# Application Prototype for Inclusive Literacy for People with Reading Disabilities

Laberiano Andrade-Arenas[1], Roberto Santiago Bellido-García[2], Pedro Molina-Velarde[3], Cesar Yactayo-Arias[4]

Facultad de Ciencias e Ingeniería, Universidad de Ciencias y Humanidades, Lima, Perú[1]
Departamento de Estudios Generales, Universidad César vallejo, Lima, Perú[2]
Facultad de Ingeniería, Universidad Tecnológica del Perú, Lima, Perú[3]
Departamento de Estudios Generales, Universidad Continental, Lima, Perú[4]

*Abstract*—**This article details the process of creating a prototype mobile application that aims to promote inclusive literacy for people with reading disabilities. The goal of this application is to help people with reading difficulties to become more independent so that they can participate in society and take advantage of educational and employment opportunities that were previously unavailable to them. The methodology used in this work is Design Thinking as it is a user-centered creative approach to solving difficult challenges and addresses creativity, design and problem solving. The results obtained from the expert judgment based on Atlas TI 22 provide a valuable perspective on the viability and potential of these technological tools. The analysis of the results of the application prototype designs gives an encouraging picture of 85%. Similarly, 75% confirm that the app effectively complements inclusive literacy efforts, a significant achievement in line with the objective, and 70% appreciate the app's interaction with people with reading disabilities. Finally, a staggering 87% would gladly recommend the app, underscoring its valuable impact. In conclusion, the article discusses how mobile applications can help people with reading difficulties become more literate. The good reception of the prototype confirms the importance of technology in inclusive education and the value of this approach to improving the lives and education of this demographic.**

*Keywords*—*Atlas TI 22; inclusive literacy; mobile applications; reading disability; design thinking*

## I. INTRODUCTION

The aim of this study was to report on the design of specialized reading materials, such as books with altered fonts and simplified text [1]. According to the findings, this type of content helped people with reading difficulties to read and comprehend what they read. The authors also discuss the advantages of cooperative and group learning for language acquisition [2]. The researchers found that when people with reading difficulties worked together in small groups, they were able to encourage and support each other as they learned.

However, despite advances in technology and education, considerable impediments remain in the way of literacy for people with reading difficulties [3]. Many potential elements come into play here, including cognitive, sensory, financial, and lack of specialized educational resources [4]. Symptoms can range from having trouble interpreting words to having trouble understanding what they read [5]. The impact has far-reaching effects, limiting social, employment and educational opportunities and prolonging marginalization.

Promoting inclusion and empowering people with reading difficulties requires action [6]. The study and creation of mobile applications tailored to inclusive literacy not only have the capacity to remove conventional barriers but also to reinvigorate learners [7]. With the results of this study, we hope to develop effective strategies to respond to the educational challenges faced by this population and give them access to resources that take into account their particular strengths and preferences [8]. The positive effects of promoting diversity and inclusion in the community are not limited to the individuals directly involved [9].

The importance of this article is to report on the creation of a prototype mobile application for inclusive literacy, aimed at users with reading difficulties. In the same way provide a welcoming and individualized classroom environment in which students can work on their reading comprehension problems [10]. The goal of this application is to help people with reading difficulties to become more independent so that they can participate in society and take advantage of educational and employment opportunities that were previously unavailable to them.

An innovative and potentially fruitful solution to the pedagogical difficulties faced by people with reading disabilities is presented: the development of mobile applications for inclusive literacy. This article delves into the global context, explains the problem, explains why this study is important, and sets the goal of creating a prototype mobile application that will help create a more just and egalitarian world.

The structure of the research is based on the following: Section II will present the literature review, Section III will present the methodology used in the research, Section IV will present the results, Section V will present the discussions and finally Section VI will present the conclusions and future work.

## II. LITERATURE REVIEW

For students with reading difficulties, inclusive literacy is a rapidly expanding area of study. The purpose of this literature review is to examine the various methods and techniques employed in inclusive literacy for individuals with reading difficulties. The education and literacy of this population will be examined along with research, programs, and practices that aim to improve their accessibility.

The authors [11] studied how mobile apps and screen readers, two examples of accessible technologies, can help people with reading difficulties become more literate. The results showed that text comprehension improved by using read-aloud features and by modifying the material. This group's reading comprehension and access to information were greatly enhanced by the use of technology.

The results of this study focus on the effectiveness of using flexible methods of teaching and reading. The authors [12] emphasize that students' reading comprehension and engagement increased when individualized tactics such as guided reading and the use of pictograms were introduced. These results underscore the need for personalized approaches to reading and writing instruction. The research also focused on the production of accessible literature for people with reading difficulties, such as simplified texts and audiobooks [13]. The results showed that the use of these modified materials increased interest in reading and improved comprehension. There is a broad consensus that the availability of literature in accessible formats is crucial to enable and encourage reading autonomy.

They discuss individuals with reading problems and the effects of teacher training in inclusive practices on their literacy. Also, the authors [14], teachers who received professional training were more adept at modifying lessons and providing students with individualized attention. As a result, the children's reading ability improved significantly, demonstrating the value of inclusive education. The study also analyzed the effectiveness of collaboration between teachers, speech-language pathologists and assistive technology specialists. Using a combination of methods from different fields, specialists were better able to meet the specific needs of individuals. The results underscored the need for inclusive literacy strategies.

Similarly, the authors [15] studied people with reading problems to see how increasing their literacy levels affected their ability to relate to others and feel self-confident. Those who made efforts to improve their skills felt more ownership of their lives and had easier access to resources. Because of its good effects on quality of life, universal literacy is important. The authors also detail how they have included artificial intelligence (AI) and augmented reality (AR) in their teaching of reading [16]. Mobile apps and devices equipped with these features facilitated interaction with written content and provided a more immersive learning environment. The findings point to the potential of technology to increase literacy opportunities for all.

According to the authors [17], they aim to demonstrate a comprehensive strategy to promote digital literacy among India's most marginalized rural population as part of the government's ambitious Digital India initiative. For low literacy learners in resource-poor environments with poor Internet bandwidth, lack of ICT facilities and inconsistent power, tackling multiple literacies at once poses a major challenge. The educational concept is an effective way to bring tablet-based digital literacy directly to communities, thus overcoming long-standing obstacles [18]. In order to improve both digital and life skills, it draws on a variety of actors, including pre-existing civil society, schools, and government agencies, to deliver digital literacy and awareness. It demonstrates the benefits of a holistic approach to digital literacy as a tool to promote digital equity.

On the other hand, the authors [19] do a study to report on the design of specialized reading materials, such as books with altered fonts and simplified text. According to the findings, this type of content helped people with reading difficulties to read and understand what they read. The authors also discuss the benefits of cooperative and group learning for language acquisition. The researchers found that when people with reading difficulties worked together in small groups, they were able to encourage and support each other as they learned.

As more and more students with disabilities enroll in mainstream universities, the question of how best to accommodate them has become more pressing. The authors [20], define the support provided to these students remains a crucial task, despite the emphasis on inclusion and engagement in policy and practice. This collective case study used interviews and focus groups to gather information from 125 secondary school staff members from seven different schools about their experiences with students with disabilities [21]. Using the results of this research as a basis, a series of professional development initiatives were designed with the goal of improving the inclusion of older students with disabilities.

In this literature review, we analyzed the effectiveness and applicability of various techniques and a comprehensive synthesis of the most important findings. While it is true that the authors have expanded knowledge about intelligence, they have not offered any concrete plans on how to implement it using mobile applications.

## III. METHODOLOGY

Design Thinking is a method for identifying problems and proposing novel user-centered solutions. In this approach, priority is given to the requirements, desires, and feelings of the people for whom a product, service or experience is developed [22]. Product and service creation, as well as business innovation and complicated problem solving, are some of the areas in which this approach has been successful. Its human-centered approach and its ability to inspire innovation have led to its widespread adoption beyond the design world. The Design Thinking process is based on a series of five phases, the exact number of which will vary depending on the model or source used as shown in Fig. 1.
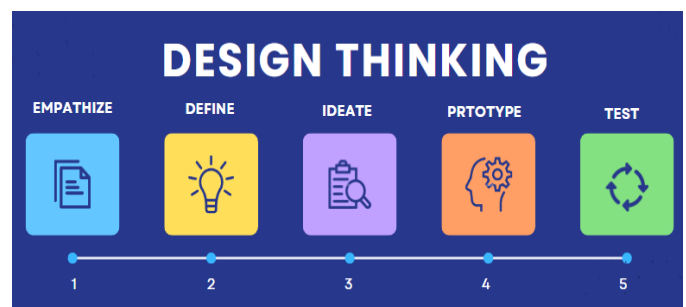


Fig. 1. Phases of design thinking.

## A. Empathize

In this phase, the group investigates the target audience to learn more about their desires, needs, feelings and routines [23]. In doing so, it hopes to better understand the difficulties encountered by users. To do so, it can resort to interviews, participant observations and other ethnographic research methods. Table I shows the four questions posed for the interview with parents of people with reading disabilities.

TABLE I.        INCLUSIVE LITERACY QUESTIONS

| N° | Questions |
|---|---|
| 1 | Tell me about the learning and literacy experience of your child with a reading disability? |
| 2 | What kind of support or assistance has your child received to improve his/her reading skills? |
| 3 | Have you currently used any mobile apps or technology to support your child's literacy? |
| 4 | What specific content do you think would be most useful for your child in an inclusive literacy application? |

## B. Define

The "Define" phase of Design Thinking is the second step of the process and attempts to properly identify and characterize the problem or challenge that the design will address. A well-defined objective in this phase ensures that the rest of the design process moves in the right direction. Table II shows four questions posed for the survey to experts in special education using ICTs taking into account the interview report made in the previous step.

TABLE II.        MOBILE APPLICATION QUESTIONS ON INCLUSIVE LITERACY

| Dimensions | Questions |
|---|---|
| Support | Does the mobile application currently support you in developing your reading and comprehension skills more effectively? |
| Accessibility | Is the mobile application currently accessible for use by children with reading disabilities? |
| Monitoring | Are children frequently monitored by their teachers for academic progress in literacy in the proper use of the mobile application? |
| Motivation | Are special children motivated through appropriate strategies in the teaching and learning process by their teacher? |

Table III shows the current status and prototype status of mobile applications for inclusive literacy for each of the dimensions such as support, accessibility, monitoring and motivation.

## C. Ideas

The third step of Design Thinking, "Ideate" is about coming up with a wide range of original ideas and possible solutions to the problem or challenge identified in "Conceive" [24]. The goal at this point is to develop as many ideas as possible without worrying about their feasibility, thus encouraging diverse thinking, for the design of prototypes, about inclusive literacy. Table IV shows four consensual activities for the design of the mobile application for inclusive literacy in people with reading disabilities.

TABLE III.        CURRENT AND PROPOSED SITUATION

| Dimension | Current status | Proposed Situation |
|---|---|---|
| Support | We currently do not have a mobile support application. | To create a prototype of a mobile application to support learning. |
| Accessibility | Generally, there is no App available for its use. | Create a user-friendly App. |
| Monitoring | There is no frequent monitoring of your teacher. | There must be a monitoring and control plan |
| Motivation | No adequate motivation strategies | Strategies must be implemented in order to motivate |

TABLE IV.        CONSENSUAL ACTIVITIES FOR THE DESIGN OF THE MOBILE APPLICATION

| N° | Consensual activities |
|---|---|
| Support | Design registration and Login to enter the inclusive literacy application for people with disabilities. |
| Accessibility | Conduct intuitive language and cognitive therapy inclusive literacy design for people with disabilities. |
| Monitoring | Design a mobile application of inclusive literacy educational games for people with disabilities. |
| | Design a mobile cognitive therapy application |
| Motivation | Design a mobile application for teaching reading for people with basic level disabilities |
| | Design a mobile application for teaching reading for people with intermediate level disabilities |

## D. Prototyping

The fourth step of Design Thinking is called "Prototyping" and its objective is to build rapid, low-cost prototypes of the solutions chosen in the "Ideate" phase [25]. Before settling on a final solution, ideas can be visualized and evaluated using these prototypes. At this point, the most important thing is to get feedback quickly and collect user feedback to help shape future iterations of the solutions.

Fig. 2 shows the Registration and Login of the inclusive literacy application. Users can access their own accounts and their own material by registering and logging into a mobile application. This function is essential to create a personalized and secure environment for all users.

Additionally, the registration and login process plays a pivotal role in enhancing user engagement and tracking individual progress within the app. By offering a personalized experience, users can easily pick up where they left off, track their achievements, and tailor their learning journey to meet their unique needs. This not only fosters a sense of ownership but also reinforces the commitment to fostering inclusive literacy, making the application a valuable tool for learners of all backgrounds and abilities.

Intuition-based cognitive and linguistic processing Designing for literacy inclusion requires a deep understanding of the strengths and weaknesses of people with cognitive or reading disabilities. Successful, accessible learning environments are the result of the combined efforts of educators, speech-language pathologists, and developers of

mobile apps and educational platforms. It helps people with disabilities improve their language and literacy skills by providing them with accessible information and tools. Images, visual elements and visual symbols are used extensively throughout the design to reinforce main points and improve readability. How to assemble vowels, combine by size and color (see Fig. 3).
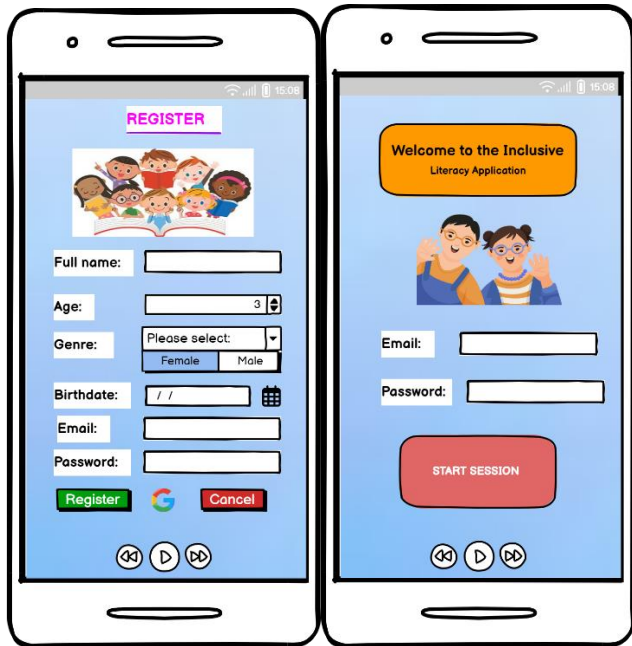


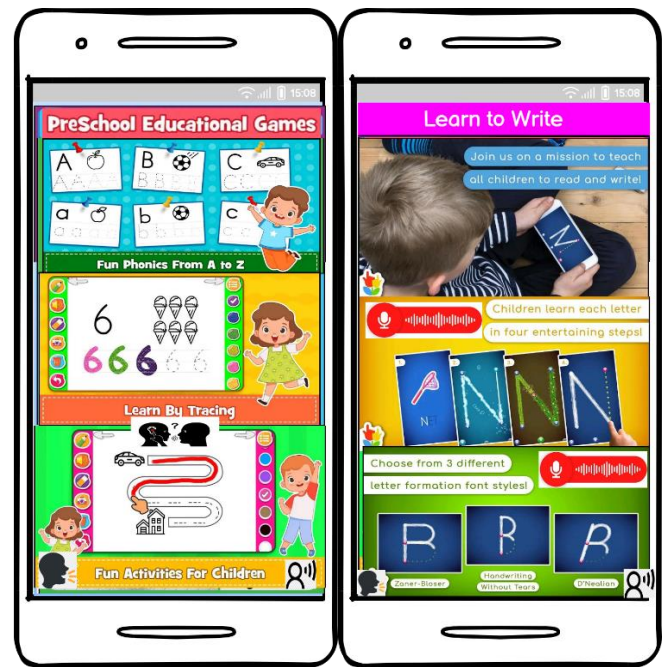Fig. 2. Application registration and login.



Fig. 3. Cognitive therapy.

Accessible, intelligible, and engaging learning experiences are the goal of the intuitive design of disability-inclusive literacy games. These video games take into account the specific needs of players to ensure that everyone has an equal opportunity to master the language, phonetic, letter recognition, and writing skills they offer. As shown in Fig. 4.



Fig. 4. Basic level educational games.

These inclusive educational games are modifiable to meet the needs of children with reading disabilities, giving them a voice in the learning process. These games provide a stimulating environment for children to learn to read and write using visual, auditory and tactile elements (see Fig. 5).

These inclusive educational games not only offer customization to cater to the specific requirements of children with reading disabilities but also play a crucial role in fostering inclusivity in the broader educational landscape. By accommodating diverse learning needs, they empower children with reading disabilities to actively participate in the learning process, promoting a sense of inclusion and equity. Additionally, these games serve as a dynamic and engaging platform for children to develop their literacy skills. Through a combination of visual, auditory, and tactile elements, they create a multisensory learning experience that appeals to various learning styles and strengths, further enhancing the accessibility and effectiveness of literacy instruction. Moreover, by embracing technology in education, these games align with the evolving digital era, preparing students with valuable digital literacy skills that are essential for their future success in a technology-driven world. In essence, these inclusive educational games not only bridge educational gaps but also nurture a more inclusive, adaptable, and tech-savvy generation of learners.
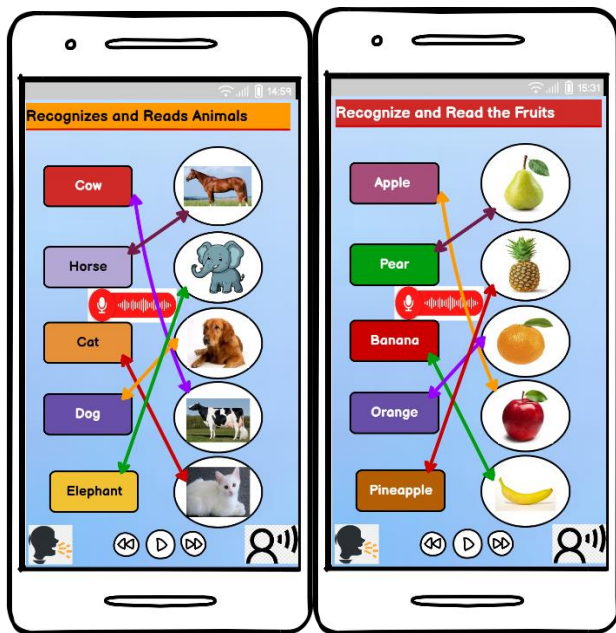
Fig. 5.    Intermediate level educational games.

## IV.  RESULTS

### A.  About the Interview

Parents of people with reading disabilities were interviewed about inclusive literacy, especially in children, analyzing through Atlas TI 22 (See Fig. 6).

The utilization of Atlas.ti software in interviews holds significant importance as it empowers researchers to efficiently analyze and interpret qualitative data. This powerful tool facilitates the systematic organization of large volumes of textual, audio, or visual data, enabling researchers to uncover patterns, themes, and insights that might otherwise remain concealed. Its robust coding and data visualization capabilities not only streamline the research process but also enhance the rigor and credibility of qualitative studies, ultimately contributing to a deeper understanding of complex phenomena and more informed decision-making in various academic and professional domains.

- Experience:

It has been observed that all parents mention challenges in their children's learning experience, highlighting moments of frustration due to reading difficulties. However, a positive attitude toward each child's individual progress and their unique capacity to learn is also evident. This suggests that adaptability and a focus on individual achievements are essential aspects of the learning experience for these children.

- Support:

The analysis reveals that all parents have sought support and assistance both within the school environment and therapeutic settings. Speech and language therapy sessions emerge as a common intervention to enhance pronunciation and auditory comprehension. Furthermore, collaboration with specialized tutors and the adaptation of learning environments are mentioned as effective strategies to address the unique needs of these children. This suggests that a combination of school-based and therapeutic approaches is crucial for the development of reading skills in children with reading disabilities.

- Use of Mobile Applications:

While all parents have experimented with mobile apps to support their children's literacy, there is a consistent search for a solution that perfectly aligns with the children's needs. Apps offering interactive exercises and voice narration have proven effective in maintaining interest and engagement. However, the lack of options perfectly tailored to the specific needs of the children underscores the importance of adaptability and customization in literacy apps.

- Content:

The analysis of parents' responses regarding useful content in an inclusive literacy app demonstrates a consensus on the significance of multimodality. The combination of text, images, and audio is essential to cater to diverse learning styles. Furthermore, interactive activities that reinforce vocabulary, sentence formation, and comprehension are considered valuable for enhancing reading skills. This highlights the need for tailored content addressing multiple aspects of literacy.

### B.  Expert Testing

Fifth, in the testing phase of Design Thinking, prototyped solutions are subjected to more rigorous testing with experts. In this phase, the solution is tested to gauge its interaction, usability, interface and quality before it is fully implemented. Expert validation of the design of the inclusive literacy prototypes was performed through evaluation with eight experts (E).

The solution undergoes testing to fine-tune its interaction, usability, interface, and quality before full implementation. The validation of the inclusive literacy prototype designs involved assessment by eight experts. The resulting average scores are as follows: For interaction, the mean was 81.25, indicating generally positive expert perceptions. Usability averaged 82.5, implying good overall usability. Interface garnered a high average of 91.25, reflecting strong approval of the design. The quality received an average of 82.5, denoting consistent good quality. Collectively, experts' evaluations suggest promising potential, yet addressing specific improvement areas noted by individual experts will further amplify their effectiveness and user experience (see Table V).

TABLE V.        EXPERT VALIDATION

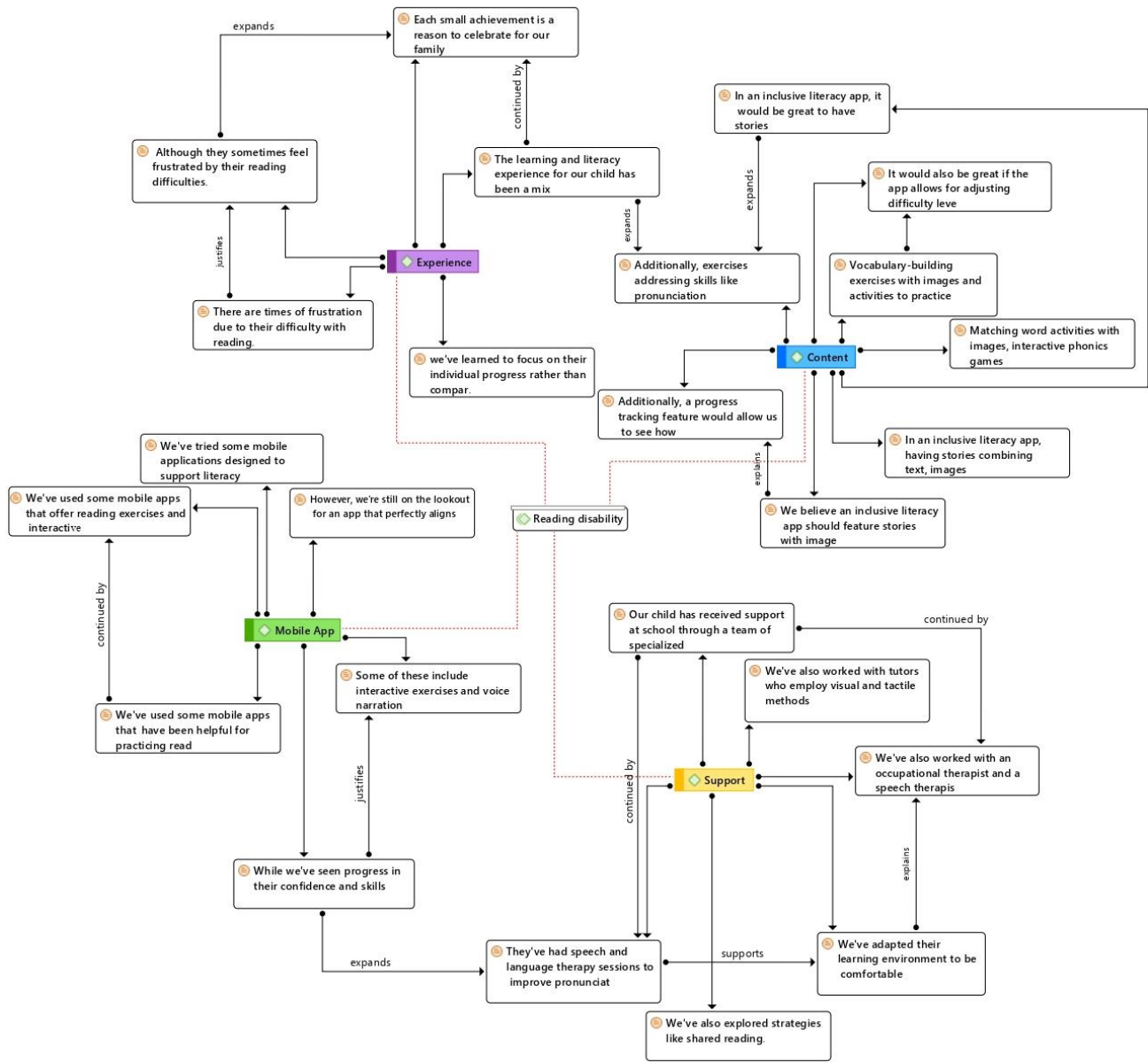| Criteria | E1 | E2 | E3 | E4 | E5 | E6 | E7 | E8 | Media |
|---|---|---|---|---|---|---|---|---|---|
| Interaction | 80 | 90 | 80 | 90 | 70 | 80 | 80 | 80 | 81.25 |
| Usability | 70 | 80 | 90 | 80 | 80 | 90 | 80 | 90 | 82.50 |
| Interface | 80 | 90 | 90 | 100 | 100 | 90 | 90 | 90 | 91.25 |
| Quality | 80 | 80 | 80 | 90 | 80 | 80 | 80 | 90 | 82.50 |

Fig. 6. Network analysis with the use of ATLAS ti22.

## C. About the Survey

Table VI shows the four questions posed for the survey to parents about the use of the mobile application for inclusive literacy in people with reading disabilities.

TABLE VI. PARENT SURVEYS ON THE USE OF THE MOBILE APPLICATION

| N° | Questions |
|---|---|
| 1 | Is the design of the mobile application user friendly? |
| 2 | Did the use of the mobile application serve as a complement for inclusive literacy? |
| 3 | Does the mobile application interact with people with reading disabilities? |
| 4 | Would you recommend the mobile application for inclusive literacy? |

The analysis of the results from our prototype of a mobile application for inclusive literacy in individuals with reading disabilities paints an encouraging picture. With an impressive 85%, the majority find the application design to be user-friendly, a vital aspect for creating a comfortable user experience. Furthermore, 75% confirm that the application effectively complements inclusive literacy efforts, a significant achievement in line with our goal. While 70% appreciate the application's interaction with individuals with reading disabilities, delving into the reasons behind the 30% who didn't share the same perception would be valuable. Lastly, an astounding 87% would gladly recommend the application, underscoring its valuable impact. While we're on the right track, it's crucial to address the feedback from those who didn't respond positively to continue refining and meeting their needs (see Fig. 7).
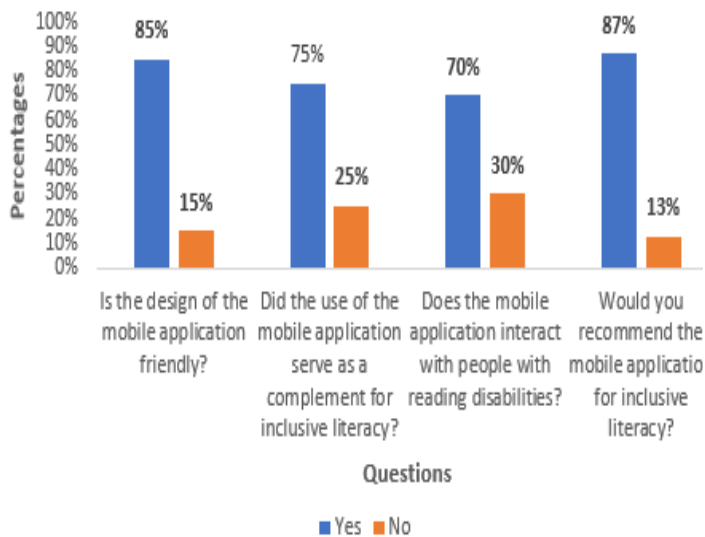
Fig. 7.    Questions on the use of the mobile application.

## V.    DISCUSSIONS

The authors [12] emphasize that reading comprehension and student engagement increased when individualized tactics such as guided reading and the use of pictograms were introduced. In the present research work, prototypes of didactic mobile applications specifically designed to enrich cognitive-behavioral therapy skills in people with reading disabilities were developed.

This study builds on previous research highlighting the importance of mobile applications and screen readers in promoting literacy among people with print disabilities [11]. Also, by adapting mobile applications for inclusive literacy to the needs of people with reading disabilities, the scope of these opportunities can be increased. Thus, in the present work, the contribution to the development of reading and writing skills, as well as to the full integration and participation of this population in society was realized.

This work was carried out based on interviews with parents and surveys of experts in special education with the use of ICTs. In the same way, the results were based on the inclusion of expert judgments and AtlasTI22 of the use of prototype mobile applications for inclusive literacy in people with reading disabilities. In contrast, the authors [15] did not conduct surveys and interviews, only studied people with reading disabilities to see how increasing their literacy levels affected their ability to relate to others and feel confident.

## VI.    CONCLUSIONS AND FUTURE WORK

In conclusion, this study has investigated and developed the prototypes of mobile applications, with the aim of promoting inclusive literacy among people with reading difficulties. In order to evaluate the effectiveness and value of the proposed applications, interviews and surveys were conducted to collect the opinions of experts in the field to assess the effectiveness and usefulness of the proposed applications. The results obtained from expert judgment provide valuable insight into the feasibility and potential of these technological tools.

Analysis of the results of the prototype application designs yields an encouraging 85%. Similarly, 75% confirmed that the app effectively complements inclusive literacy efforts, a significant achievement in line with the objective, and 70% appreciated the app's interaction with people with reading disabilities. Finally, a staggering 87% would gladly recommend the app, underscoring its valuable impact. As for the methodology, design thinking was used as it is based on the human being approach, which addresses creativity, design and problem solving. A limitation of the research work is that it was not possible to contact directly the institutions of inclusive education to conduct interviews and make a qualitative analysis. As future work, it is recommended to implement the prototypes of mobile applications of inclusive education for people with reading disabilities complemented with augmented reality.

## REFERENCES

[1]    M. P. Campos, M. G. Retuerto, A. Delgado, and L. Andrade-Arenas, "Educational Platform to Improve Learning for Children with Autism," *International Journal of Engineering Pedagogy (iJEP)*, vol. 13, no. 2, pp. 20–35, Mar. 2023, doi: 10.3991/IJEP.V13I2.33969.

[2]    C. I. Martínez-Alcalá *et al.*, "Digital inclusion in older adults: A comparison between face-to-face and blended digital literacy workshops," *Frontiers in ICT*, vol. 5, no. AUG, p. 335246, Aug. 2018, doi: 10.3389/FICT.2018.00021/BIBTEX.

[3]    N. ChePa, N. Azzah Abu Bakar, L. Lim Sie-Yi, U. Utara Malaysia, and K. Malaysia, "Criteria and Guideline for Dyslexic Intervention Games," *International Journal of Advanced Computer Science and Applications*, vol. 13, no. 9, pp. 162–172, Dec. 2022, doi: 10.14569/IJACSA.2022.0130919.

[4]    W. Barber, "Inclusive and accessible physical education: rethinking ability and disability in pre-service teacher education," *Sport, Education and Society,* vol. 23, no. 6, pp. 520–532, Jul. 2016, doi: 10.1080/13573322.2016.1269004.

[5]    J. W. McKenna, M. Solis, F. Brigham, and R. Adamson, "The Responsible Inclusion of Students Receiving Special Education Services for Emotional Disturbance: Unraveling the Practice to Research Gap," *Behavior Modification*, vol. 43, no. 4, pp. 587–611, Mar. 2018, doi: 10.1177/0145445518762398.

[6]    N. I. Othman, N. A. M. Zin, and H. Mohamed, "Play-Centric Designing of a Serious Game Prototype for Low Vision Children," *International Journal of Advanced Computer Science and Applications*, vol. 11, no. 5, pp. 199–205, 2020, doi: 10.14569/IJACSA.2020.0110528.

[7]    F. Kiuppis, "Inclusion in sport: disability and participation," *Sport in society*, vol. 21, no. 1, pp. 4–21, Jan. 2016, doi: 10.1080/17430437.2016.1225882.

[8]    S. A. Boyle, D. McNaughton, and S. E. Chapin, "Effects of Shared Reading on the Early Language and Literacy Skills of Children With Autism Spectrum Disorders: A Systematic Review," *Focus on Autism and Other Developmental Disabilities,* vol. 34, no. 4, pp. 205–214, May 2019, doi: 10.1177/1088357619838276.

[9]    S. G. Wood, J. H. Moxley, E. L. Tighe, and R. K. Wagner, "Does Use of Text-to-Speech and Related Read-Aloud Tools Improve Reading Comprehension for Students With Reading Disabilities? A Meta-Analysis," *Journal of learning disabilities*, vol. 51, no. 1, pp. 73–84, Jan. 2017, doi: 10.1177/0022219416688170.

[10]   D. Chadwick *et al.*, "Digital inclusion and participation of people with intellectual disabilities during COVID-19: A rapid review and international bricolage," *Journal of Policy and Practice in Intellectual Disabilities*, vol. 19, no. 3, pp. 242–256, Sep. 2022, doi: 10.1111/JPPI.12410.

[11]   L. Stinken-Rösner *et al.*, "Thinking Inclusive Science Education from two Perspectives: inclusive Pedagogy and Science Education RISTAL 3 / 2020 Research in Subject-matter," *RISTAL. Research in Subject-matter Teaching and Learning*, vol. 3, pp. 30–45, 2020, doi: 10.23770/rt1831.

[12] K. Ishaq, N. A. M. Zin, F. Rosdi, A. Abid, and Q. Ali, "Usefulness of Mobile Assisted Language Learning in Primary Education," *International Journal of Advanced Computer Science and Applications*, vol. 11, no. 1, pp. 384–395, Spring 2020, doi: 10.14569/IJACSA.2020.0110148.

[13] A. Jalil, T. Tohara, S. M. Shuhidan, F. Diana, S. Bahry, and M. Norazmi Bin Nordin, "Exploring Digital Literacy Strategies for Students with Special Educational Needs in the Digital Age.," *Turkish Journal of Computer and Mathematics Education (TURCOMAT)*, vol. 12, no. 9, pp. 3345–3358, Apr. 2021, doi: 10.17762/TURCOMAT.V12I9.5741.

[14] A. Sánchez-Morales, J. A. Durand-Rivera, and C. L. Martínez-González, "Usability Evaluation of a Tangible User Interface and Serious Game for Identification of Cognitive Deficiencies in Preschool Children," *International Journal of Advanced Computer Science and Applications*, vol. 11, no. 6, pp. 486–493, 2020, doi: 10.14569/IJACSA.2020.0110661.

[15] B. Xie, N. Charness, K. Fingerman, J. Kaye, M. T. Kim, and A. Khurshid, "When Going Digital Becomes a Necessity: Ensuring Older Adults' Needs for Information, Services, and Social Inclusion During COVID-19," *Older Adults and COVID-19*, vol. 32, no. 4–5, pp. 460–470, Jul. 2020, doi: 10.1080/08959420.2020.1771237.

[16] I. Koomson, R. A. Villano, and D. Hadley, "Intensifying financial inclusion through the provision of financial literacy training: a gendered perspective," *Applied Economics,* vol. 52, no. 4, pp. 375–387, Jan. 2019, doi: 10.1080/00036846.2019.1645943.

[17] S. Druga, S. T. Vu, E. Likhith, and T. Qiu, "Inclusive AI literacy for kids around the world," ACM International Conference Proceeding Series, pp. 104–111, Mar. 2019, doi: 10.1145/3311890.3311904.

[18] K. de Bruin, "The impact of inclusive education reforms on students with disability: an international comparison," *International Journal of inclusive education*, vol. 23, no. 7–8, pp. 811–826, Aug. 2019, doi: 10.1080/13603116.2019.1623327.

[19] J. J. Murray, K. Snoddon, M. De Meulder, and K. Underwood, "Intersectional inclusion for deaf learners: moving beyond General Comment no. 4 on Article 24 of the United Nations Convention on the Rights of Persons with Disabilities," *International Journal of Inclusive Education*, vol. 24, no. 7, pp. 691–705, Jun. 2018, doi: 10.1080/13603116.2018.1482013.

[20] D. Maciver, C. Hunter, A. Adamson, Z. Grayson, K. Forsyth, and I. McLeod, "Supporting successful inclusive practices for learners with disabilities in high schools: a multisite, mixed method collective case study," *Disability and rehabilitation,* vol. 40, no. 14, pp. 1708–1717, Jul. 2017, doi: 10.1080/09638288.2017.1306586.

[21] A. Kart and M. Kart, "Academic and Social Effects of Inclusion on Students without Disabilities: A Review of the Literature," *Education Sciences 2021, Vol. 11, Page 16*, vol. 11, no. 1, p. 16, Jan. 2021, doi: 10.3390/EDUCSCI11010016.

[22] K. D. Elsbach and I. Stigliani, "Design Thinking and Organizational Culture: A Review and Framework for Future Research," *Journal of Management*, vol. 44, no. 6, pp. 2274–2306, Jan. 2018, doi: 10.1177/0149206317744252.

[23] P. Micheli, S. J. S. Wilner, S. H. Bhatti, M. Mura, and M. B. Beverland, "Doing Design Thinking: Conceptual Review, Synthesis, and Research Agenda," *Journal of Product Innovation Management*, vol. 36, no. 2, pp. 124–148, Mar. 2019, doi: 10.1111/JPIM.12466.

[24] M. Altman, T. T. K. Huang, and J. Y. Breland, "Peer Reviewed: Design Thinking in Health Care," *Prev Chronic Dis*, vol. 15, no. 9, p. 180128, Sep. 2018, doi: 10.5888/PCD15.180128.

[25] J. P. S. Bartra, J. F. H. Puja, M. G. Retuerto, and L. Andrade-Arenas, "Prototype of Mobile Application Oriented to the Educational Help for Blind People in Peru," *International Journal of Interactive Mobile Technologies (iJIM)*, vol. 16, no. 17, pp. 130–147, Sep. 2022, doi: 10.3991/IJIM.V16I17.32075.