Revista Latinoamericana de Psicología

http://revistalatinoamericanadepsicologia.konradlorenz.edu.co/

ORIGINAL

Efficacy of a cognitive stimulation programme using technology on older adults' self-esteem, self-efficacy, and autonomy

Daniela Cebreros-Valenzuela[a], Sonia Verónica Mortis-Lozoya[b]*, Elizabeth Del Hierro-Parra[b], Jaime Muñoz-Arteaga[c]

[a] *Universidad de Sonora, México*
[b] *Instituto Tecnológico de Sonora, México*
[c] *Universidad Autónoma de Aguascalientes, México*

Received 31 January 2019; accepted 20 January 2020

KEYWORDS
Cognitive stimulation,
self-esteem,
self-efficacy,
autonomy,
older adults

Abstract The objective of this study was to verify the effectiveness of a cognitive stimulation programme using technology: PESCO MX in comparison to a traditional programme that used non-technological recreational activities to improve levels of self-esteem, self-efficacy, and autonomy in older adults. In this quasi-experimental investigation, 63 participants were divided into three groups of older adults attending three different senior day-care centres. One group was treated with technology, another without technology, and the third group received no programme. All three groups were measured pre-test and post-test. The results show a significant difference in the three variables between the technology group and the control group; however, there is no difference in the pre-test results. Another finding shows significant differences between the three groups for the self-efficacy variable; differences were also found between the group that did not use technology and the control group. There was also a difference between the group without technology and the group that used the PESCO MX (the latter being higher). In general, a cognitive stimulation programme using technology benefitted self-esteem, self-efficacy, and autonomy, which indicates that this programme can contribute to improving the quality of life during old age. Finally, the theoretical and practical implications of this study were analysed.

Eficacia de un programa de estimulación cognitiva con tecnología en la autoestima, autoeficacia y autonomía de adultos mayores

PALABRAS CLAVE
Estimulación cognitiva,
autoestima,
autoeficacia,
autonomía,
adultos mayores

Resumen El objetivo de este estudio fue comprobar la eficacia de un programa de estimulación cognitiva con tecnología: PESCO MX, frente a un programa tradicional con actividades lúdicas sin tecnología, para mejorar los niveles de autoestima, autoeficacia y autonomía en adultos mayores. En esta investigación cuasi-experimental 63 participantes fueron divididos en tres grupos de adultos mayores de tres diferentes estancias, a uno de ellos se le aplicó el programa con tecnología, a otro sin tecnología y el tercer grupo no se le suministró ningún programa; a los tres se les to-

* Autor para correspondencia.
e-mail: smortis@itson.edu.mx

https://doi.org/10.14349/rlp.2020.v52.5

maron dos medidas pretest y postest. Los resultados muestran una diferencia significativa en las tres variables entre el grupo con tecnología y el grupo control, en el pretest no existe diferencia alguna. Otro hallazgo muestra diferencias significativas, para la variable de autoeficacia, entre los tres grupos; es decir, también se encontraron diferencias entre el grupo sin tecnología y el grupo control, además de entre el grupo sin tecnología y el grupo que utilizó el PESCO MX, siendo más alto este último. En general, la autoestima, autoeficacia y autonomía se vieron más beneficiadas a través de un programa de estimulación cognitiva con tecnología, lo que indica que este programa puede contribuir a mejorar la calidad de vida durante la vejez. Finalmente se analizaron las implicaciones teóricas y prácticas de este estudio.

There has recently been an increase in publications on aging and different approaches that take into consideration the biological, psychological, and social changes that older adults face. In cognitive stimulation studies that use technology, those oriented to diminishing cognitive impairment stand out, such as the ones undertaken by Fernández-Calvo, Rodríguez-Pérez, Contador, Rubio-Santorum, and Ramos (2011) and Gaitán et al. (2013).

Research has been undertaken on the effectiveness of cognitive stimulation programmes that reflect improvements in the intellectual areas they stimulate, such as attention, memory, reasoning, executive functions, intelligence, language, and concentration. For instance, Finn and McDonald's (2011) work demonstrates that older adults with mild cognitive impairment can improve their performance significantly when given repeated practice on computerized cognitive exercises. In addition to this achievement, it has been proved that learning ICT skills enhance the development of cognitive processes such as attention, memory, intelligence, and language with appropriate modifications according to population needs.

In this context, projects such as those carried out by Rute-Pérez, Rodríguez, Rodríguez, Hurtado, and Caracuel (2016) and Szymanowski (2016) preconize several strategies to solve this is with computer-based cognitive stimulation and training programmes.

Alternatively, there have been studies in which intellectual skills were improved through stimulation without the use of technology. For example, Motta (2009) reviews several cognitive stimulation and training programmes that have shown effectiveness in delaying the deterioration of daily activities in older adults; such as Cadavid, Villada, & Klimenko's (2011) intervention, which attempted to improve the senior population's attention and memory for them to achieve better cognitive performance.

In addition to these types of interventions, cognitive stimulation goes together with communication skills, which, according to Rodríguez and Basto (2012), are necessary to promote thinking as language and thought are reciprocal skills.

Furthermore, Velilla, Soto, and Pineda (2010) propose administering a programme of cognitive multifactor stimulation (PCMS) to establish the changes in Working Memory (WM) in an elderly female group with amnesic type MCI (A-MCI).

However, there are important challenges associated with face-to-face cognitive stimulation and training programmes, such as the costs of providing these services to a growing population, so it is necessary to identify fast, effective, and low-cost solutions to delay cognitive decline associated with aging. "Normal or successful aging" are becoming more and more familiar compared to "pathological aging" because the increase in the population of older adults in the country has increased some institutions' interest in creating "mental health" programmes and studying the characteristics that this age group present.

In this sense, Motta (2009) and Barrantes (2010) share an idea similar to the previous one: cognitive stimulation must encompass other important areas such as biological, perceived self-efficacy in their daily activities, communication skills, and social relationships. Therefore, cognitive stimulation must achieve the following objectives: maintain intellectual skills in order to preserve autonomy and functionality, create an environment with enough stimuli that facilitates reasoning and physical activity, as well as improving interpersonal relationships.

Additionally, we also found studies related to autonomy: (a) for which older adults increased their autonomy scores after cognitive stimulation intervention; however, the measurement of daily activities showed no variations (Martínez, 2012); and, (b) presented a significant improvement in their indicators of cognitive deterioration and quality of life, but none of the groups experienced significant changes in autonomy (Miranda, Mascayano, Roa, Maray, & Serraino, 2013).

The gaps found in previous studies relate to the development of cognitive stimulation and its incidence in other fundamental biopsychosocial variables in the elderly. Indeed, while noticing physical, psychological, and social changes, older adults wish to remain physically and cognitively healthy. There is, however, still a need to develop more interventions that can preserve their cognitive functions and preserve or improve their Quality of Life (QOL).

Moreover, issues relating to the elderly have been addressed by different isolated approaches. Based on the literature review, it can be seen that that research trends for the elderly have been mainly in the psychological area, with an emphasis on improving intellectual areas and reducing cognitive impairment as well as their physical abilities.

However, the impact that the development of these cognitive skills has on self-esteem, self-efficacy, and autonomy has not been addressed. All these variables are important because they directly affect quality of life. According to Rosenberg (1965), self-esteem is a feeling towards oneself, which can be positive or negative and is constituted by

the individual's own characteristics. An adequate level of self-esteem guarantees that the older adult will be able to face important setbacks in life with dignity and will not lose heart easily (Bonet, 1994).

Self-efficacy is the second QOL factor. Bandura (1999) conceptualizes this as the evaluation that each person makes about their own ability or competence to perform an action that allows them to achieve certain results. In adults, this assessment will depend on the expectations they have of their own abilities and aptitudes and the difficulties associated with a task (González, 2005).

Pavón and Arias (2013) have reached the conclusion that self-efficacy is associated with the feeling of having ability to participate in conflicts that arise in everyday life. Older persons who do not perceive adequate levels of self-efficacy tend to show low self-esteem and negative feelings towards overcoming obstacles of old age. However, San Juan, Pérez, and Bermúdez (2000) comment that adults with high self-esteem are confident in their own abilities and act with motivating thoughts. This perception of self-esteem can influence feelings, thoughts, and actions, and, as a consequence the elderly can achieve their personal goals and objectives: there is an influence on their self-efficacy.

Lastly, we can define autonomy as: "…[the] capacity and freedom to think for oneself, with a critical sense and application within the context in which one is immersed ... it is deduced that the more knowledge, the greater the possibility of autonomy and that ignorance is the absence of it ..." (Díaz-Osorio, 2009, pp. 23-24). The elderly's self-esteem, self-efficacy, and autonomy are associated factors that will directly affect their daily lives.

In terms of several factors that affect and/or benefit QOL in older adults, the World Health Organization (WHO, 2014) mentions that aging is a challenge for society, which must adapt to maximally improve older people's health and functional capacity. In Mexico, there are 12.4 million people aged sixty and over, which represents 10.4% of the total population, and the number is increasing (Instituto Nacional de Estadística y Geografía [INEGI], 2016).

Consequently, the objective of this research is to check the effectiveness of a cognitive stimulation programme that uses technology (PESCO MX) versus a traditional programme that only includes recreational activities (without technology) to improve the levels of self-esteem, self-efficacy, and autonomy in older adults attending elderly day-care centres at the National Institute for Older Adults (Instituto Nacional para Adultos Mayores or INAPAM for its acronym in Spanish) in Cajeme, a municipality in the south of the Sonora state, Mexico.

Method

This research is quasi-experimental since the sample was not random; the older adults were already grouped as they attend INAPAM senior day-care centres. We worked with three groups in three INAPAM day-care centres. In the first group, a cognitive stimulation programme using PESCO MX software was applied, for the second group, a cognitive stimulation programme was used traditionally (recreational activities without the use of technology), and no treatment was applied to the third control group.

Participants

All participants attended INAPAM senior day-care centres: 63 older adults in total. They all met the following inclusion criteria: being aged sixty or older, having basic reading skills, which was determined by a simple reading test when they read the informed consents, having no previous computer experience, and being a healthy person without mental or degenerative diseases (dementia, Alzheimer's). The latter was relevant as older adults with these types of diseases cannot attend these day-care centres; they have to go to a different type of eldercare. For the sample selection, a non-probabilistic, intentional type procedure was used.

The participants were in one of three groups containing 21 older adults from three INAPAM day-care centres in Cajeme. There were 63 older people in total, 71.4% (n = 45) women and 28.6% (n = 18) men, the ages ranged from 60 to 95 (average 72.6 and mode 70). Regarding marital status, 49.2% were married, 34.9% widowed, 7.9% were single, 4.8% were in consensual union, and 3.2% were categorized as being in 'other' civil situations. Regarding level of education, 34.9% had completed secondary school, 23.8% had completed primary school, 20.6% had a truncated primary school education, and 7.9% had completed high school.

Instruments

The following instruments were selected because they were validated and adapted in Mexico for a population of older adults. Three instruments were applied, which are described below:

1. Rosenberg's Scale of Self-Esteem (1965), consists of ten affirmations of feelings that each person has about themselves. Six of the affirmations are positive and four are negative. There are four scales: 1 (*strongly disagree*) to 4 (*strongly agree*); Negative affirmations are assigned the inverse score (α=.76).
2. Fernández-Ballesteros' Self-efficacy Scale (2009) is made up of ten items, and it measures the perception of personal efficacy in relation to health, cognitive, socio-emotional, physical, and functional skills that are present during old age. It is a 5-level Likert type scale: 1 (*nothing*) to 5 (*much*) (α=.90).
3. The Daily Life Activities Inventory of the Older Adult (INACVIDIAM, for its Spanish acronym: Inventario de Actividades de la Vida Diaria del Adulto Mayor) created by Acosta-Quiroz (2011), has two versions: male with 26 items and female with 27 items to measure autonomy through the frequency of daily activities, the satisfaction associated with said frequency, and the difficulties in carrying out these activities (α=.92 in men and α=.80 in women). Using this instrument, the items were analysed using the frequency of the activities carried out in the adults' daily lives, and the following Likert scale was used: never, sometimes, very often, and every day.

Procedure

In the first stage, we were authorized to use the PESCO MX and apply it in the present study. The PESCO MX software has 12 stimulation exercises, and these exercises

are divided into four cognitive areas: memory, planning, attention, and reasoning.

To explain the purpose of this research, an appointment was then made with the INAPAM coordinator, who suggested the three senior day-care centres with the largest populations of older adults. To recruit participants, an invitation was made to be part of a cognitive stimulation programme and sent to the adults in the day-cares. The purpose of the research was also explained and those who agreed to participate signed informed consent. It is also relevant to note that they were already grouped since the seniors were members of one of the three day-cares, which were randomly selected for each intervention.

In the second stage, the PESCO MX programme activities were adapted to recreational activities without technology so that both experimental groups could have the same number of activities and stimulate the same intellectual areas: memory, planning, and reasoning.

In the third stage, the pre-test was applied to the three groups, and a poster was placed in each centre detailing the application dates for the cognitive stimulation programmes. In the fourth stage, there was a two-week period to begin the cognitive stimulation programmes. Four 27-inch touch screens were taken to the *Vida Plena* centre, which was the experimental group that would be using technology, the 21 adults were grouped into groups of four and played three games per session. Each session lasted approximately forty minutes. In the *Esperanza* centre, cognitive stimulation activities without technology were given to groups (the same as the with the group using technology). Sessions lasted forty minutes and included three playful activities activities.

In the fifth stage, a month had passed after the culmination of the cognitive stimulation programme with and without technology until the post-test was applied to the three groups. In the sixth stage, cognitive stimulation activities that did not use technology were applied to the control group (*Providencia* day-care centre) in order to comply with the ethical principles of experimental research with human beings and to provide them with the same cognitive stimulation benefit.

The two cognitive stimulation programmes and their characteristics are explained below: PESCO MX and the traditional method with recreational activities (without technology).

Cognitive Stimulation Programme Mexican version (PESCO MX for its Spanish acronym, or Programa de Estimulación Cognitiva)

The purpose of PESCO MX is to promote a general improvement of the cognitive and social functioning of the person (Clare & Woods, 2004). It runs on 23-inch touch screens that work intelligently by recognising ten contact points at the same time, which allows for efficient application and quick control of software usage. The quality of the FULL HD screen of 1920 x 1080 resolution allows for excellent image quality. These screens were used in the study and facilitated the interaction of the elderly with the software.

This software has 12 exercises to stimulate the following cognitive skills:

1) Memory: list of errands, vowels and numbers, bag of objects, dictation of numbers, memorizing images.
2) Planning: complete the series, package distribution, and word series.
3) Attention: lost items, word series.
4) Reasoning: puzzle, word relationship.

In addition, it has a virtual assistant called Don Beto so that participants could identify with him as he offers them guidance and explains the objectives and steps of each exercise. This also motivates them (see figure 1).

The PESCO MX automatically records the scores of each exercise. At the end of each exercise the programme records the user's performance through their successes and errors. This performance is stored by the programme, and the adult is rewarded with a gold, silver, or bronze medal. This type of incentive stimulates competitiveness and provides a sense of achievement (see figure 1).

The differences between the PESCO MX and the PESCO, which was developed at the University of Granada (Rute-Pérez, Santiago-Ramajo, Hurtado, Rodríguez-Fórtiz, & Caracuel, 2014) are related to their design and format: the images were changed for figures more familiar to older adults in the north-western region of Mexico, Mexican Spanish words (specifically from Sonora) were used, the colour tones are stronger, the pastel tones were removed because they were not distinguished by older adults, and the name of the virtual assistant is Don Beto instead of Pepe.

Traditional Cognitive Stimulation Program (recreational activities)

These activities were created to stimulate the same intellectual areas and are based on the PESCO MX design guides, which pay attention to the elderly's particular

Figure 1. Gold and silver medals as award in each exercise

characteristics; however, the recreational activities were elaborated with physical material (sheets, pencil, foamy, cut-out material, etc).

The activities of the Cognitive Stimulation Programme that did not use technology are as follows:

1) Memory: list of errands, memorize numbers and vowels, guess who I am, memorize the images, bag of objects.
2) Planning: complete the saying, sequence of activities, order the activities.
3) Attention: tangram, hidden animals.
4) Reasoning: three in-line game, math problems.
Below are several images of the 'playful activities' that were carried out during the traditional cognitive stimulation programme.

Data analysis

Data analysis was undertaken with the statistical programme SPSS version 23, *ANOVA* test for repeated measures. The effect size and statistical power were calculated through the GPower programme where the effect size was described as small, medium, and large in the terms presented by Cárdenas and Arancibia (2014) as reference values for the effect size of the different tests of statistical significance.

Results

Table 1 shows the performance of the three groups (mean and standard deviation), pretest and postest, for each of the selected dependent variables. Post-hoc tests were performed in search of differences of significant means in the test scores between groups. They resulted in no differences of significant means between groups in the pre-test ($p > 0.05$); however, differences of significant means were found in the post-tests. These differences are shown in table 1.

The results of the ANOVA indicated that there were no significant differences between the pre-treatment groups on the Self-Esteem scale (Rosenberg's Scale of Self-Esteem) ($F_{2.42}$=0.96, p=0.39). However, the effect of the group that worked with technology (PESCO MX) was significantly higher in the post-test ($F_{2.42}$ = 3.98, p<0.024). Post-treatment contrasts indicated that the control group scored significantly lower than the technology group. (p=.024). The effect of the factor ($F_{1.42}$ = 14.79, p<0.001) and of the Self-Esteem interaction (Self-Esteem-Treatment Group) were significant ($F_{2.42}$=3.37, p<0.05). The group with the technology-mediated intervention (PESCO_MX) showed a significantly greater increase in the self-esteem scale compared to the traditional group (playful activities) and the control group. Figure 2 shows the performance of the groups in Self-Esteem before and after treatment. Additionally, according to Cárdenas and Arancibia (2014), the effect size was small (<0.25), and the effect power was calculated (see table 2).

For the Self-efficacy scale (Fernández-Ballesteros' Self-efficacy scale) ANOVA results indicated that there were no significant differences between the pre-test groups ($F_{2.42}$=1.93, n.s.). However, the effect of the group that used the PESCO MX was significant in the post-test ($F_{2.42}$= 23.90, p<0.001). Post-test contrasts indicated that the group without technology (p= .001) and the control group (p= .000) scored significantly lower than the group with technology. Meanwhile, the group with no technology treatment scored significantly higher than the control group (p= .026). The effect of the factor ($F_{1.42}$= 14.79, p<0.001) and of the interaction (Self-efficacy _ treatment) were significant ($F_{2.42}$= 3.37, p<0.05): the group with the technology-mediated intervention (PESCO_MX) showed a significantly greater increase in the scale of self-efficacy in comparison with the recreational activities group and the control group. Figure 3 shows the Self-efficacy performance of the groups both before and after the treatment. The size and power of the effect were calculated; according to Cárdenas and Arancibia (2014), the effect was large (≥ 0.40) for self-efficacy and power of 0.95 (see table 2).

Regarding the Autonomy scale (Acosta-Quiroz's 2011 INACVIDIAM), the performance of the groups in terms of their Autonomy before and after the treatment is presented in Figure 4. The results of the ANOVA indicated there were no significant differences between the pre-treatment groups in the Autonomy scale ($F_{2.42}$= 1.82, n.s.). Similarly to

Table 1 Mean and standard deviation of Self-Esteem, Self-efficacy, and Autonomy of the groups (pre- and post-treatment)

	Group 1	Group 2	Group 3	Post-hoc
Self-esteem Pre-test	2.87 (0.47)	2.70 (0.42)	2.78 (0.25)	n.s.
Self-esteem Post-test	3.24 (0.21)	3.13 (0.32)	2.97 (0.38)	b*
Self-efficacy Pre-test	4.27 (0.69)	3.88 (0.75)	3.90 (0.73)	n.s.
Self-efficacy Post-test	4.51 (0.25)	3.87 (0.75)	3.43 (0.39)	a**, b**,c*
Autonomy_Pre-test	1.74 (0.49)	1.56 (0.34)	1.49 (0.30)	n.s.
Autonomy_Post-test	2.02 (0.36)	1.71 (0.36)	1.50 (0.27)	b*

1 = with technology, 2 = without technology, 3 = control. n.s. = non-significant

a) Differences between group 1 and group 2, b) differences between group 1 and group 3, c) differences between group 2 and group 3. Signification margins: $p \leq 0.017$ (*), $p \leq 0.001$ (**); marginal difference $p > 0.05$

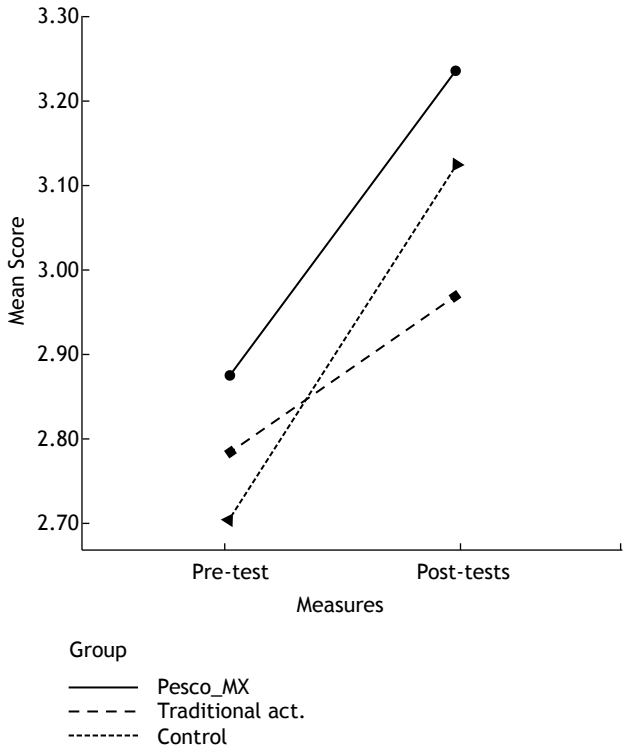

Figure 2. Change in self-esteem scale scores according to treatment (1 = group with technology; 2 = group without technology; 3 = control group)

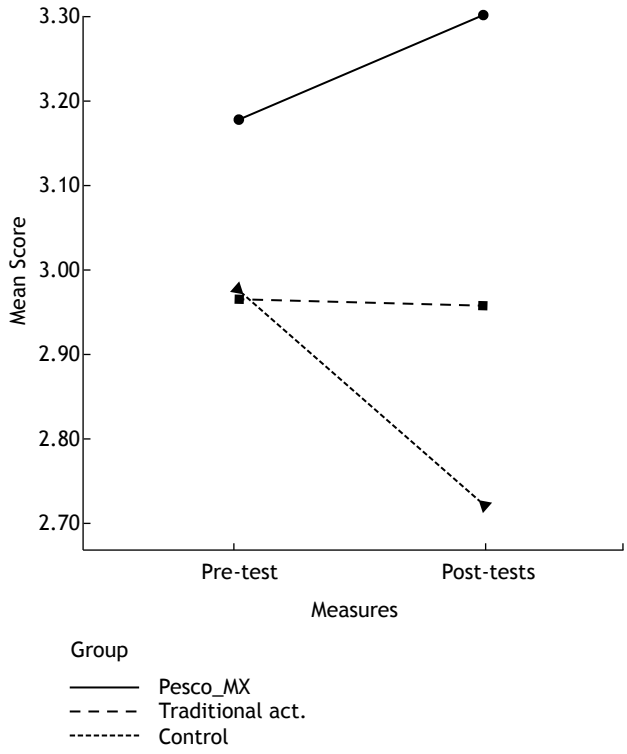

Figure 3. Change in the scores of the Self-efficacy scale according to the treatment (1 = group with technology; 2 = group without technology; 3 = control group)

Table 2. Effect size and power for measured variables

	Effect size	Power
Self-esteem	0.22	0.95
Self-efficacy	0.51	0.95
Autonomy	0.45	0.96

the other scales, the effect of the group that worked with technology was significant in the post-test ($F_{2.42}$=5.05, p<0. 01). Post-treatment contrasts indicated that the control group scored significantly (p= .01) lower than the group that used technology. In this case, however, there was no significant difference between the traditional group (without technology) and the control group. The effect of the factor ($F_{1.42}$= 8.70, p<0.001) and of the (Autonomy treatment) interaction were significant ($F_{2.42}$= 5.59, p<0.05): the group with the technology-mediated intervention (PESCO_MX) showed a significantly greater increase in the autonomy scale compared to the control group. Finally, the size and potency of the effect were calculated. According to Cárdenas and Arancibia (2014), the effect size had a medium effect of 0.45 on autonomy (≥0.25) and 0.96 on power (see table 2).

Discussion and conclusions

The findings show an increase in the levels of self-esteem, self-efficacy, and autonomy after the intervention (cognitive stimulation programme) using technology. It was

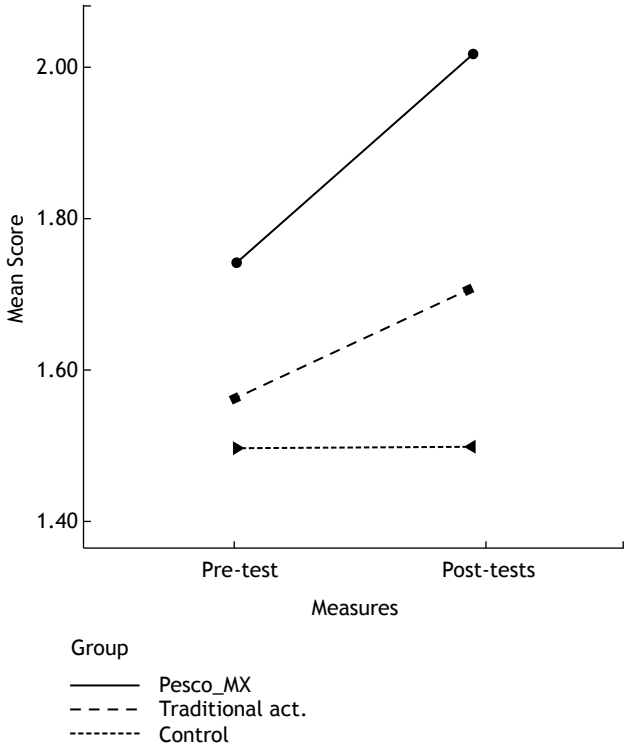

Figure 4. Change in Autonomy scale scores according to treatment (1 = group with technology; 2 = group without technology; 3 = control group)

shown that there were significant differences between the level of self-esteem, self-efficacy, and autonomy for the group that used technology and the control group.

Therefore, the results obtained show that the cognitive stimulation programme that used technology (PESCO MX) has proved more effective than the traditional programme with playful activities activities (without technology). The above indicates that participating in a cognitive stimulation programme that uses technology (PESCO MX) helps to improve self-esteem, self-efficacy, and autonomy in older adults.

We can infer that a cognitive skills programme that uses technology not only helps to improve cognitive skills: memory, planning, attention, and reasoning, which has already been proven by several authors (Acosta-Quieoz, 2011; Aldana, García, & Jacobo, 2012: Chan, Ngai, Leung, & Wong, 2009; Wolinsky, Vander, Howren, Jones, & Dotson, 2013), but it also affects the self-esteem, self-efficacy, and autonomy in older adults. This enhances the benefits achieved by traditional cognitive stimulation programmes using recreational activities.

Self-esteem is a key concept in aging since there is a significant decrease during old age compared to other stages such as adolescence and adulthood (Orth, Trzesniewski, & Robins, 2010). Due to the above, it is very important to try programmes that help this age group to improve their feelings towards themselves: to achieve positive self-esteem. This will help them to face the physical, psychological, and social changes that are characteristic during this stage (Wagner, Lang, & Neyer, 2013).

In the group that used technology, results showed an increase in this variable, which indicates positive self-esteem in older adults. In Schmitt and Allik's (2005) research, the scale of self-esteem was simultaneously applied to 53 nations, and a similar score was obtained, which indicated that positive self-evaluation can be culturally universal.

Regarding the level of self-efficacy, the results show a significant increase after the cognitive stimulation programme for the group that used technology (PESCO MX) as well as the group without technology (recreational activities) in comparison to the control group. This indicates that both interventions affected self-efficacy, but the group that used technology was affected to a greater extent (see table 2).

This means that the cognitive stimulation programme is effective in improving the levels of self-efficacy in older adults with and without technology. These results are consistent with those obtained by Blanco-Molina (2010) and Blanco and Salazar (2017) in Costa Rica. They conclude that this variable is a predictor of successful aging and quality of life during old age.

Self-efficacy is essential for development during all stages of life, but especially during old age since it impacts one's beliefs, emotions, and behaviours, if a person feels capable and trusts in their own abilities, they can gain benefits and achieve personal satisfaction (Rice, Lockenhoff, & Cartensen, 2002). Due to the above, we can infer that this variable affects self-esteem (Pavón & Arias, 2013) and autonomy because when you feel able to perform an activity you feel more satisfied with yourself and can perform daily activities more independently.

Regarding autonomy, the findings show a significant increase in the group with technology compared to the control group. These results are similar to those presented by Orozco, Anaya, Santiago, and García (2016) when they used a physical activity (Tai Chi) to measure the cognitive area and autonomy through INACVIDIAM. The group of Tai Chi practitioners obtained significantly higher scores than the sedentary group as well as greater frequency and satisfaction when performing daily activities.

These results indicate that the use of the cognitive stimulation programme with and without technology improves the frequency and perception of satisfaction in older adults' daily activities. Likewise, the results of Herrera, Muñoz, Martin, and Cid's (2011) study indicate that there are various programmes to promote functional capacities, such as: (a) cognitive maintenance and rehabilitation, (b) programmes to approach technologies, (c) promoting autonomy, and (d) preventing dependency. In this sense, it is important to create specialized programmes for older adults in order to prevent issues associated with aging.

The PESCO MX cognitive skills programme also contributes to counteract the progressive decrease of autonomy during old age since the frailty of the elderly increases with age and their daily lives are either effected, which causes deterioration in their autonomy, or they become totally dependent (Rodríguez, Collazo, Ricard, & Bayarre, 2013).

In conclusion, our findings show theoretical and practical implications related to the perception of self-esteem, self-efficacy, and autonomy in older adults. They also indicate how these variables were most benefited through a cognitive stimulation programme using technology. Consequently, the PESCO MX programme can be used not only to improve the cognitive abilities of this age group, but it also impacts the three variables studied. It will, therefore, contribute to improving their quality of life.

We suggest continuing to create and promote cognitive stimulation programmes to improving older adults' QOL by using a larger sample. In addition, research that includes other variables such as social, family, physical activities, etc, are required to fully measure the biopsychosocial approach to the older adult. Likewise, we recommend continuing to conduct research into psychoeducational technology to develop more collaborative studies with different academic nuclei. This is in order to obtain multidisciplinary results that would present a better perspective on the general development of the elderly and the repercussions of technology.

References

Acosta-Quiroz, C. (2011). Inventario de Actividades de la Vida Diaria del Adulto Mayor (INACVIDIAM), México: Manual Moderno.

Aldana, G., García, L., & Jacobo, A. (2012). Las Tecnologías de la Información y Comunicación (TIC) como alternativa para la estimulación de los procesos cognitivos en la vejez. *Revista CPU-e*, *14*, 153-166.

Bandura, A. (1999). Ejercicio de la eficacia personal y colectiva en sociedades cambiantes. In A. Bandura (Ed.), *Autoeficacia: Cómo afrontamos los cambios de la sociedad actual* (19-54). Bilbao, España: Editorial Desclée de Brouver.

Barrantes, B. (2010). Fortalecimiento de las habilidades cognitivas: alternativa para mejorar la calidad de vida. Presented at the *III Congreso Internacional de Gerontología*. Retrieved from http://docplayer.es/19591032-Fortalecimiento-de-las-habilidades-cognitivas-alternativa-para-mejorar-la-calidad-de-vida.html

Blanco-Molina, M. (2010). Predictores psicosociales del envejecimiento activo: evidencias en una muestra de personas adultas mayores. *Anales en Gerontología*, *6*(6), 11-29.

Blanco, M., & Salazar, M. (2017). Predictores socioemocionales y cognitivos: su papel en la comprensión del envejecimiento con éxito en el contexto costarricense. *Universitas Psychologica, 16*(1), 1-16. https://doi.org/10.11144/Javeriana.upsy16-1.pscc

Bonet, J. V. (1994). *Sé amigo de ti mismo. Manual de autoestima.* Madrid: Sal Terrae.

Cadavid, R. Villada, G., & Klimenko, O. (2011). Diseño, aplicación y evaluación de un programa de estimulación cognitiva para los adultos mayores institucionalizados en el hogar Santa Isabel. *Psicoespacios*, *5*(7), 43-64.

Cárdenas, M., & Arancibia, H. (2014). Statistical power and effect size calculating in G*Power: Complementary analysis of statistical significance testing and its application in psychology. *Salud & Sociedad, 5*(2), 210-244.

Cardiel, R. M. (1994). La medición de la Calidad de Vida. En L. Moreno, F. Cano-Valle y H. García-Romero (Eds.), *Epidemiología Clínica* (pp. 189-199). México: Interamericana-McGraw Hill.

Chan, C. L., Ngai, E. K., Leung, P. K., & Wong, S. (2009). Effect of the adapted virtual reality cognitive training program among Chinese older adults with chronic schizophrenia: a pilot study. *International Journal of Geriatric Psychiatry. A Journal of the Psychiatry of Late Life and Allied Sciences, 25*(6), 643-649.

Clare, L., & Woods, R. (2004). Cognitive training and cognitive rehabilitation for people with early-stage Alzheimer's disease: A review. *Neuropsychological rehabilitation 14*(4), 385-401.

Cohen, J. (1988). Statistical Power Analysis for the Behavioral Sciences. Second Edition. Hillsdate, NJ: LEA.

Díaz-Osorio, J. (2009). *Formación para el ejercicio de la autonomía.* PLACE: Fundación Universitaria Luis Amigó.

Fernández-Ballesteros, R. (2009). *Una psicología de la Vejez. Una psicogerontología aplicada.* Madrid, Spain: Pirámides.

Fernández-Calvo, B., Rodríguez-Pérez, R., Contador, I., Rubio-Santorum, A., & Ramos, F. (2011). Eficacia del entrenamiento cognitivo basado en nuevas tecnologías en pacientes con demencia tipo Alzheimer. *Psicothema,* 23, 44-50.

Finn, M., & McDonald, S. (2011). Computerised Cognitive Training for Older Persons with Mild Cognitive Impairment: A Pilot Study Using a Randomised Controlled Trial Design. *Brain Impairment, 12*(3), 187–199. https://doi.org/10.1375/brim.12.3.187

Gaitán, A., Garolera, M., Cerulla, N., Chico, G., Rodriguez-Querol, M., & Canela-Soler, J. (2013). Efficacy of an adjunctive computer-based cognitive training program in amnestic mild cognitive impairment and Alzheimer's disease: a single-blind, randomized clinical trial. *International Journal Geriatric Psychiatry, 28*(1), 91-99. https://doi.org/10.1002/gps.3794

González, L. (2005). ¿Cómo mejorar la calidad de vida y el bienestar subjetivo de los ancianos? In L. Garduño, B. Salinas, & M. Rojas (Eds.), *Calidad de Vida y Bienestar Subjetivo en México* (pp. 259-294). México: Plaza y Valdés. UDLA-Puebla.

González, R. (2016). *Efectos de un software de estimulación cognitiva sobre la atención, memoria, razonamiento, planificación y actividades instrumentales en mayores.* (Tesis de maestría). Instituto Tecnológico de Sonora, Sonora, México.

Herrera, M. E., Muñoz, M. I., Martin, G. V., & Cid, G. M. (2011). Experiencias españolas en la promoción de la autonomía personal en las personas mayores. *Gaceta Sanitaria, 25*, 147-157.

Instituto Nacional de Estadística y Geografía (INEGI) (2016, October 1). Estadísticas a propósito del día internacional de las personas de edad, datos nacionales. Retrieved from http://www.inegi.org.mx/saladeprensa/aproposito/2016/edad2016_0.pdf

Martínez, C. (2012). *Impacto de la estimulación cognitiva en las actividades de la vida diaria en adultos mayores con deterioro cognitivo leve y moderado.* (Tesis de licenciatura). Universidad Nacional Autónoma de México. México.

Miranda, C., Mascayano, T., Roa, H., Maray, G., & Serraino, G. (2013). Implementación de un programa de estimulación cognitiva en personas con demencia tipo Alzheimer: un estudio piloto en chilenos de la tercera edad. *Universitas Psychologica, 12*(2), 445. https://doi.org/10.11144/Javeriana.UPSY12-2.ipec

Motta, M. (2009). Estimulación cognitiva: un reto en Colombia. *Acta Neurológica Colombiana*, *25*(4).

Organización Mundial de la Salud (OMS). (2014). *Envejecimiento.* Retrieved from http://www.who.int/topics/ageing/es/

Orozco, C. O., Anaya, C. M., Santiago, V. J., & García, V. M. (2016). Cognición, actividades de la vida diaria y variables psicológicas mujeres adultas mayores practicantes de Tai Chi Chuan (Yang). *Retos*, *30*, 222-225.

Orth, U., Trzesniewski, K., & Robins, R. (2010). Selfesteem development from young adulthood to old age: A cohort-sequential longitudinal study. *Journal of Personality and Social Psychology, 98*(4), 645-658.

Pavón, M., & Arias, C. (2013). La percepción de autoeficacia para envejecer desde una perspectiva de género. *Revista Latinoamericana de Ciencia Psicológica*, *5*(2), 74-80.

Rebok, G. W., Ball, K., Guey, L. T., Jones, R. N., Kim, H. Y., King, J. W., ... & Willis, S. L. (2014). Ten year effects of the advanced cognitive training for independent and vital elderly cognitive training trial on cognition and everyday functioning in older adults. *Journal of the American Geriatrics Society, 62*(1), 16-24. https://doi.org/10.1111/jgs.12607

Rodríguez, R., & Basto, M. (2012). Beneficios de un programa de estimulación cognoscitivo/comunicativo en adultos con deterioro cognitivo moderado derivado de demencia. *Revista Areté*, *12*(1), 128-139.

Rosenberg, M. (1965). *La autoimagen del adolescente y la sociedad.* Buenos Aires: Paidós. (Traducción de 1973).

Rice, C., Lockenhoff, C. E., & Cartensen, L. (2002). En busca de la independencia y productividad: cómo influyen las culturas occidentales en las explicaciones individuales y científicas del envejecimiento. *Revista Latinoamericana de Psicología*, *34,* 133-154.

Rodríguez, A., Collazo, M., Ricard, J., & Bayarre, H. (2013). Intersectoralidad como una vía efectiva para enfrentar el envejecimiento de la población cubana. *Revista Cubana de Salud Pública*, *39*(2), 323-330.

Rute-Pérez, S., Rodríguez-Domínguez, C., Rodríguez-Fórtiz, M. J., Hurtado-Torres, M. V., & Caracuel, A. (2016). Training working memory in elderly people with a computer-based tool. In *International Conference on Computers Helping People with Special Needs* (pp. 530-536). Publisher: Springer, Cham.

San Juan P., Pérez, A., & Bermúdez, J. (2000). Escala de Autoeficacia General: Datos psicométricos de la adaptación para población española. *Psicothema, 12*, 509-513.

Schmitt, D. P., & Allik, J. (2005). Simultaneous Administration of the Rosenberg Self-Esteem Scale in 53 Nations: Exploring the Universal and Culture-Specific Features of Global Self-Esteem. *Journal of Personality and Social Psychology*, *89*, 623-42.

Solomon, R. L. (1949). An extension of control group design. *Psychological Bulletin*, *46*, 137-150.

Szymanowski, A. (2016). *Desarrollo de Software para el ejercicio de capacidades intelectuales en personas de la tercera edad.* Retrieved from https://www.unaj.edu.ar/wp-content/uploads/2016/03/15-Software-para-la-tercera-edad.pdf

Vega, F. (2012). *Estimulación Cognitiva en Adultos Mayores con Envejecimiento Normal Residentes en Bogotá.* (Tesis de maestría). Universidad de San Buenaventura. Colombia.

Velilla, J., Soto, R., & Pineda, S. (2010). Efecto de un programa de estimulación cognitiva en la memoria operativa de pacientes con deterioro cognitivo leve amnésico. *Revista Chilena de Neuropsicología, 5*(3), 185-198.

Wagner, J., Lang, F., & Neyer, F. (2013). Self-esteem across adulthood: The role of resources. *European Journal of Ageing, 11*, 109-119.

Wolinsky, F. D., Vander, M. W., Howren, M. B., Jones, M.P., & Dotson, M. M. (2013). A randomized controlled trial of cognitive training using a visual speed of processing intervention in middle aged and older adults. *PLoS ONE, 8*(5). https://doi.org/10.1371/journal.pone.0061624

Yuni, J. & Urbano, C. (2008). La estimulación cognitiva de adultos mayores desde la perspectiva de la ecología de la vejez. *Perspectivas en Psicología*, 5(2), 75-83.