# AlfaLotería: Mobile Application for Enhancing Literacy Skills in Youth and Adults with Educational Gap Through the Lottery Game

Blanca Dina Valenzuela-Robles[1], René Santaolaya-Salgado[1],
Omar Alexis Sánchez-Medina[1], Jaime Muñoz-Arteag[2]
And Mariana Ortíz-Garcia[3]

[1] Computer Science Department TecNM/CENIDET, 62490 Cuernavaca, Morelos, México
{blanca.vr, rene.ss, m21ce068}@cenidet.tecnm.mx

[2] Universidad Autónoma de Aguascalientes, Aguascalientes, México
jaime.munoz@uaa.edu.mx

[3] TecNM/Instituto Tecnológico de Zacatecas, Zacatecas, México
mariana.ortíz@zacatecas.tecnm.mx

**Abstract.** This article details the development of a mobile application aimed at improving literacy skills among illiterate individuals in the Morelos region of Mexico. The primary objective is to provide an accessible and effective tool that facilitates the acquisition of reading and writing skills for those experiencing educational deficits. The application was developed using contemporary mobile technologies and integrates serious gaming elements. It features a module for an educational lottery game that includes letter, word, and sound recognition, grounded in an educational framework designed for life and work. The application is customized to meet user needs, initially offering the game in Mexican Spanish and the Amuzgo indigenous language. This application serves as a valuable resource with the potential to reduce illiteracy by offering a tool tailored to the needs of indigenous communities.

## 1 Introduction

According to the Political Constitution of the United Mexican States, every individual has the right to education, and the state must provide high-quality educational services. This ensures that the population has the opportunity to complete education from preschool to upper secondary level. Recent studies by INEGI indicate that the educational gap increased by 0.3 percentage points, from 19.0% to 19.2%, between 2018 and 2020. These studies also show that the three states with the highest educational gap are Chiapas, Oaxaca, and Michoacán, whereas the states with the lowest educational gap are Mexico City, the State of Mexico, and Coahuila [1].

Although the state of Morelos is not among the states with the highest educational disadvantages, it has small communities with adults and indigenous people who are illiterate.

The General Education Law also establishes that adult education is part of our national educational system. In Mexico, according to data from the National Institute for Adult Education (INEA), 35% of individuals over 15 years old were in a state of total educational gap, meaning more than 30 million Mexicans. Of these, 5.5% were illiterate, 10.9% had not completed primary education, and 18.6% had not finished secondary education. In absolute terms, the number of people in this situation increased considerably in the last three decades of the previous century. This trend slightly changed at the beginning of the 2000s but has not varied significantly to this day.

Educational gap and illiteracy are widespread problems in the country, especially in the poorest regions, leading to minimal opportunities for personal development and widening the digital and educational divide. Some of the causes of illiteracy include not attending school, lack of relevant educational services, economic, social, political, and cultural imbalances, extreme poverty, insufficient rural schools and teachers, primary-level dropout, parents' lack of conviction about literacy, low motivation among participants in the literacy process, internal migration, and, finally, the lack of adequate and indigenous-oriented content.

Currently in Mexico, teaching and learning processes for illiterate adults are facilitated through programs such as Zero Illiteracy, Literacy Yes, Literacy Campaign, Reduction of Educational Gap, and the Educational Model for Life and Work (MEVyT) [2].

Educational attention for individuals aged 15 and older must focus on the quality of teaching and learning processes, taking into account the age and living conditions of enrolled individuals. This means adapting the literacy program content to the needs of young people and adults. According to [3] and [4], the use of interactive educational resources via mobile devices facilitates both the development of skills and competencies and the reduction of the average learning time.

In light of the above, there is a need to develop interactive educational resources, such as serious games, through mobile devices and integrate them into the country's processes, programs, or models as support for teaching reading and writing to illiterate youth and adults.

Technologies serve as tools for the dissemination of information, communication, and education, influencing all political, economic, and social contexts. The use of technologies is changing work practices, creating new social, work, and leisure environments, and transforming lifestyles and forms of participation and social inclusion [2].

Therefore, the development of a mobile application that integrates serious games, such as the lottery game, and directly impacts literacy learning significantly contributes to reducing the educational gap in this population.

## 2 Background

This section presents some key concepts relevant to the development of the project in question, as well as some related works found in the literature.

### 2.1 Illiteracy in Mexico

Illiteracy is a social issue affecting the adult population and youth over 15 years old who are characterized by their inability to read, write, or understand and handle basic mathematical concepts. This situation hinders their integration into the productive sector. According to data obtained by INEGI, in Mexico, over the past 50 years, the percentage of illiterate individuals aged 15 and older decreased from 25.8% in 1970 to 4.7% in 2020, equivalent to 4,456,431 people who cannot read or write. The highest percentage of illiterate individuals is found among those aged 75 and older. The states with the highest percentage of illiterate populations are Chiapas, Guerrero, and Oaxaca [1].

Inclusion and the development of digital skills must be a priority for all governments. A few generations ago, the focus was on ensuring students had books, pencils, and pens, and that they could read and write. Today, in addition to these, the aim is to provide them with internet access, digital skills, and the development of computational thinking to prepare them for the future world.

The significant use of technologies promotes lifelong education and continuous training in various educational contexts where technologies are used as facilitators of learning.

### 2.4 Illiteracy in Indigenous Communities

Based on the criterion of indigenous households, the National Institute of Indigenous Peoples quantifies the indigenous population at a total of 11.1 million people. This group constitutes an important segment of our society due to their historical and cultural richness, providing a sense of belonging and identity to the Nation and all Mexicans.

In Mexico, there are 7.4 million individuals aged three and older who speak an indigenous language, which represents 6.1% of the total population within that age range. The federal entities with the highest percentage of indigenous language speakers are Oaxaca (31.2%), Chiapas (28.2%), Yucatán (23.7%), and Guerrero (15.5%). These four entities account for 50.5% of the total indigenous language speakers in the country.

In Mexico, the illiteracy rate among the indigenous language-speaking population aged 15 and older is 20.9 percent. This contrasts significantly with the non-indigenous language-speaking population, where the illiteracy rate is 3.6 percent, representing a gap of 17.3 percentage points [5].

Regarding the indigenous population with mobile service coverage in at least one technology (2G, 3G, or 4G), more than 90% of the population in 26 of the 66 indigenous communities have access to this service, according to the Federal Institute of Telecommunications (IFT). In states such as Chiapas, Guerrero, and Oaxaca, 57% of the indigenous population has mobile service coverage in at least one technology (2G, 3G, or 4G), which represents approximately 2,188,058 people [6].

The Amuzgo population is 67,349 people, mostly concentrated in the states of Guerrero and Oaxaca. According to the Atlas of Indigenous Peoples of Mexico, it is estimated that 17% of this population has a mobile phone [7].

Therefore, the development of a mobile application for literacy education in the indigenous population, especially the Amuzgo people, is feasible due to several factors: the significant indigenous population that could benefit from an educational tool specifically designed for them; the high illiteracy rate among indigenous language speakers, highlighting an urgent need for effective educational programs; the increasing mobile service coverage in indigenous communities, enabling access to advanced educational technologies; and the substantial proportion of the Amuzgo population with access to mobile phones, ensuring a potential audience for the application.

## 2.2 M-Learning

Mobile learning, or m-Learning, is the use of mobile technologies for learning anytime and anywhere. m-Learning empowers students to be active participants in their education by enabling information search, the creation of new knowledge, increased communication and collaboration among learners, and informal learning activities outside of formal curricular settings.

M-Learning allows technology to support the teaching and learning process independently of a physical environment for resource access, facilitating easy information retrieval through wireless connections.

The use of mobile devices can support and expand resources and materials available to students. Mobile learning fundamentally relies on leveraging mobile technologies as the foundation of the learning process. Therefore, for quality education and social inclusion, mobile learning should integrate connected and self-regulated student learning, open, flexible, and ubiquitous learning, and the implementation of active learning methodologies [8].

## 2.3 Serious Games

Short serious games for education are video games designed to develop user competencies in a specific area. To achieve this, it is necessary to consider the various technologies and disciplines involved. These technologies should be developed and

utilized with a multidisciplinary and goal-oriented approach, placing the user's benefits at the center of the process. Studies have been conducted on the impact of digital games on older adults. For example, [9] suggests that digital games can improve both social interaction and cognition in the elderly. Similarly, [10] indicates that preliminary results show older adults exhibit positive changes in attitude and perspective when interacting with new technologies, demonstrating a strong interest in using digital games for serious purposes.

The lottery game intertwines with the promotion of literacy and becomes a vivid reflection of Mexico's cultural and linguistic mestizaje. The lottery has contributed, albeit in a limited yet profound manner, to language exchange and the creation of a more structured social fabric by playing its role as entertainment and distraction. When used for educational purposes, it can be considered a serious game. The lottery is adapted to teach reading and writing skills. By using images and associated words, participants can learn to recognize and write words in their native language.


## 2.3  The Educational Model for Life and Work (MEVyT)

The National Institute for Adult Education (INEA) offers education tailored to the needs and interests of individuals aged 15 and older who lack basic education, including literacy, primary, and secondary education.

The Educational Model for Life and Work (MEVyT) employs the generative word method, which is based on the use and analysis of commonly used words within the population's vocabulary. These words are selected because individuals are familiar with their meanings and can relate them to their own experiences, hence they are called generative words. Their meanings are related to health, nutrition, or recreation, and reading them evokes situations, experiences, and knowledge that trigger conversations. Following this, activities are carried out where the uses of writing and reading are similarly recognized [2].

In the generative word method, teaching starts from a contextualized real-life situation, with each word being accompanied by an image that helps learners associate the words with the drawings. It is believed that when words are presented in boxes representing their meanings, they can be learned quickly. Through generative words, individuals expand their communication possibilities. The teaching of the word involves handling and analyzing commonly used words in the population. The selected words are special because people know their meanings and can relate them to their experiences. Through generative words, individuals broaden their communication opportunities [11].


## 2.4  Related Work

The reviewed works present various approaches to adult literacy using mobile technologies and interactive methods. Research on mobile applications in reading instruction [12] and Dispurse Focus [13] emphasize the use of ICT to enhance literacy and provide basic digital skills, respectively, addressing the need for basic digital competencies in an increasingly technological world and highlighting two universal

objectives: inclusive education and support for economic growth through technology. The Amrita Learning App [14] and the augmented reality prototype [15] offer personalized and culturally appropriate approaches, using stories and advanced technology to facilitate learning; these innovative approaches aim to improve acceptance and understanding among older adults, focusing on providing educational support in an engaging and relevant format.

The study on communicative competencies [16] reveals the limitations of applying traditional methods in disadvantaged contexts and underscores the need to adequately integrate ICT. The "Yo, Sí Puedo" program [17] stands out for its practical and audiovisual approach, demonstrating high effectiveness in various vulnerable contexts. The project in Costa Rica [18] and the focus on the complexity of learning [19] highlight the importance of the social context and the adaptation of educational methods to the specific needs of the students.

## 3.1 Development of the Mobile Application

The application was designed using the Education for Life and Work Model (MEVyT) as a guide. This is the educational program of the National Institute for Adult Education (INEA), representing the best alternative for literacy, primary, and secondary education for young people and adults in Mexico. It won the UNESCO Literacy Prize in 2011. The curricular structure of this model, represented in Fig. 1, is divided into basic and diversified modules, each subdivided into three levels: initial, intermediate, and advanced. The initial level goes beyond traditional literacy; with the first module, people learn to read, write, and acquire basic skills such as writing and spelling their names, which is fundamental to their identity.

The initial and intermediate levels correspond to primary education, while the advanced level corresponds to secondary education. This application is specifically developed for the initial level of the basic module, covering topics such as "The Word," "Getting Started," and "Mathematics for Beginners".



**Fig. 1.** Curricular Scheme of the Spanish-speaking MEVyT

### 3.2 AlfaLotería: architecture mobile application.

The architecture of the AlfaLotería application is designed using a three-layer architecture, as illustrated in Fig. 2. This consists of the presentation layer, the business logic layer, and the data layer.

This architecture ensures a robust and scalable structure for the AlfaLotería mobile application, enabling effective reinforcement of literacy skills through an engaging and culturally relevant game.
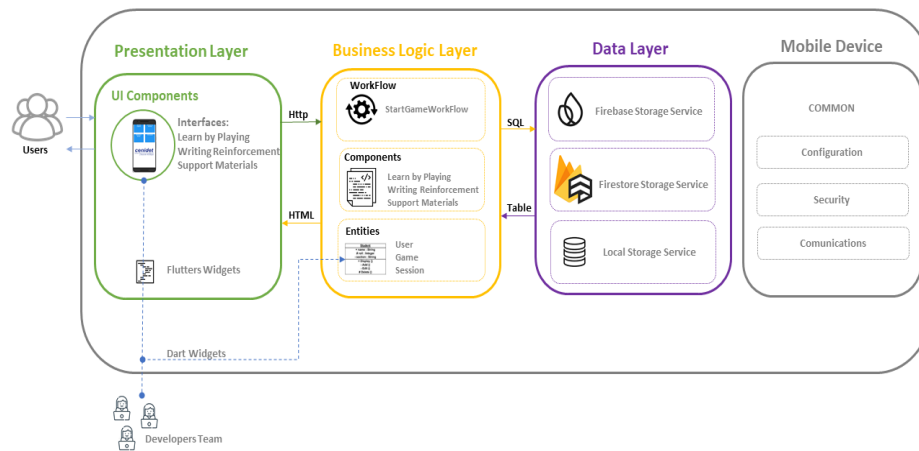


**Fig. 2.** AlfaLotería: architecture mobile application.

The presentation layer uses Flutter to develop the application's frontend, which includes three different user interface components: the interface for educational games in both Mexican Spanish and the Amuzgo indigenous language, the interface for writing practice activities, and the interface for accessing additional resources and materials.

The business logic layer defines the components, workflow, and entities, managing the application's internal logic, data processing, and the interaction between the presentation layer and the data layer. It determines how the educational lottery game functions in both Spanish and Amuzgo, and it establishes the logic for writing exercises, answer verification, and the organization of educational materials. These entities work together to manage game data and logic in a structured and modular way.

The data layer handles the interaction with multimedia files stored both locally and, in the cloud, using Firebase services to manage file storage in Firebase Storage and providing access to the Firestore real-time database. This layer enables the efficient retrieval of images and sounds for the AlfaLotería application, ensuring effective execution of the lottery games chosen by users.

### 3.3 Implementation of the AlfaLotería Mobile Application

AlfaLotería is a mobile application developed using Flutter, an open-source UI toolkit created by Google, and Dart, a programming language optimized for client-side applications also developed by Google. This technology choice ensures efficient performance on both Android and iOS devices. Flutter facilitates the creation of attractive and highly interactive user interfaces, while Dart provides fast performance and a smooth development experience. To manage and serve the images and sounds of the lottery cards, Firestore was integrated, offering an efficient solution for handling multimedia databases.

The application incorporates serious games, initially featuring an educational lottery game in both Mexican Spanish and the Amuzgo indigenous language. The design prioritizes intuitiveness, accessibility, and ease of use, with initial instructions provided via audio.

A set of images and sounds based on generator words was created to form the lottery cards, which are displayed on the mobile screen in a 16-image grid. The set of cards appears randomly at the top of the screen, with each card's image or word being called out. A sample of the deck of cards designed for this purpose is shown in Fig. 3 and 4. Players can mark the corresponding image or word on their grid as it is called.



**Fig. 3.** Sample of the deck of cards in the Amuzgo indigenous language.



**Fig. 4.** Sample of the deck of cards in Mexican Spanish.

Each word's sound, in both Spanish and Amuzgo, was recorded clearly and slowly to avoid background noise and ensure high audio quality.

The main screen of the app presents the initial menu, as shown in Fig. 5, integrating three modules: Learn by Playing, Writing Reinforcement, Supporting Material, and Information.

Learn by Playing: This module offers access to the educational lottery game, available in both Mexican Spanish and the Amuzgo indigenous language. It is designed to engage users in a playful learning experience that enhances their literacy skills.

Writing Reinforcement: This section focuses on practical writing exercises. It provides users with interactive activities aimed at improving their writing skills through tailored exercises and feedback.

Supporting Material and Information: This module provides additional resources and materials to support the learning process. Users can access supplementary content such as guides, tutorials, and other educational aids.

Information: This section offers general information about the application, including instructions, updates, and contact details for support.
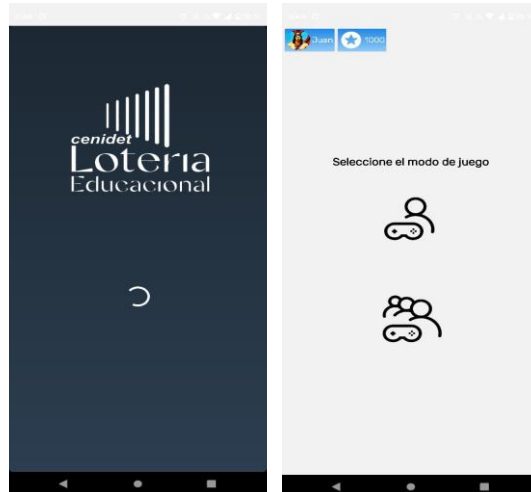
In Fig. 6, the initial screens of the educational lottery game are shown. Users can choose between individual or multiplayer game modes, allowing them to engage in the game either solo or with others.

The menu is designed to be user-friendly, ensuring that all features are easily accessible and that users can navigate through the application seamlessly.

Fig. 6 displays the initial screens of the educational lottery game, where users can select the game mode, either individual or multiplayer. The initial menu of the AlfaLotería application is designed to provide users with a straightforward and intuitive navigation experience.



**Fig. 5.** Main menu of the AlfaLotería Application.

**Fig. 6.** Start Screens of the Educational Lottery Game: AlfaLotería.

In single-player mode, the screen shown in Fig. 7 is displayed, featuring the educational lottery game board in Spanish. The game cards will appear randomly at the top of the mobile screen, and the player must mark the corresponding card on their board.

In multiplayer mode, up to four players can be selected, a limitation due in part to the limited screen space on mobile devices. Players can choose between Mexican Spanish or the Amuzgo indigenous language, as depicted in Fig. 8. Additionally, users have the option to adjust the time intervals between card appearances based on their reading pace.
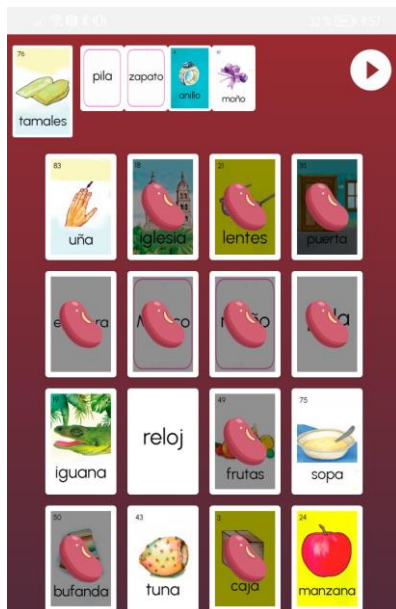


**Fig. 7.** Educational Lottery Game Board in Mexican Spanish for Single Player.
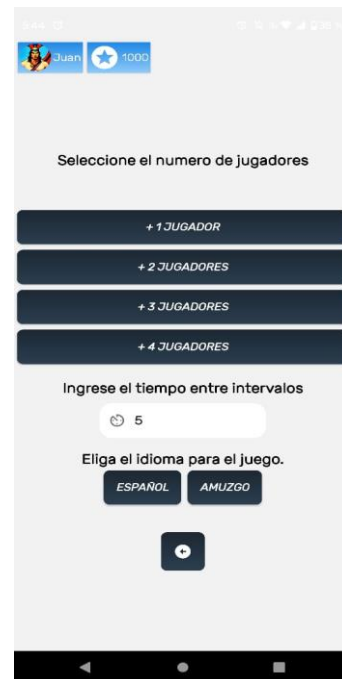
**Fig. 8.** Player Selection Screen for the Educational Lottery Game.

While playing, users must mark the card on their board that matches the one displayed and called out at the top of the screen. As the game progresses, users can view the progress of other participants at the bottom of the screen as depicted in Fig, 9 and 10. At the end, if any player is declared the winner, a notification will appear on the screen indicating the winning user. As can be seen, the images of the cards and the board are displayed in both Spanish and Amuzgo. Similarly, the cards are called out in both languages.

**Fig. 9.** Multiplayer Game Board Screen in Mexican Spanish.



**Fig. 10.** Multiplayer Game Board Screen in Amuzgo.

The application includes a writing reinforcement module and an information module. Fig.11 illustrates the canvas where users have the opportunity to write and practice the learned words, thus contributing to the enhancement of writing skills in young and older adults. Fig. 12 presents the information provided by INEA, aimed primarily at users with an advanced reading level.
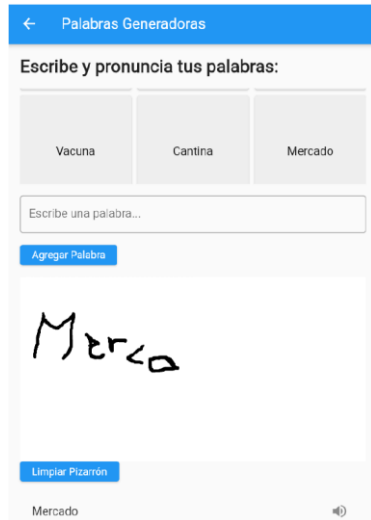
**Fig. 11.** Writing reinforcement module
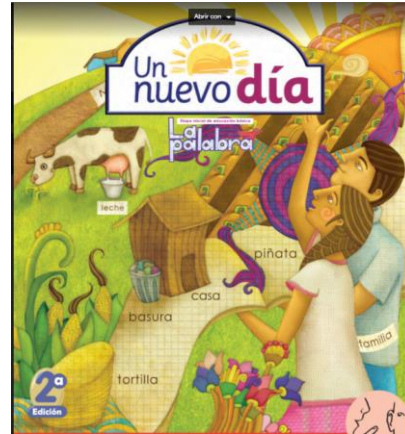


**Fig. 12.** Educational Resource in the Support Material Module

## 5  Conclusions and Future Work

### 5.1 Conclusions

The development of the AlfaLotería mobile application, aimed at reinforcing literacy among illiterate individuals in the Morelos region of Mexico, presents an innovative and promising approach to addressing a significant challenge in adult education. It is not only feasible but also stands as an essential tool for the social inclusion of indigenous populations in Mexico. With its design based on modern technologies and serious games, the application provides an accessible and potentially effective tool for improving reading and writing skills among groups with educational gap.

The design principles and functionalities implemented are based on proven educational and technological methodologies. However, the next crucial step is to conduct empirical studies and pilot tests with real users to assess its effectiveness and efficiency. These tests will enable the collection of valuable data, allow for adjustments based on user needs, and validate the educational impact of the application. Evaluating the benefits and advantages of integrating serious games into educational strategies will be essential for optimizing its use and maximizing its benefits.

## 5.2 Future Work

Expansion of Language Support: It is proposed to expand the educational lottery game modules to include various indigenous languages of Mexico. This will enable the application to serve a broader and more diverse audience, strengthening its ability to address language barriers in education.

Development of Automatic Correction Tools: It is suggested to extend the literacy reinforcement module by incorporating algorithms for automatic text review and correction. This functionality could provide immediate feedback to users, enhancing the accuracy and effectiveness of the learning process.

Long-Term Impact Studies: Conduct longitudinal studies to evaluate the long-term impact of the application on literacy improvement and social inclusion within target communities. These studies will provide a comprehensive view of the application's sustained effectiveness and guide future enhancements.

Optimization and Accessibility: Continue optimizing the application to ensure compatibility with a wider range of devices and improve its accessibility for users with varying levels of digital literacy.

These steps will not only enhance the functionality and reach of the application but also solidify its role as a key tool in promoting inclusive education and reducing educational gap in Mexico.

## References

1. Analfabetismo. Cuéntame de México, https://cuentame.inegi.org.mx/poblacion/analfabeta.aspx?tema=P.
2. Cursos y Materiales del MEVyT. http://www.cursosinea.conevyt.org.mx/index.php.
3. Díaz, F. J., Queiruga, C. A. & Fava, L. A. Juegos serios y educación. in (2015).
4. Picca, D., Jaccard, D. & Eberlé, G. Natural Language Processing in Serious Games: A state of the art. IJSG 2, (2015).
5. Instituto Nacional de Estadística y Geografía (INEGI). Comunicado de Prensa Núm. 430/22, https://www.inegi.org.mx/contenidos/saladeprensa/aproposito/2022/EAP_PueblosInd22.pdf
6. Encuesta Nacional sobre Disponibilidad y Uso de Tecnologías de la Información en los Hogares (ENDUTIH) 2020. https://www.inegi.org.mx/programas/dutih/2020/ (2022).
7. Atlas de los Pueblos Indígenas de México. Atlas de los Pueblos Indígenas de México. INPI https://atlas.inpi.gob.mx/.
8. Pérez, A. G. & Díaz, M. J. S. Aspectos pedagógicos, tecnológicos y de interacción social del aprendizaje móvil: Revisión Sistemática de Literatura. Educatio Siglo XXI 39, 257–280 (2021).
9. Lee, S., Shi, C.-K. & Doh, Y. Y. Toward a game literacy program for adults in their 50s and older: changing perceptions through game experiences. Educational Gerontology 49, 619–637 (2023).
10. Kaufman, D., Sauvé, L., Renaud, L., Sixsmith, A. & Mortenson, B. Older Adults' Digital Gameplay: Patterns, Benefits, and Challenges. Simulation & Gaming 47, 465–489 (2016).
11. Larentes Da Silva, A. Paulo Freire, el INEA y la educación de jóvenes y adultos en México. RIES 173–188 (2018) doi:10.22201/iisue.20072872e.2018.24.272.
12. Jiménez-García, M. & Martínez-Ortega, Ma. D. L. Á. El Uso de una Aplicación Móvil en la Enseñanza de la Lectura. Inf. tecnol. 28, 151–160 (2017).

13. FOCUS - Stiftelsen Dispurse. https://dispurse.org/vart-arbete/dispurse-litteracitetsutbildning/focus/.
14. "Amrita Learning App" - A Mobile Application Designed to Tackle Low-Literacy - Amrita Vishwa Vidyapeetham. https://www.amrita.edu/news/amrita-learning-app-a-mobile-application-designed-to-tackle-low-literacy/ (2019).
15. Rojas Arias, F. A. & Pertuz Egea, J. D. Prototipo de Realidad Aumentada para el Proceso de Alfabetización en la Población de Adultos Mayores. (2018).
16. Coronel Cabanillas, A. & Rodelo Pérez, J. Alfabetización de Adultos: Claroscuros de Mujeres Alfabetizadas En Un Contexto Rural Adverso. http://www.cuadernosartesanos.org/2020/cac170.pdf (2020) doi:10.4185/cac170.
17. Canavire, Lic. V. B. Educación para adultos en América Latina: programa de alfabetización "Yo, sí puedo". cpue 128–143 (2011) doi:10.25009/cpue.v0i13.40.
18. Palma-Villegas, C. M. Alfabetización de jóvenes y adultos mayores en la comunidad de Bajo Tejares, San Juan, San Ramón: una oportunidad para continuar aprendiendo. ECI 0, (2013).
19. Flórez Romero, R., Arias Velandia, N. & Guzmán, R. J. El aprendizaje en la escuela: el lugar de la lectura y la escritura. Educación y Educadores 9, 117–133 (2006).