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PAPER

Mobile Intervention with Neural Networks for the Mental Health of Older Adults

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ABSTRACT

This study presents an applied study with a pure experimental design to evaluate the effectiveness of the application, with the objective of reducing the levels of loneliness and depression through the use of a mobile application based on neural networks in older adults in the city of Trujillo. In addition, software development technologies such as Flutter, Flask, and ExpressJs were used. The results indicate a significant decrease in the levels of emotional and social loneliness and depression in the experimental group (EG) compared to the control group (CG). Reductions of 15.03% in the level of emotional loneliness (LEL), 24.74% in the level of social loneliness, and a remarkable 44.12% in the level of depression were observed in the EG. In addition, a significant increase of 6% in the mood index was evidenced in the EG. This led to the conclusion that after mobile implementation based on neural networks, the alternative hypothesis is supported, statistically demonstrating the effectiveness of the application in reducing loneliness and depression in older adults. These findings suggest a positive impact on the emotional well-being of this population, underscoring the utility of technology in addressing mental health issues in this demographic.

KEYWORDS

information technology, artificial intelligence, computer application, data analysis, mental health

1 INTRODUCTION

As technology advances and becomes an indispensable part of our lives, it is important to recognize that while young people often benefit greatly from it, older adults face a series of significant challenges. These obstacles include limited access to information systems, fear of making mistakes or damaging devices, constant updates and changes, and physical difficulties [1].

On the other hand, it has been observed that information and communication technologies played a crucial role during the pandemic. Countries such as Chile have

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used these technologies to provide remote care to older adults, thus addressing the geographical and labor gap that hinders access to healthcare [2].

Furthermore, falls represent one of the main causes of hospitalization among older adults in urban areas. To address this issue, assisted living communities have emerged, using technology to improve the quality of life of older adults. In recent decades, the rates of fatal falls among people over 85 years old have increased by a concerning 41%. However, in assisted living communities, these figures range between 1.07% and 3.5% of falls per resident per year.

The fear of falling not only affects the physical health of older adults but can also lead to depression, social isolation, and a general deterioration in their well-being. To address this issue, fall detection technologies using artificial intelligence have been implemented. These technologies have proven to be effective, with a success rate of 20–30% in fall prevention. By using continuous learning algorithms and monitoring systems based on sensors and sound recognition, older adults at higher risk of falls, depression, or infections can be identified, allowing for timely intervention to protect these vulnerable individuals [3].

Considering the above, it is identified that in the city of Trujillo, a large number of older adults may experience feelings of isolation and social disconnection due to various factors such as loss of friends and family, mobility issues, health, retirement, and the inability to participate in everyday activities. Loneliness and depression among older adults can have serious consequences for their health, increasing the risk of developing diseases such as high blood pressure, diabetes, heart disease, and dementia, significantly decreasing their quality of life, and even leading to death.

The general objective of this study is to reduce levels of loneliness and depression through the use of a mobile application based on neural networks among older adults in Trujillo in the year 2023. To achieve this goal, the following specific objectives are proposed: decrease emotional loneliness, reduce social loneliness, mitigate depression, and improve mood. The overarching hypothesis proposed is that if older adults in Trujillo use a mobile application based on neural networks, then they will experience a decrease in levels of loneliness and depression in the year 2023.

2 BIBLIOGRAPHIC REVIEW

In the study conducted by [4], the agile methodology known as Scrum was chosen to develop a mobile application aimed at informing, motivating, and enriching the lifestyle of elderly patients with diabetes. This initiative focused on addressing common issues in the adult population, such as sedentary behavior and demographic aging, while also considering relevant economic aspects. It is also important to mention that aging brings about physical changes that are the cause of health problems and cognitive decline. Therefore, [5] dedicated itself to the development of a mobile application conceived as both an emotional and physical tool for the elderly population, providing them with resources and services aimed at maintaining their physical and emotional well-being. This application aimed to make three significant contributions to quality of life: firstly, to promote autonomy and active aging by addressing psychosocial issues such as loneliness and depression; secondly, to prioritize intuitive interfaces that would facilitate older people in making decisions about their health; and finally, to highlight the importance of adapting technologies to various cultural contexts according to the specific needs identified.

Furthermore, in the study conducted by [6], it is emphasized that mobile applications emerge as a promising tool for early detection of cognitive disorders, delivery of personalized training, and improvement of mental performance.

However, there is a marked scarcity of applications that comprehensively address cognitive training, assessment of poor memory, and cognitive monitoring in multiple facets for the adult population. In response to these deficiencies, the RODI application underwent a comprehensive analysis of usability, utility, feasibility, and effectiveness in its interaction with older adults. The results revealed that this mobile application effectively enhanced cognitive abilities in an accessible and familiar environment.

The adoption of mobile health applications could offer a solution to challenges related to aging; thus, [7] points out that mobile applications could be of great assistance in improving the quality of life for older adults with cognitive disabilities. Although the importance of using these applications in relation to cognitive impairment was recognized, there is a need for further exploration of their mediating role in quality of life. In this regard, [8] mentioned that as people age, it is common for them to experience various physical impairments such as blurred vision, hand and arm tremors, as well as a decline in mobility and posture. These conditions significantly influence how older adults use and interact with their smart devices. However, it is important to note that some older adults, due to their physical disabilities or illnesses, may feel excluded from common activities within their age group and may face additional challenges when using these devices. One of the most important findings represented a valuable contribution to the design community, as they could serve as a guide or standard for designers interested in developing assistive technology using a touchscreen interface, thus ensuring that older adults confined to their homes can access and use these devices comfortably and efficiently, improving aspects such as font size, color contrast, icon size, touchscreen button sensitivity, keyboard size, and scrolling area, among others.

3 METHODOLOGY

3.1 Research design

The study was of an applied type; [9] defined it as a pragmatic exploration of theories, seeking to apply the knowledge acquired during professional training, linking it with basic study, as it depends on the results discovered by the researcher, and aiming to solve problems of daily life or stabilize specific practical events through valid scientific theories that were previously published.

The study had an experimental design of pure experimental degree [10], considering that this type of design has four forms linked to the designs, which are random selection of individuals, casual group assignment, operating variables, and checking external agents. These aspects of the design ensure that the results and their validity are of high value with respect to the cause (see Figure 1).

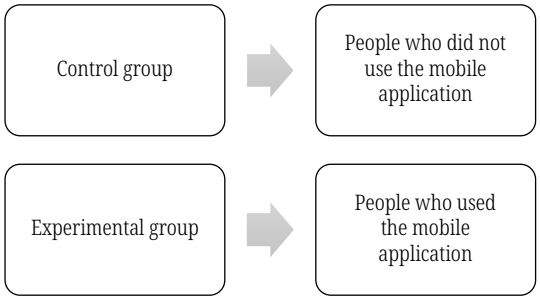

Fig. 1. Research design

3.2 Participants

The population consisted of all older adults worldwide, making it impossible to establish the number of individuals [11]. The population consists of all elements included in the study that were defined and limited to the study problem. On the other hand, [12] mentioned that the sample is the subset or part taken from the population in which the study will be conducted. Therefore, the sample taken for the study consisted of 60 older adults. Additionally, [10] emphasized that sampling is the method used to collect elements of a sample, as it consists of a set of rules, criteria, and procedures. For this reason, the inclusion criteria for older adults are only those aged over 60, and the exclusion criteria are older adults under 60 who do not have an academic degree.

3.3 Data collection instruments

[13] mentioned that data collection techniques are used to gather and measure information that will address a specific objective. Therefore, some techniques include interviews, surveys, observations, focus groups, documents or records, ethnography, and the Delphi technique. [14] pointed out that a data collection instrument primarily focuses on creating the necessary conditions for measurement. For this reason, any instrument used in data collection must be reliable and, above all, valid, as if one of these elements is not met, the instrument will be invalid, and the results it generates will not be viable. [15] and [16], using the UCLA Loneliness Scale (University of California at Los Angeles), presented the survey as a data collection technique, outlining the necessary items to measure emotional and social loneliness indicators. [17] presented its survey, mentioning the necessary items that allowed measuring the viability of the depression indicator. On the other hand, [18] presented an adaptation of the subjective well-being scale, outlining the necessary items to measure the mood index indicator. [11] also establishes that direct observation is necessary in a study as it allows observing the phenomenon under investigation, thus collecting information directly from the events performed.

3.4 Procedures and implementation

The sample of study participants was designed to consist of 60 individuals divided into groups of 30 randomly using Excel. Those with the number 1 in randomness would use the software and belong to the experimental group (EG), while those with the number 0 would not use the software and belong to the control group (CG). Subsequently, the necessary ethical permissions for the study were obtained, which involved presenting the study to the Ethics Committee of the Universidad Cesar Vallejo. The committee reviewed and approved the proposal, ensuring compliance with the ethical principles mentioned earlier. Therefore, for data collection, questionnaires and observation sheets were used. The questionnaire included GDS, UCLA, and EBS scales to assess loneliness and depression in older adults. Additionally, observation sheets provided a more detailed insight into the experiences of the study subjects, both in the CG and in the EG, using the mobile application.

3.5 Development fundamentals

Within agile methodologies for mobile application development, [19] mentions that the Mobile-D methodology is based on five essential phases for software

development, which are exploration, initiation, production, stabilization, and system testing.

Exploration. In the initial phase of the project, significant definition activities were carried out to establish the foundations for the development of the mobile application. Given the nature of the application, designed to assist older adults in various areas of their daily lives, it was clearly established that the primary target audience would be precisely these individuals. However, the importance of involving other stakeholders, such as family members, caregivers, and healthcare professionals, who also play relevant roles in the well-being and care of older adults, was recognized.

Initiation. In this crucial phase of the project, considerable effort was dedicated to configuring all the necessary elements for the development of the mobile application aimed at assisting older adults. From selecting the appropriate frameworks to creating an optimal working environment, every detail has been meticulously considered to ensure an efficient and successful development process.

The process began by establishing the necessary frameworks for development and carefully selecting tools that best suit the project's needs. Additionally, special emphasis was placed on project planning. A detailed plan was developed, covering all iterations and activities that will be carried out from the beginning to the completion of development. This plan serves as a comprehensive guide for the team, ensuring that everyone is aligned regarding the objectives and tasks to be carried out at each stage of the project.

A fundamental part of this phase has been the creation of initial prototypes for the user interfaces. These prototypes serve as a visual representation of how the final application will look and function, allowing the team and stakeholders to better visualize and understand the product in development.

Regarding the technology used, priority has been given to the adoption of current and efficient technologies to ensure the intuitiveness and effectiveness of the application. Tools such as Flutter for mobile development, Node.js for the backend, and Python for neural network processing have been selected, backed by Flask and MongoDB as the NoSQL database. This combination of technologies has been carefully chosen to provide a smooth and satisfying user experience, as seen in Figure 2.

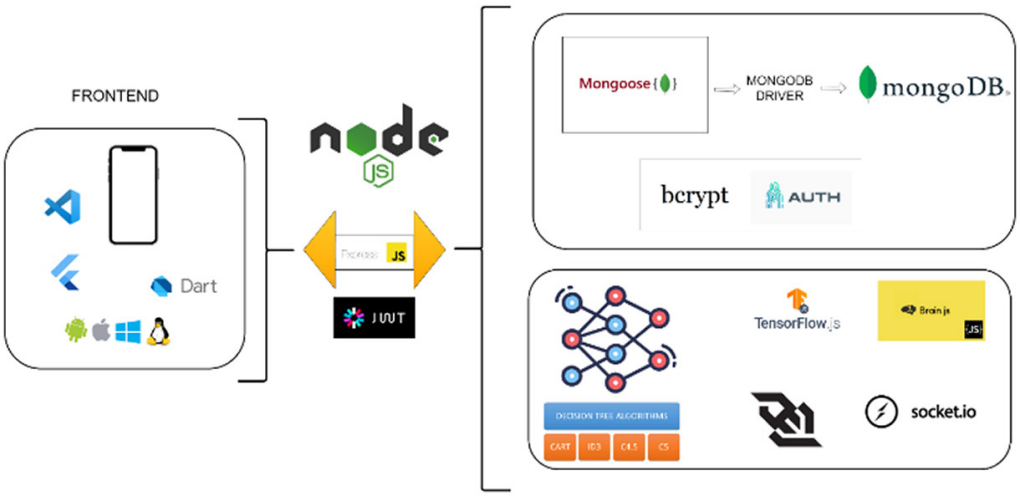

Fig. 2. Software architecture

Production. During this phase, software development has been carried out with a focus on implementing all previously identified and analyzed requirements.

Each iteration of interface and functionality development has undergone a feedback process to ensure continuous improvement and alignment with the needs of the end user.

The focus on continuous improvement has translated into an iterative and collaborative process where each version of the software has been refined based on the feedback received. This has allowed not only the correction of possible flaws or deficiencies but also the optimization of the user experience and the addition of new valuable functionalities.

Furthermore, emphasis has been placed on improving the scalability of the software by adopting solid development principles and practices. A clean architecture, based on SOLID principles, has been implemented to promote modularity, code reuse, and ease of maintenance. Additionally, the adapter pattern has been employed to ensure system interoperability and flexibility, facilitating its adaptation to future changes and requirements.

It is important to highlight that the software interfaces have been well-received by end users, who have appreciated their user-friendliness and ease of use. This reflects the success of user-centered design and the effectiveness of the iterative development process, which has allowed for adjusting and optimizing the interfaces based on the real preferences and needs of users, as seen in Figure 3.

Fig. 3. Main home screen

Each section within the application allowed the user to interact with more people in their environment, aiming to promote active aging within this population (see Figures 4 and 5).

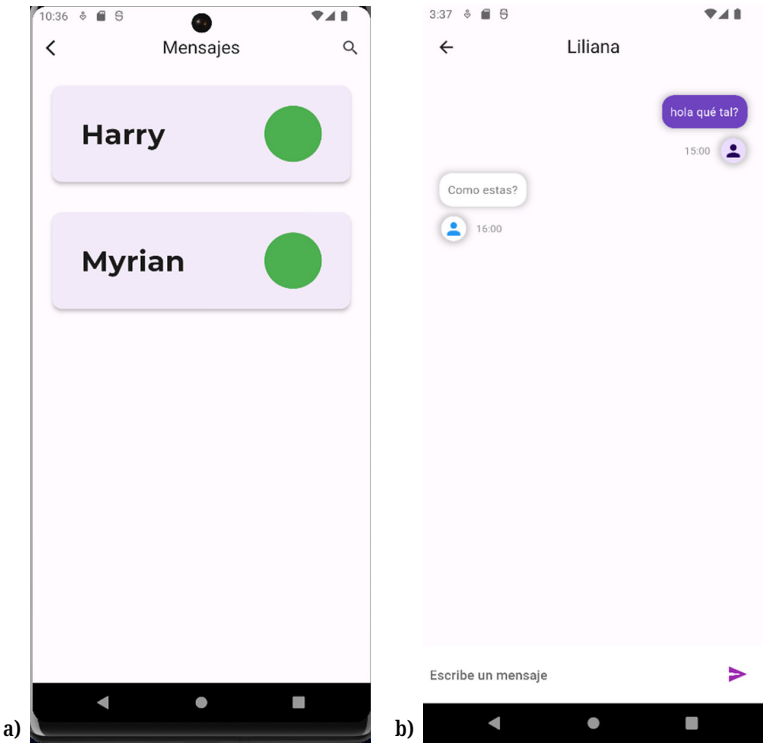

Fig. 4. a) Friends' interfaces; b) Conversation's interface

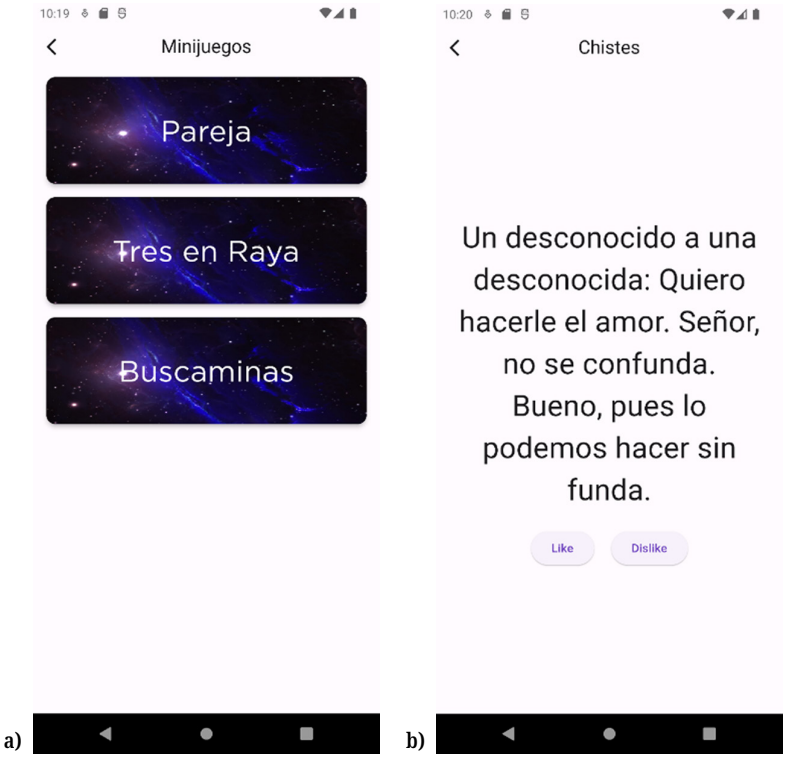

Fig. 5. a) Minigames interface; b) Jokes interface

On the other hand, to assess levels of loneliness and depression in older adults, a strategy combining technology and traditional data collection methods was implemented. The survey designed for this purpose was integrated into the mobile

application, allowing users to enter their responses easily and accessibly. Once the survey was completed, the responses were processed by artificial neural networks, which classified them to determine the degree of depression and loneliness experienced by each older adult, as shown in Figure 6.

However, for those participants assigned to the CG, a different approach was chosen. In this case, observation cards and traditional surveys were used, which were administered directly and in person on a weekly basis over a two-month period. This approach allowed for evaluating the participants' experience without the influence of the mobile application, thus providing a relevant point of comparison with the experimental group.

This mixed data collection strategy ensured a comprehensive and rigorous evaluation of levels of loneliness and depression in participating older adults. By combining traditional methods with cutting-edge technology, a complete and accurate understanding of the situation was achieved, enabling solid conclusions to be drawn about the impact of the mobile application on the mental and emotional health of older adults.

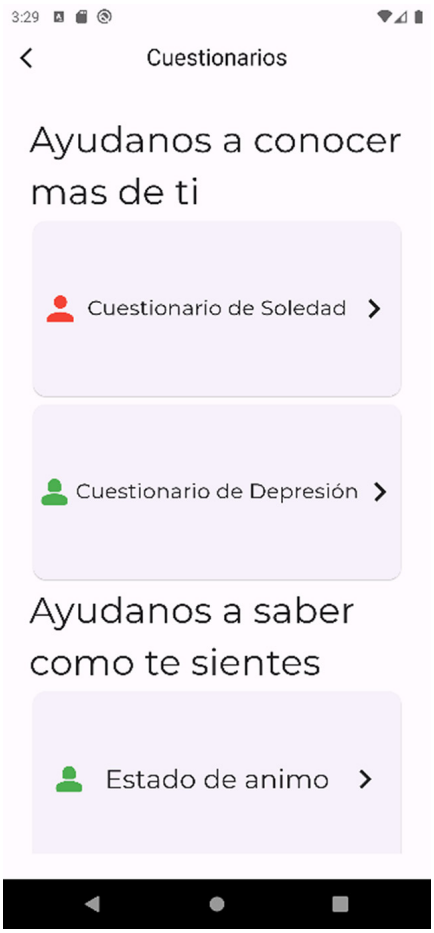

Fig. 6. Questionnaires for DGS, UCLA y EBS

System stabilization and testing. During these final stages of the project, comprehensive integration of all system components was carried out to ensure comprehensive functionality and cohesion among the different elements. To achieve this goal, unit and functional testing were implemented in all areas of the software, with a particular focus on validating forms and evaluating the response times of the mobile application.

Unit tests focused on verifying the correct operation of each code unit individually, ensuring that they fulfilled their specific functionalities accurately and reliably. On the other hand, functional tests focused on evaluating the system's behavior as a whole, verifying that all functions interacted properly and that project requirements were satisfactorily met.

One of the critical aspects evaluated during these tests was the efficiency of the forms, both in terms of their technical operation and usability for end users. Comprehensive tests were conducted to ensure that the forms were intuitive, accessible, and capable of effectively capturing the necessary information.

Furthermore, specific tests were conducted to evaluate the response times of the mobile application, ensuring that it was agile and responsive to user interactions. Loading, processing, and response times were measured and analyzed under various conditions to identify potential bottlenecks and optimize the overall system performance.

Each error identified during testing was addressed diligently and systematically, with corrections implemented in subsequent versions of the software. This iterative and continuous improvement-oriented approach ensured that the final product was robust, reliable, and capable of meeting the expectations and needs of end users.

4 RESULTS

4.1 Results and discussion of the use of a mobile application to reduce the level of emotional loneliness in the elderly

Table 1 describes the descriptive statistics for the control group (LEL-CG) and the experimental group (LEL-EG) in terms of levels of emotional loneliness in older people, suggesting that the evaluated mobile application has a positive impact on reducing emotional loneliness. The EG shows a significantly higher proportion of individuals with mild levels of emotional loneliness (76.7%) compared to the CG (56.7%). In addition, the EG has no cases of severe emotional loneliness, while the CG has 3.3%. These findings indicate a potential benefit of the mobile application in mitigating emotional loneliness in the elderly.

Table 1. Descriptive statistics for the control and experimental groups

	Slight	Moderate	Severe
LEL-CG	56.7%	40.0%	3.3%
LEL-EG	76.7%	23%	0

The amount of data for the indicator level of emotional loneliness (LEL) in the posttest of the CG and EG is less than 50. Therefore, the Shapiro-Wilk test was applied to evaluate the normality of the data. For the CG, the value of p was 0.001, indicating that the data do not follow a normal distribution, because it is less than 0.05 (∞). Similarly, the EG presented a value of p equal to 0.004, which also suggests that the data are not normally distributed (refer to Table 2).

Table 2. Shapiro-Wilk normality test for the control and experimental groups

Group	Statistic	p
Control	0.862	0.001
Experimental	0.886	0.004

It is important to highlight that the data on the LEL indicator in the post-test for both CG and EG do not show a normal distribution. As a consequence, the non-parametric Mann-Whitney U test was applied to examine the differences between independent groups.

The result of this test revealed a value of *p* equal to 0.005, which is less than 0.05. Therefore, sufficient statistical evidence is available to reject the null hypothesis (*H*0), which holds that the use of a mobile application increases the LEL. Instead, the alternative hypothesis (*Ha*), which postulates that the use of a mobile app decreases the levels of emotional loneliness in older adults, is accepted; see Table 3.

Table 3. Mann-Whitney U statistic for the level of emotional loneliness (LEL) indicator

Indicator	Statistic	*p*
LEL	276	0.005
Nota. H_a μ Control Group > μ Experimental Group		

4.2 Results and discussion of the use of a mobile application to reduce the level of social loneliness in the elderly

Table 4 reveals a significant difference in the LSL-CG and the LSL-EG in older people. The EG shows a marked reduction in emotional loneliness, with 93.0% experiencing mild levels, compared to 60% in the CG. In addition, only 6.7% of the EG have moderate emotional loneliness, compared to 40% of the CG. These findings show a positive impact of using a mobile application in the experimental group.

Table 4. Descriptive statistics for the control and experimental groups

	Slight	Moderate
LSL-CG	60%	40.0%
LSL-EG	93.0%	6.7%

Since the amount of data for the level of social loneliness indicator in the posttest for the CG and EG is less than 50, the Shapiro-Wilk test was applied to assess the normality of the data. For the CG, the value of *p* was 0.04, indicating that the data do not follow a normal distribution since it is less than 0.05 (∞). In contrast, the EG presented a value of *p* equal to 0.384, suggesting that the data are normally distributed; see Table 5.

Table 5. Shapiro-Wilk normality test for the control and experimental groups

Group	Statistic	*p*
Control	0.926	0.04
Experimental	0.964	0.384

It is relevant to note that the data for the Level of Social Loneliness indicator in the posttest for the CG do not follow a normal distribution, while for the EG they do. Therefore, the nonparametric Mann-Whitney U statistical test was applied to examine differences between independent groups.

The result of this test revealed a value of *p* equal to 0.013, which is less than 0.05. Thus, sufficient statistical evidence is available to reject the null hypothesis (*H*0), which holds that the use of a mobile application increases the level of social loneliness. In contrast, the alternative hypothesis (*Ha*), which postulates that the use of a mobile application decreases the levels of social loneliness in older adults, is accepted; see Table 6.

Table 6. Mann-Whitney U for the Level of Social Loneliness (LSL) indicator

Indicator	Statistic	*p*
LSL	299	0.013
Nota. H_a μ Control Group > μ Experimental Group		

4.3 Results and discussion of the use of a mobile application to reduce the level of depression in the elderly

Table 7 shows the descriptive statistics for the control group (DL-CG) and the experimental group (DL-EG) in terms of levels of depression in the elderly, indicating a notable difference between the two groups. In the EG, 90% of the participants are in the category of normal depression, while only 33.3% of the CG present this condition. In addition, the CG has a higher prevalence of mild depression (53.3%) compared to 10.0% in the EG. There are no cases of moderate depression in the EG, while 13.3% of the CG experience it. These findings show that the use of a mobile application in the EG is associated with a significant reduction in the levels of depression in the elderly.

Table 7. Descriptive statistics for the control and experimental groups

	Normal	Slight	Moderate
DL-CG	33.3%	53.3%	13.3%
DL-EG	90%	10.0%	0

Since the amount of data for the depression level indicator in the posttest of the CG and EG is less than 50, the Shapiro-Wilk test was applied to evaluate the normality of the data. For the CG, the value of *p* was 0.189, indicating that the data are normally distribute, because it is greater than 0.05 (∞). In the case of EG, the value of *p* was 0.061, suggesting that the data are also normally distributed (refer to Table 8).

Table 8. Shapiro-Wilk normality test for the control and experimental groups

Group	Statistic	*p*
Control	0.952	0.189
Experimental	0.934	0.061

It is important to note that the data for the level of depression indicator in the post-test for both CG and EG show a normal distribution. Therefore, the parametric statistical T-student test was applied to examine differences between independent groups.

The result of this test revealed a value of *p* equal to 0.001, which is less than 0.05. Thus, sufficient statistical evidence is available to reject the null hypothesis (*H*0),

which holds that the use of a mobile application increases the level of depression. In contrast, the alternative hypothesis (*Ha*), which postulates that the use of a mobile application decreases the level of depression in older adults, is accepted (refer to Table 9).

Table 9. T-student T-statistic for the Depression Level indicator (DL)

Indicator	Statistic	Gl	*p*
DL	4.4	58	0.001
Nota. H_a μ Control Group > μ Experimental Group			

4.4 Results and discussion of the use of a mobile application to increase mood index in elderly people

Table 10 presents descriptive statistics for the control group (IMI-CG) and the experimental group (IMI-EG) in terms of mood index in the elderly, showing notable differences between the two groups. In the EG, 66.7% of the participants exhibit their mood at a medium level, while 90% of the CG is in this category. In addition, 33.3% of the EG exhibits high levels of mood, compared to 6.7% of the CG. These results suggest that the use of a mobile application in the EG may be associated with improvements in mood.

Table 10. Descriptive statistics for the control and experimental groups

	Under	Medium	High
IMI-CG	3.3%	90%	6.7%
IMI-EG	0	66.7%	33.3%

Since the amount of data in the mood index indicator of the post-test of the CG and the EG is less than 50, the Shapiro-Wilk test was taken into account, which for the CG gave a value *p* equal to 0.526, which is greater than 0.05(∞), it is concluded that the data are normally distributed. Likewise, the EG, gave as a value *p* equal to 0.337, which is greater than 0.05 (∞), it is determined that the data are normally distributed (refer to Table 11).

Table 11. Shapiro-Wilk normality test for the control and experimental groups

Group	Statistic	*p*
Control	0.97	0.526
Experimental	0.961	0.337

It is necessary to conclude that the data of the mood index indicator of the posttest of the CG and EG, is normally distributed, therefore, the parametric statistical test T-student was applied to test the differences between independent groups.

Consequently, the value of *p* is 0.001 and this is less than 0.05, therefore, the results provide sufficient statistical evidence to reject the null hypothesis, which states that the use of a mobile application decreases the mood index (*H*0) and accept the alternate hypothesis is which states that the use of a mobile application increases the mood index in older adults to (*Ha*) (refer to Table 12).

Table 12. T-student T-statistic for the Mood Index Indicator (IMI)

Indicator	Statistic	Gl	*p*
IMI	–3.13	58	0.001
Nota. H_a μ Control Group < μ Experimental Group			

5 DISCUSSION

With respect to the first indicator, LEL, a total of 2.13 points were obtained from the average data obtained from the CG, and a total of 1.81 points were obtained from the average data obtained from the EG, which showed a decrease of 0.32 points. In addition, with the calculation of the formula, a 100% LEL was obtained in the CG and an 84.97% LEL in the EG, thus, there was a decrease of 15.03% in the LEL in the group that used the mobile application. These results can be compared with those of [20], who in 2023 managed to decrease emotional loneliness by 28.86%. [21] refers to emotional loneliness as the feeling of isolation or disconnection on an emotional level, regardless of the physical presence in a social environment. This state is manifested when a person experiences the absence of meaningful or intimate relationships, or when existing connections lack emotional depth and mutual understanding.

With respect to the second indicator, level of social loneliness, a total of 1.64 points were obtained from the average data obtained from the CG and a total of 1.30 points were obtained from the average data obtained from the EG, which showed a decrease of 0.34 points. In addition, with the calculation of the formula, a 100% level of social loneliness was obtained in the CG and a 79.26% level of social loneliness in the EG, thus there was a decrease of 20.74% in the level of social loneliness in the group that used the mobile application. These results can be compared with [22] in 2023, where his system managed to verify the level of loneliness of the elderly by 75%. [23] loneliness is based on the perception of a gap between what a person desires within his or her interpersonal relationships.

With respect to the third indicator, level of depression, a total of 0.34 points was obtained from the average of the data obtained from the CG, and a total of 0.19 points was obtained from the average of the data obtained from the EG, which showed a decrease of 0.15 points. Furthermore, with the calculation of the formula, a 100% level of depression was obtained in the CG and a 55.88% level of depression in the EG, thus, there was a decrease of 44.12% in the level of depression in the group that used the mobile application. These results can be compared with [24] in the year 2021, where the normal level of depression was 78.50% and 21.50% of people presented symptoms of depression [25]. Depression was defined as a feeling of sadness that arises at the moment of predisposing and precipitating events in a person's life.

With respect to the fourth indicator, mood index, a total of 3.85 points were obtained from the average data obtained from the CG, and a total of 4.21 points were obtained from the average data obtained from the EG, which showed an increase of 0.36 points. In addition, with the calculation of the formula, 64.16% of the mood index was obtained in the CG and 70.16% of the mood index in the EG, thus there was an increase of 6% in the mood index in the group that used the mobile application. These results can be compared with [26] in the year 2022, where the degree of motivation and mood of older adults was 62.5% [27]. Mood refers to the general or predominant emotional disposition of a person at a given time. It is the way a person

feels internally and can influence his or her perception of the world, thoughts, and behavior. Mood can be influenced by a variety of factors, including external events, personal experiences, and biological and chemical factors, among others.

6 CONCLUSIONS

A significant reduction in levels of emotional, social, and depressive loneliness was observed, along with a notable increase in mood index, following the implementation of a neural network-based mobile application. In the EG, a decrease of 15.03% in emotional loneliness, 20.74% in social loneliness, and 44.12% in depression was found, alongside a 6% increase in mood index compared to the CG. Statistical analyses revealed *p*-values of 0.005, 0.013, and 0.001, respectively, providing sufficient evidence to accept the alternative hypotheses in all cases.

In addition to the quantitative results obtained, it is important to highlight the qualitative impact that this intervention could have on the lives of older adults. The possibility of accessing a mobile application designed specifically to meet their emotional and social needs could significantly improve their quality of life, providing them with a greater sense of connection to their environment and overall well-being.

However, it is important to recognize that this study has limitations and areas for future study. For example, it would be beneficial to conduct long-term follow-up to assess the durability of the observed positive effects and explore how the mobile intervention could be more effectively integrated into existing healthcare and social support systems for older adults.

Furthermore, ongoing adaptation and customization of the mobile application could be considered to address the specific needs of different subgroups of older adults, taking into account factors such as education level, health status, and individual preferences.

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