equitable access for people who are deaf.

We report here findings from our initial exploration of using tangible interface elements in the codesign of a literacy platform for deaf users. This approach was inspired by PICTIVE (Plastic Interface for Collaborative Technology Initiatives through Video Exploration) [3], a technique that combines low-tech design components with video analysis to promote user involvement in the design process. Our observations are based on a workshop conducted as a pilot for learning about the potential of this codesign technique.

## 2 Related work
In this section, we briefly discuss work on participatory design with deaf participants and on the use of PICTIVE as a research technique, as it has been adapted for our codesign approach.

Related work [6, 7, 9, 11] presents participatory user research with deaf codesigners that involves alternative or adapted techniques and provides visual and tangible elements to enhance collaboration. Research with deaf teenagers or adults is already a challenge when researchers are not fluent in a specific sign language. In that case, most work has relied on the support of sign language interpreters. However, working with deaf children who are not fluent in sign or written language is an even greater communication challenge in the technology design process, as reported by [11].

In this context, PICTIVE was brought to our attention as a potentially helpful technique to support a design process involving communication barriers. Thus, we were interested in learning how it had been used previously in similar settings. When searching for "PICTIVE technique", 148 results were obtained; however, only one refers specifically to its use with deaf participants. Schefer and

Zaina [9] used PICTIVE in their participatory design section; however, instead of using paper, they used presentation slides as the tool for codesigning, with previously selected images of interface representations. Other works found in the literature report research with children [10], with older users [5], and with people who are blind or have low vision [2].

## 3 Methodology

As part of the initial activities in our project, we conducted interviews with deaf students to collect data on technology preferences, prior experience, and requirements for a literacy design platform. Next, in the current stage, we planned to codesign a low-fidelity prototype with deaf students.

The PICTIVE technique has been recommended for interface design in early stages of a project [4]. This technique uses low-tech representations (e.g., plastic and paper supplies, colored pencils, and pens) and video recordings [3]. With PICTIVE, even though deaf participants manipulate only static interface elements, they have an opportunity, from the outset, to collaborate even without programming or graphic design skills. The visual nature of PICTIVE is highly relevant for our collaborators and, since we are working with deaf children and teenagers, the ludic aspect of PICTIVE can also be motivating.

We thus chose PICTIVE for an initial codesign activity. One motivation for this decision was that we wanted to use a participatory technique that could help participants to recognize familiar interface elements to create their "ideal" interfaces. Still, we opted to keep the possibility of freehand drawing open so participants could propose interface components not included in the predefined set.

An in-person research session was held in June 2022, with duration of around 90 minutes, at the facilities of Manzanillo's Deaf Association (AMAS, after it initials in Spanish) in Mexico. Various members of the association are users of the official Mexican Sign Language, (LSM, after its initials in Spanish). Four researchers, an LSM interpreter and six deaf volunteers who signed the informed consent, participated in the session. Other people invited to be at AMAS on this date acted only as observers. These observers included the AMAS' manager, teachers and parents of deaf children, deaf children who still do not communicate in written or sign language, and several deaf adults.

Six deaf volunteers (Figure 1) answered a seven-question pre-session survey. Three identified themselves as men and three as women, with ages ranging from 12 to 54. Four use LSM as their first language, one is still learning LSM, and one communicates using LSM and in writing. Three use their cell phones frequently, and three only occasionally. None of the participants use tablets, and only two of them occasionally use a computer. A snapshot of the codesign session is displayed in Figure 2.

## 4 Preliminary results

From the researchers' viewpoint, the main goal of the workshop was to explore the potential and applicability of our tangible interface approach to codesign. For workshop participants, however, the goal was to produce low-fidelity prototypes for two user interfaces considered as part of the literacy platform: A welcome screen that presents the platform and explains its purpose, and a menu of various educational games intended to assist deaf participants in the process of learning how to read and write in Spanish. The resulting interfaces are shown in Figures 3 and 4.

The process of creating the target interfaces was significantly facilitated by the availability of tangible interface representations. Participants were able to identify popular icons, such as those used for social networks, emojis, as well as interface components used for representing user profiles, images, or games.

**Figure 1. Pre-session survey.**

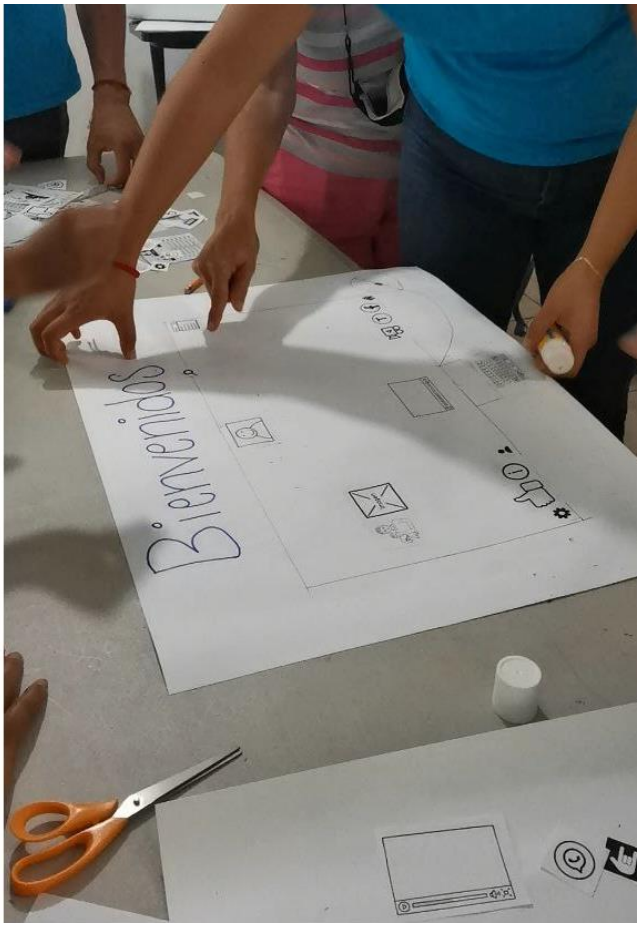

**Figure 2. Codesign session in progress.**

Once the goals were clear to them, participants used the available tangible interface components and moved them around a base cardboard on which they also drew freely to reify the interfaces they had in mind. After some discussion, they reached consensus on specific layouts and functionality for each of the two interfaces.

Overall, our appraisal of the tangible interface approach is positive, and we are planning to continue to apply it in the following

codesign iterations. However, we do need to consider several further adaptations to the initial set of interface components, as well as to the way our codesign sessions are conducted, so as to take advantage of the experience and observations in our pilot session, which are discussed next.


**Figure 3. Low-fidelity prototype of the welcome page.**


**Figure 4. Low-fidelity prototype of the game selection interface.**

## 5 Discussion

Several lessons have been derived from our pilot session. We discuss them briefly below.

*Providing task perspective*. Initially, participants found it difficult to grasp the session's expected outcomes. Instead of designing the welcome screen first, and then move on to the game selection interface, they tried to include all the intended functionality in a single interface. This was solved by placing two base cardboards that acted as separate working spaces for each interface. Interestingly, this was suggested by our LSM interpreter and significantly expedited the work. Thus, it helps to provide, from the start, as many working spaces as interfaces are expected to be generated. This way, participants can visualize which components might belong in each interface.

*Tangible elements and workspace size*. Seeking to offer participants a wide range of alternatives, we printed multiple copies of a large number of potential interface components. In order to avoid clutter and confusion, the available tangible components could be displayed as stacks and provided on demand, and their size and number should consider the dimensions of the available collaboration workspace. The size of the workspace could be predefined roughly according to the device for which the design is meant, and orientation could also be indicated from the beginning. The size of the tangible interface components can be offered in several sizes, according to the grid that is common for the specific device and orientation. For example, if the design is for a mobile device and a vertical orientation is specified to participants, the size of the workspace could scale from a popular aspect ratio such as 16:9, and the components could be made available in 1- to 4-column width sizes. The sizes of components can be approximate, and the grid does not need to be visible, as the goal is that participants can have a better perception of the available space.

*Emphasis on sign language interface components*. Participants were initially inclined to use some static text components in the proposed interfaces. However, when questioned about their preferred communication means, they readily switched to including dynamic LSM videos (for example, for the welcome interface). This suggests the opportunity to ideate and introduce more sign language-oriented components in the initial tangible interface set. Also, this is consistent with previous findings, reported in [8].

*Group and individual working spaces*. Some participants had ideas that diverged from the ongoing interface being generated by the group. One of them tried to arrange tangible interface components on a separate space. This may suggest the need to provide additional temporary spaces so participants may elaborate ideas prior to suggesting its integration to the interface.

*Teamwork management*. Our experience with the pilot session also suggests that some degree of moderation may be needed in order to make sure that all ideas are pondered. If hearing participants from diverse areas participate as codesigners, e.g., a graphic designer or a linguist, it would be helpful to define in advance the roles each type of participant will have, so they make their contributions without interfering with the ideas of participants in other roles. For example, graphic designers could oversee the use of interface components according to their purpose, but they would not interfere with the discussion of deaf codesigners regarding the use of images over text for menu options, or of LSM videos over written instructions. We may consider what other existing techniques prescribe in this regard and combine them with our evolving adaptation of PICTIVE.

*Working with LSM interpreters*. Conveying the intention and explaining the methodology and goals of the codesign exercise was challenging. The role of our LSM interpreter was key in facilitating communication both ways, between researchers and deaf participants. Our design exercise benefited from her being open and proactive, and her knowing the participants. In general, it is important to have LSM interpreters participate in session planning and get feedback from them in advance.

*Working with deaf role models*. Whenever possible, session planning should consider the participation of deaf adults who are regarded as culture role models for younger students. This would make sure that deaf culture aspects are taken into account in the codesign process. Deaf role models and LSM interpreters could also work together to become familiar with signs for specialized or technical terms that need to be introduced to session participants.

*Ambient factors*. Along with the staff of our host (AMAS), we planned our pilot codesign session for about five to six deaf

participants. We were pleased to be welcomed by a much larger group, which included additional deaf students as well as some relatives who were interested in learning about our project. Although we only worked with six deaf participants, unnecessary noise was generated by other people in the room. In this sense, clear rules for both participants and observers are helpful to make collaboration and facilitation easier. Also, we were able to switch from a presentation-oriented room by rearranging furniture and equipment to produce a suitable layout for discussion and collaboration. This is an important ambient consideration for subsequent design iterations.

## 6 Ongoing and future work

As noted earlier, this work is part of a much broader project. We are currently working in parallel activities: a team of teachers of deaf students, deaf adults and a linguist who is also a teacher of Spanish as a second language, are working on the selection and organization of contents and the instructional design of the lessons and exercises; a technical team is taking care of the back-end development plan; while a team of interaction designers, graphic designers and researchers specialized in interface design for deaf users, are exploring the alternatives for codesigning with deaf participants. We plan to build upon this initial experience with tangible interfaces and continue to work with the deaf community in every stage of development, so as to better understand their context, motivations and needs. Ultimately, we aim to make sure that the resulting literacy platform is codesigned with and appropriated by the deaf community.

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## 8 References

[1] dos Santos Paim, P., & Silva Prietch, S. Problems and Solutions in the Design for Deaf Persons who are Sign Language Users to Adopt Assistive Technology Products. *Journal of Interactive Systems 10*, 70 (2019) 70-81. https://doi.org/10.5753/jis.2019.554

[2] Kim, H. N., Smith-Jackson, T. L., & Kleiner, B. M. Accessible haptic user interface design approach for users with visual impairments. *Universal Access in the Information Society 13*, 4 (2014) 415–437. https://doi.org/10.1007/s10209-013-0325-0

[3] Muller, M. J. PICTIVE---an exploration in participatory design. *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems Reaching through Technology - CHI '91*, (1991), 225–231. https://doi.org/10.1145/108844.108896

[4] Muller, M. J., Haslwanter, J. H., & Dayton, T. *Participatory Practices in the Software Lifecycle*. In M. G. Helander, T. K. Landauer, & P. V Prabhu (Eds.), Handbook of Human-Computer Interaction (Second Edition) (Second Edi, pp. 255–297). North-Holland, 1997 https://doi.org/https://doi.org/10.1016/B978-044481862-1.50077-7.

[5] Lindsay, S., Jackson, D., Schofield, G., & Olivier, P. Engaging older people using participatory design. *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, (2012), 1199–1208. https://doi.org/10.1145/2207676.2208570.

[6] Paim, P., Prietch, S., & Duarte, A. CoDesign in the Exploratory Phase of an Assistive Technology product Design to support the Teaching-Learning Process of Brazilian-Portuguese Language for Visual Persons. *Proceedings of the 17th Brazilian Symposium on Human Factors in Computing Systems*, (2018), 1–9. https://doi.org/10.1145/3274192.3274204

[7] Piper, A. M., & Hollan, J. D. Supporting medical conversations between deaf and hearing individuals with tabletop displays. *Proceedings of the ACM 2008 Conference on Computer Supported Cooperative Work - CSCW '08*, (2008), 147. https://doi.org/10.1145/1460563.1460587.

[8] Sanchez, J. A., Prietch, S., & Cruz-Cortez, J. I. Natural Sign Language Interfaces for Deaf Users: Rationale and Design Guidelines. 2022 IEEE Mexican International Conference on Computer Science (ENC), (2022), 1–7. https://doi.org/10.1109/ENC56672.2022.9882905

[9] Schefer, R. P., & Zaina, L. A. M. Designing social networking apps on mobile devices. *Proceedings of the 34th ACM International Conference on the Design of Communication*, (2016), 1–9. https://doi.org/10.1145/2987592.2987609

[10] Wook, T. S. M. T., & Salim, S. S. Visual interface for searching and browsing children's WebOPAC. *Universal Access in the Information Society 13*, 4 (2014) 367–385. https://doi.org/10.1007/s10209-013-0322-3

[11] Zabot, D., Andrade, S., & Matos, E. Game Design participativo com crianças surdas e com deficiência auditiva: uma experiência no ensino fundamental. *Anais Do I Workshop Sobre Interação e Pesquisa de Usuários No Desenvolvimento de Jogos*, (2019), 49–58. https://doi.org/10.5753/wiplay.2019.7839