Mobile App for the Learning of Children with Intellectual Disabilities.

Paola A. Llerena Sarcco[1], Pedro F. Diaz Zegarra[1] and Jose A. Sulla-Torres[1]

[1] *Universidad Católica de Santa María, Urb. San José s/n Umacollo, Arequipa, 04000, Perú*

Abstract

Children with Intellectual disabilities have considerable difficulties in intellectual functioning and adaptive behavior. This is such an essential aspect in children, specifically for those who suffer from intellectual disabilities. This work aims to make an App for mobile devices that encourages learning and stimulates children with intellectual disabilities. For this, the MobileD Methodology has been used, which allows the application to be developed in an Android Studio environment supported by the Firebase platform. The results obtained from the responses of the parents of families of the children involved were relevant satisfaction in usability and learning. This application can be used by specialists interested in improving children with Intellectual disabilities.

Keywords

Mobile application, Android, learning, children, intellectual disability.

1. Introduction

Children with Intellectual Disability (ID) have significant difficulties in both intellectual functioning (e.g., communication, learning, problem-solving) and adaptive behavior (e.g., everyday social skills, routines, hygiene). IDs can be mild or severe. Children with milder ID can gain independence skills, especially in communities with a good education and support system. Children with more severe forms often need more support, especially at school. There are many programs and resources available to help these children as they grow into adults. With the passage of Rosa's Law [1] in 2010, many states replaced all of the terminologies, changing from "mental retardation" to "intellectual disability." Unfortunately, people have used the new terms for a long time.

Digitization influences many activities of people, including education. Modern methods of digital education allow solving problems related to digital resources in the education, learning, and stimulation of children with disabilities [2]

On the other hand, Android technology is present in many devices, smartphones, tablets, televisions, wearables, and the jump to the home and the vehicle is underway. What has undoubtedly enabled Android's great takeoff is that it is an open-source platform.

The project provides help in the form of different game activities that reinforce visual coordination and memory, among other aspects. Our objective with this project is to take the prototype of the application and deliver a reliable version so that its implementation can be evaluated.

The work presents the following sections: an introduction, briefly explaining the current exchanges between universities. Then, a literature review related to the proposed topic is presented. The third section explains the Mobile-D methodology, mentioning the techniques, materials, and methods used to carry out this process. Then, in the results section, we show the

JINIS 2023: XXX International Conference on Systems Engineering, October 03–05, 2023, Arequipa, Peru
72128405@ucsm.edu.pe (P. A. Llerena-Sarcco); pedro.diaz@ucsm.edu.pe (P. F. Diaz-Zegarra); jsullato@ucsm.edu.pe (J. A. Sulla-Torres);
0000-0002-5085-8414 (P. A. Llerena-Sarcco); 0000-0003-0418-7952 (P. F. Diaz-Zegarra); 0000-0001-5129-430X (J. A. Sulla-Torres);

results. Finally, we have the section of the conclusions reached after having developed this process.

2. Literature Review

Some works have been carried out to identify the types of studies and the most researched topics in the population with problems related to intellectual disability [3].

Cuascota et al. [4] indicate the importance of assistant applications for people with intellectual disabilities in their social inclusion. They developed a tool for Android smartphones designed to help people with cognitive disabilities in tasks for their social inclusion using Beacon technology to locate the user's position and evaluate their functioning within an educational center. The result of the evaluation was that the application called Tk-Helper managed to reduce the time, errors, help and assistance in the tasks of a specific activity carried out by each user.

According to Fedela et al. [5] described the effectiveness of the educational games Marbel Huruf and Belajar Membaca in helping children with ID in early-stage reading. This study is limited to reading only due to the complexity of this skill. The result showed the subject's enthusiasm through the learning activities, high motivation, and increased ability, although it has not yet reached an optimal stage. The interaction and participation of the family were also necessary.

The article by Lancioni et al. [6] evaluated a smartphone-based program to promote independent leisure and communication engagement in five participants with visual impairment and mild intellectual disability. A smartphone with an Android 5.1 Operating System was used. The results showed that all the participants learned to use the smartphone. Their independent engagement times (leisure plus communication combined) increased from baseline values of zero to the mean of approximately 75% to 85% of session duration.

Barta et al. [7] created an Android-based app that helps children ages 6-9 living with autism spectrum disorder learn everyday tasks and acquire daily routines. The application consists of two parts: the first is an application of classic daily routines based on an agenda to be carried out; The second part of the application is for the practice of tasks to be carried out by the child.

The work of Paulino et al. [8] presents a music application for people with intellectual disabilities called "Piano Teacher." To validate the approach of the application, they evaluated the use of the application by a group of people with intellectual disabilities, without much user experience with mobile technologies, to measure effectiveness, efficiency, and satisfaction. An evaluation of the current state and characteristics of mobile applications was also carried out under this paradigm. Sports-based applications have also been developed, such as the work of Kartiko et al. [9].

Brown et al. [10] indicate that digital game-based learning (DGBL) can positively affect some of the basic developmental needs of people with intellectual disabilities and associated sensory impairments. The RECALL project describes developing and evaluating a new route learning system for people with disabilities using location-based services (on the Android operating system). Research has shown that a playful approach proposal can help understand map-based representations.

In addition, there are several applications oriented to the subject of studies, such as Lingokids [11], which is an application that teaches English to children through songs and games; parents can be aware of the child's learning and thus also practice together. Another is Loopimal [12], an application focused on music creation full of handcrafted animations and sound effects, and AppJugar [13], an Android application for children with intellectual disabilities. Ángel Martín Rodríguez developed this application as a prototype that would help minors with this type of disability to obtain skills that are difficult for them to develop in an environment not adapted to their needs, and others such as Soy Cappaz [14] of the MAPFRE foundation.

3. Methodology

The guidelines of the Mobile-D methodology [15] have been followed, which is made up of different phases: exploration, initialization, product phase, stabilization phase, and testing phase. Each one has a particular function so that the development of the agile methodology is efficient.

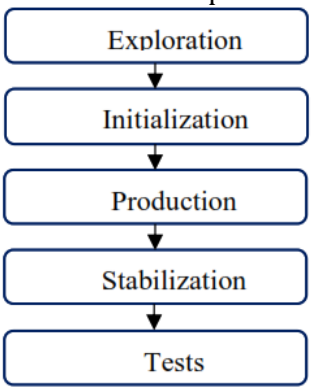

Figure 1: Phases of the Mobile-D methodology [16]

3.1. Exploration

In this phase, we generate a plan and establish the project's characteristics and essential concepts. This process is carried out in three stages: The establishment of stakeholders, the definition of scope, and the establishment of projects [17].

- Establishment of interested parties: This stage aims to identify and establish the interest groups necessary for various tasks, such as Entrepreneurs, Clients, and Competition.
- Scope definition: the purpose of this stage is to define the objectives for the project with respect to the contents and the project timeline.
- The objectives to be achieved are:
- Design and build a mobile application with a secure and user-friendly interface.
- Conduct parent surveys on the satisfaction of the application.
- Comply with quality standards to ensure operation.
- Project Establishment: Establishing a project means laying out the foundation that allows team members to work simultaneously on the same model.

3.2. Initialization

The developers prepare and identify all the necessary resources; in this phase, it is planned, then worked on, modified, and published. Plans are prepared for the following phases, and the technical environment is established, such as physical, technological, and communications resources, including training of the development team and learning of the techniques to be implemented.

Set-up project: For the environment's configuration, we worked with the Android Studio 4.0 development environment with the services of the Firebase platform of Google technology.

To implement the application called Childish, Firebase [18] was used, facilitating construction through its services. Figure 1 shows the app's link to the Firebase platform.

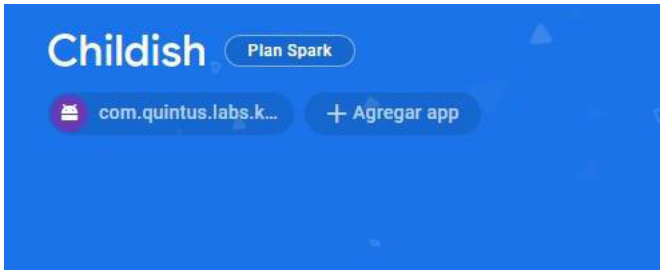

Figure 2: Childish app on Firebase

Initial Planning: The software architecture integrated with the system is based on the layered architecture, which has three main components: mobile interface, application server, and database server. The initial requirements were specified according to the IEEE 830 standard. Trials day: The output was the results obtained from executing the game activities application for children with ID.

3.3. Production

The purpose of the production phase is to implement the functionality required in the product by applying an iterative and incremental development cycle following the good practices of agile methodology.

3.3.1. Analysis of requirements and specifications

The points defined by various education professionals are the following requirements:

- It must be an application for mobile devices. - Simple use since the application is aimed at the smallest audience. - Different activities have various levels of difficulty.
- It should have a quick transition between activities to prevent the child from getting bored. The improvements to be made are as follows:
- The application must have a database in order to be able to collect the advances of the users and to be able to give it a greater pedagogical use. - Expand the catalog of available activities, including areas not previously collected.
- 'Puzzle', which helps in the spatial intelligence of the user.
- 'Catch it!' allows you to measure the reaction time. It is very dynamic, and there is the little transmission of developing reflexes, but smaller users will not notice it and will only think that they are playing.
- 'Simon' and 'Parejas' increase the number of existing activities aimed at developing short-term memory.
- 'Write' has a functionality aimed at associating not-too-complex words with their respective images.
- 'Numbers' helps to learn quite simple addition and subtraction operations.
- Preserve the scalability of the app for future implementations or adaptations by developers.

3.3.2. Design

When we chose this proposal to carry out the project, we took into account that it would not be easy since it is aimed at children with intellectual disabilities. The first thing we did was think about what we should keep and what to modify. The games we want to implement are already mentioned in the Requirements Analysis.

The following ones used were Android Studio version 4.1.0, MySql, and Firebase.

The proposed game also incorporates the interaction of music through a color palette.

The main menu is the first screen the user can see once the application is launched by clicking on the icon. Figure 3 shows the main menu.

In this phase, the different activities described below were developed:

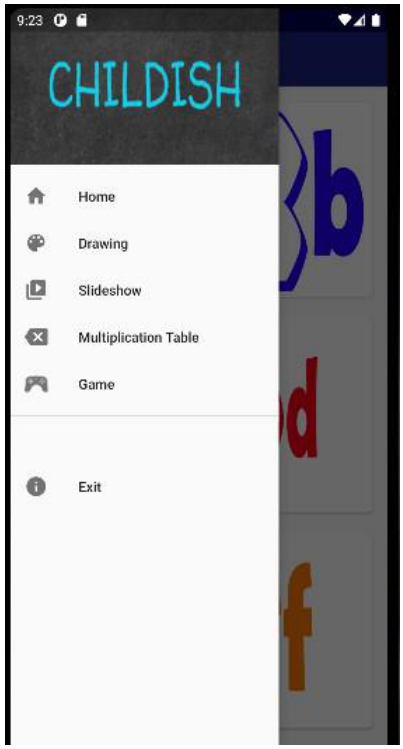

Figure 3: Main menu of the application

In this phase, the different activities described below were developed:

3.3.3. Activities

- Activity 1: Write. In Figure 4, you can see a particular set of letters with words in English, such as "Apple," "Ball," "Cat," "Duck," and "Football," and in the "E," you would have to select this to be able to write a word with this letter. In Figure 3, you can see that when you press the letter "A," several drawings of words with the letter "A" appear initially, such as "Apple and Ant"; the one that does not correspond is "Plane."

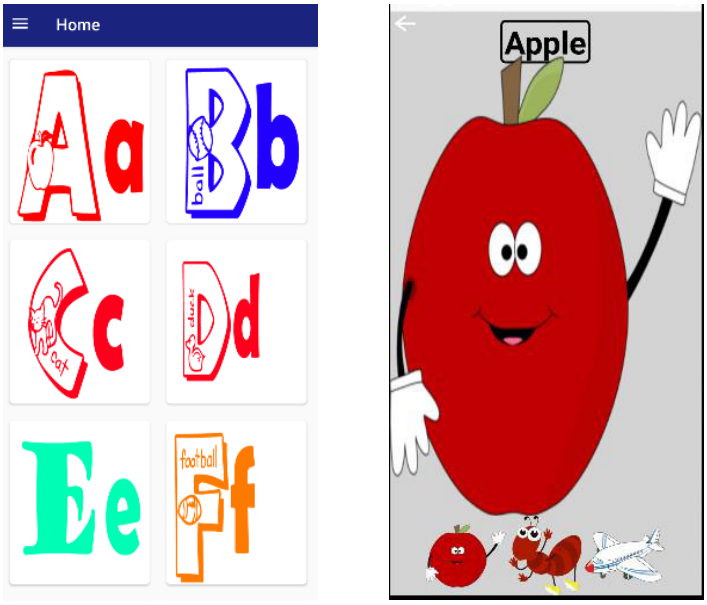

Figure 4: "Write" activity.

- **Activity 2: Draw.** In Figure 5, you can see that we have to draw freely, and that is where the space for drawing is implemented using the Paint tool. Figure 5: "Draw" activity.

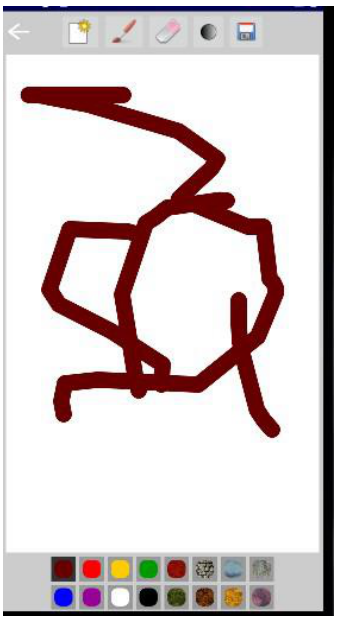

Figure 5: "Draw" activity.

- **Activity 3:** Numbers. In Figure 6, the number activity is shown, where the number to be interacted with is placed. After placing a number, it gives you its most basic multiplication table.

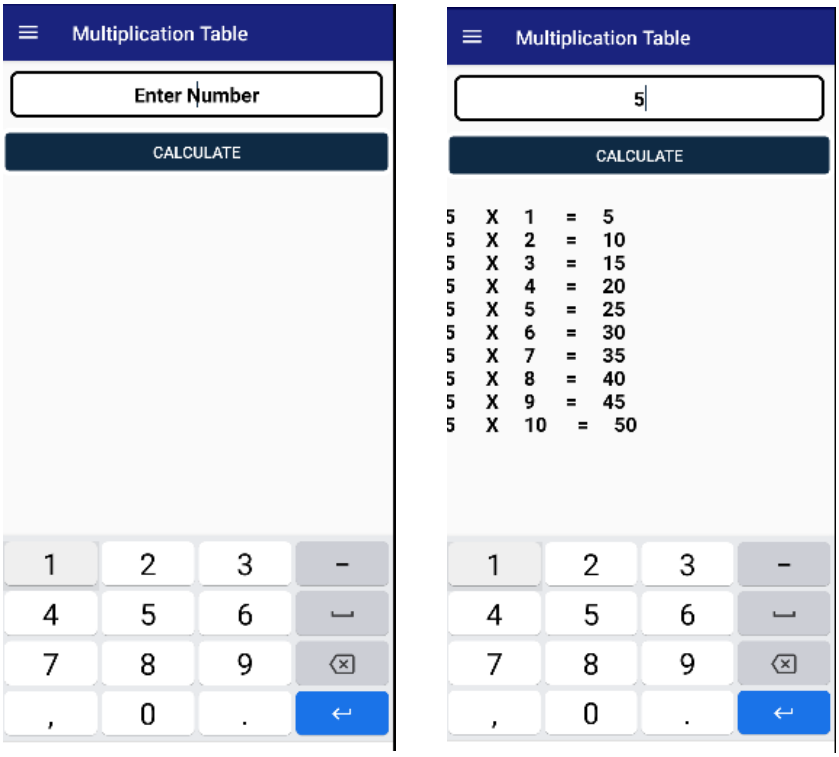

Figure 6: "Numbers" activity.

- **Activity 3: Pairs.** In Figure 7, the memory game is observed; when selecting, each one shows which image it has, and the point of all this is to memorize the drawings and then hit their image pairs.

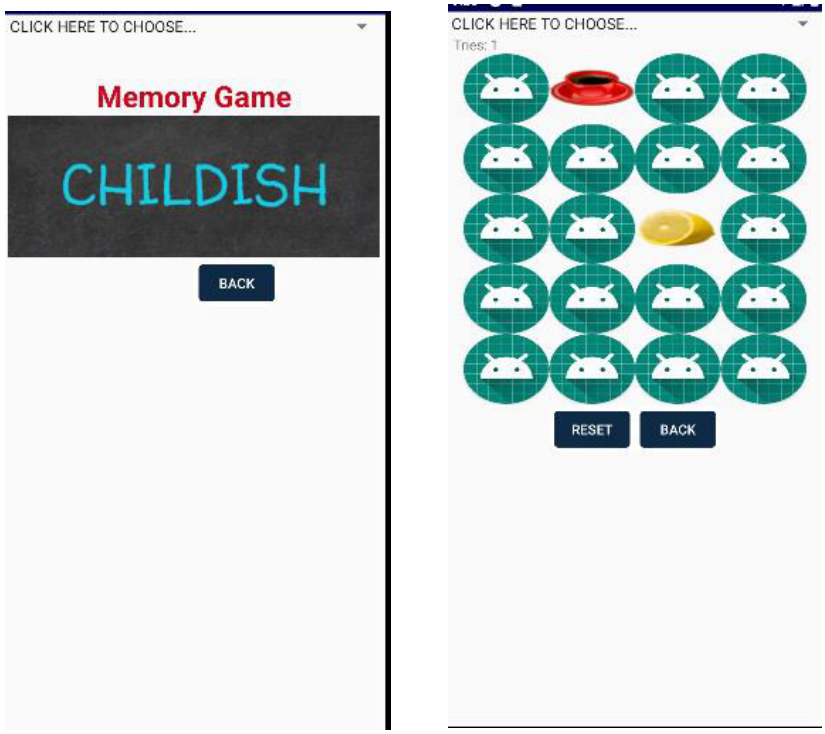

Figure 7: "Pairs" activity.

- **Activity 4: Music and Translation.** Figure 8 shows the activities of a simple music player to operate according to the colors to choose, as well as an English-to-Spanish translator for simple words.

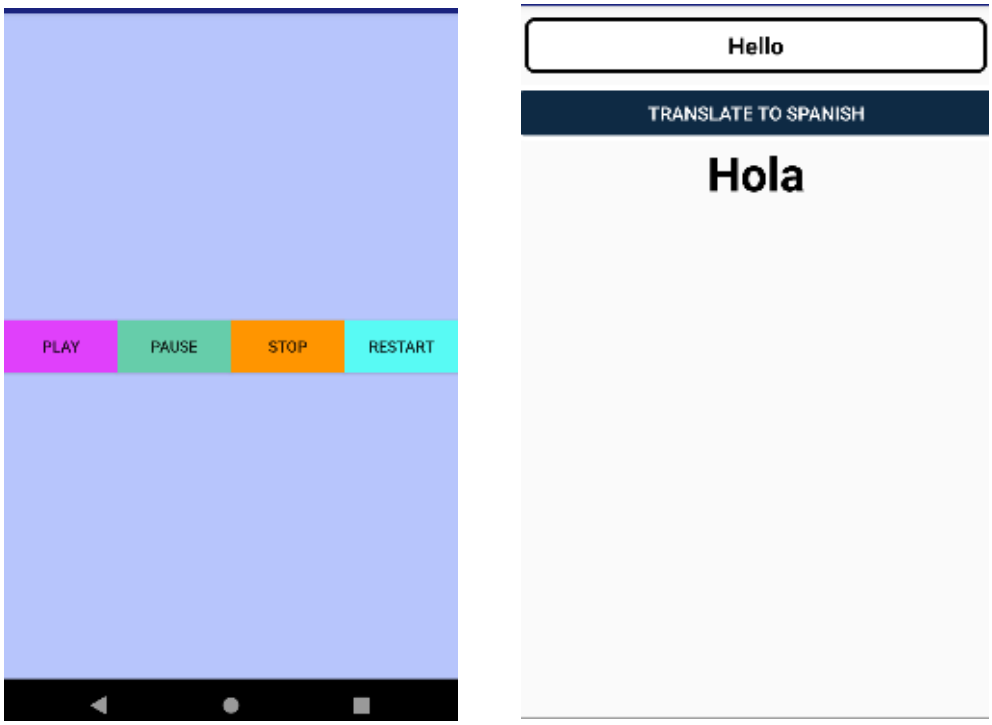

Figure 8: "Music and Translation" activities.

3.4. Stabilization

Final integration actions are carried out to ensure that the entire system works properly. Each new addition must work correctly with the rest of the software, and it is done for each new feature developed. The use of Firebase Realtime Database ensures the scalability of the data, as well as its proper access and query operations. Refactoring of Inspector Type Definition, Interface Refinements, and Acceptance Test Execution requirements.

3.5. Tests

In this last phase, the complete software is tested to check if the product implements the required functionalities correctly and to correct the errors found. In this phase, a test plan was carried out following the requirements such as Unit, Instrumentation, and UI provided by the Android Studio tool. Once completed, corrections and repairs of possible errors are made.

4. Results

This section will support the fulfillment of our objectives to be achieved. To do this, we surveyed eight parents regarding the app. The link is: https://docs.google.com/forms/d/e/1FAIpQLSeF2vsJ82gUE6xcbG01SjmGiaBeW9CqT6iniJTjV3-q5Ga7Q/viewform. Figure 10 shows the satisfaction results obtained.

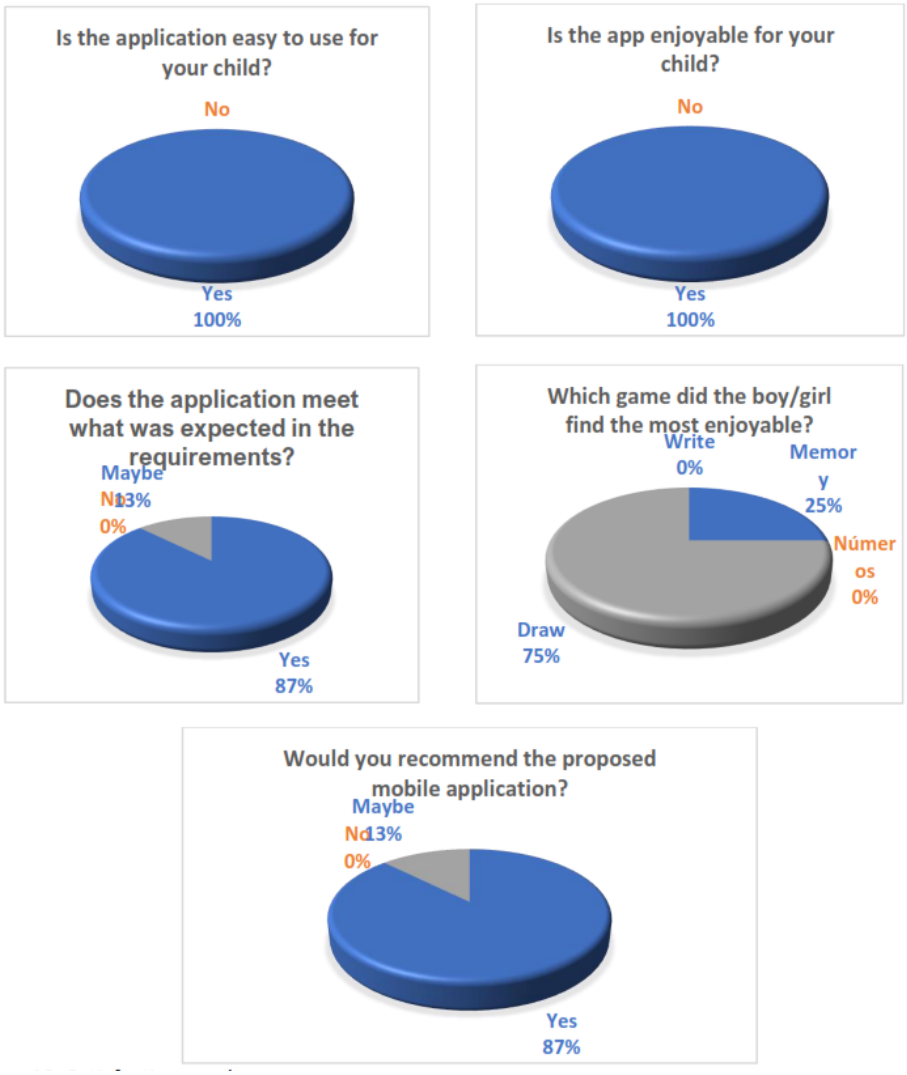

Figure 10: Satisfaction result

5. Conclusions

In this work, a mobile application was made to encourage learning and stimulate children with intellectual disabilities.

The development of the application was achieved by relying on technological tools that helped build it, such as Android Studio and the Firebase platform of Google technology. The satisfaction on the part of the parents of the intervening children indicated through a survey that in most cases, they are satisfied as an alternative in the use of mobile applications oriented to learning and stimulation of children with ID.

The developed application can be used by interested people and specialists as an alternative tool for learning and stimulating children with ID.

This application is expected to contribute to a social problem: children with intellectual disabilities.

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