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Service learning and development of digital skills for the technological inclusion of older adults

Aprendizaje en servicio y desarrollo de competencias digitales para la inclusión tecnológica de adultos mayores

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María Asunta Kuong-Cuellas
https://orcid.org/0009-0000-8484-8460
mkoungc@ucvvirtual.edu.pe
Universidad César Vallejo. Lima, Peru

Luzmila Lourdes Garro-Aburto
https://orcid.org/0000-0002-9453-9810
lgarro@ucv.edu.pe
Universidad César Vallejo. Lima, Peru

Abstract
Currently, the development of digital skills and service learning foster older adults' technological participation and promote intergenerational learning. The objective of this study was to analyze how service learning and digital competencies influence the technological inclusion of older adults in the province of Ilo during the year 2025. To this end, a correlational non-experimental design with a basic quantitative approach was used. The measurement instrument was applied to a sample of 369 older adults selected through simple random sampling. The results reveal a high level of service learning, reaching 46.6%, while the participants' digital competencies were even higher, at 69.6%. On the other hand, technological inclusion showed a medium level, at 46.3%. Spearman's correlation analysis identified a strong relationship between service learning and technological inclusion (r = 0.928), as well as a significant correlation between digital competencies and technological inclusion (r = 0.690). In conclusion, this study shows a statistically significant relationship between service learning and digital skills in the technological inclusion of older adults in Ilo. It also confirms that service learning is an effective strategy for familiarizing older adults with technology and enhancing the skills and knowledge of both them and the students involved.

Keywords: older adults, service learning, digital skills, technological inclusion.

Resumen
Actualmente, el desarrollo de habilidades digitales y el aprendizaje en servicio fomentan la participación tecnológica de las personas mayores, además de favorecer el aprendizaje intergeneracional. El objetivo de este estudio fue analizar cómo el aprendizaje en servicio y las competencias digitales influyen en la inclusión tecnológica de adultos mayores en la provincia de Ilo durante 2025. Para ello, se empleó un diseño no experimental correlacional con un enfoque cuantitativo básico. El instrumento de medición fue aplicado a una muestra de 369 adultos mayores seleccionados mediante muestreo aleatorio simple. Los resultados revelan que el nivel de aprendizaje en servicio es alto, alcanzando un 46.6 %, mientras que las competencias digitales de los participantes fueron aún mayores, con un 69.6 %. Por otro lado, la inclusión tecnológica mostró un nivel medio, con un 46.3 %. A través del análisis de correlación de Spearman, se identificó una relación fuerte entre el aprendizaje en servicio y la inclusión tecnológica (r = 0.928), así como una correlación significativa entre las competencias digitales y la inclusión tecnológica (r = 0.690). En conclusión, este estudio evidencia una relación estadísticamente significativa entre el aprendizaje en servicio y las competencias digitales en la inclusión tecnológica de los adultos mayores de Ilo. Asimismo, confirma que el aprendizaje en servicio constituye una estrategia eficaz para familiarizar a los adultos mayores con la tecnología y para potenciar las habilidades y conocimientos tanto de ellos como de los estudiantes involucrados.

Palabras clave: adulto mayor, aprendizaje en servicio, competencias digitales, inclusión tecnológica.

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Introduction

In an increasingly digitalized world, the ability to access and effectively use technologies is essential for ensuring the economic, social, and cultural inclusion of the population (Castiglioni, 2024). However, older adults face numerous obstacles that limit their full participation in the current digital environment, thereby deepening the generational divide and reducing their integration into contemporary society.

In this context, an innovative educational approach known as "service learning" has emerged, combining traditional classroom instruction with social engagement (Bonastre et al., 2021; Arribas-Cubero et al., 2021). According to Oyágüez (2024), this methodology allows students to apply their knowledge in real-world situations, contributing to the resolution of social issues while developing digital, communicative, and civic skills. Thus, service learning not only enhances digital literacy among older adults but also enriches the educational experience of younger participants, promoting intergenerational cooperation and social responsibility (Amaro et al., 2020; Florez, 2020).

Furthermore, multiple studies have shown that older adults in Latin America exhibit significant lag in the development of digital competencies, largely due to low educational levels, fear of technology, and a lack of specific training programs (Rodríguez-Pedró, 2024; Meyer et al., 2024; Mora-Chavarría & González-Matamoros, 2022; Manrique et al., 2025; Díaz et al., 2025).

It is noteworthy that digital competencies—defined as the ability to understand, manage, and evaluate the effective use of information and communication technologies (ICT)—have become an indispensable requirement (Santiago-Trujillo & Garvich-Ormeño, 2024; Arteaga & Osorio, 2024). Rentería (2021) points out that these skills range from safe internet navigation to digital content creation and technical problem-solving. According to Kuong and Chaparro (2025), for older adults, acquiring these competencies not only involves improving their technical abilities but also enhancing their self-esteem, autonomy, and quality of life.

In Peru, a significant portion of the population still does not fully leverage the opportunities offered by the internet and modern technologies, despite their growing prevalence (Flor, 2022). In particular, the Moquegua region faces a persistent challenge regarding the digital inclusion of older adults (Limache, 2024). This exclusion hampers access to relevant information, communication with family members, ongoing education, and the use of online services (Quinde et al., 2020). Consequently, there is a notable lack of long-term, quality digital training programs aimed at this group (Hernández, 2023; Escuder et al., 2020). Therefore, it is essential to design initiatives that bridge the digital divide and improve the quality of life for older adults in the context of digital transformation (Benavides & Chipana, 2021; Manzanera-Román & Haz-Gómez, 2022).

Based on this premise, the present study hypothesizes that service learning and digital competencies directly influence the technological inclusion of older adults in the province of Ilo.

Regarding background, this research is grounded in the work of Barrantes and Valverde (2020), who advocated for service learning as an educational strategy that integrates academic learning with community service, promoting joint development. It is also supported by the digital skills model proposed by Martín-Párraga et al. (2022), which establishes the foundations for competent electronic communication. Thus, understanding the potential of service learning as a strategic tool to enhance digital literacy among older adults is enriched by these theoretical references (Marqués, 2021; Palmera et al., 2023).

Moreover, the necessity of strengthening digital inclusion policies for historically vulnerable population groups, such as older adults, justifies this study (Gutiérrez et al., 2023). The digital exclusion of this sector not only violates their right to equality but also limits social development in an advanced technological society (López, 2023; Vásquez-Rizo et al., 2020). Likewise, service learning enhances university education by actively involving students in their environment while providing older adults with the digital tools needed for full integration into the knowledge society (Tomczyk et al., 2023; Pino et al., 2021).

Although the digital inclusion of older adults has generated growing interest, there remains a gap in research evaluating the effects of service learning in intergenerational contexts, particularly regarding the acquisition of enduring digital skills for this demographic. Therefore, this research addresses the following question: How do service learning and digital competencies influence the technological inclusion of older adults in the province of Ilo in 2025? Its primary objective is to determine the influence of these variables on the technological inclusion of this group.

Finally, it is observed that many current programs rely on traditional methods, limiting the incorporation of new technologies that could enrich the educational experience. Additionally, the lack of coordination between academic projects and public policies hampers the ability of these initiatives to achieve scale and have a lasting systemic impact.

In conclusion, this research is significant from both an educational and social perspective, as it proposes a model of community intervention applicable in other regions of the country (Salinas & De Benito, 2020; Padial

et al., 2020). In this way, it contributes to meeting innovative pedagogical demands and the Sustainable Development Goals, particularly SDG 4 (Quality Education) and SDG 10 (Reduced Inequalities), by incorporating service learning into university programs (López et al., 2024).

Methodology

This study adopted a quantitative methodology, utilizing numerical data collection and statistical analysis to support the hypothesis and validate the identified issues (Hernández-Sampieri & Mendoza, 2018). Furthermore, it falls within the realm of basic research, which involves applying a theoretical framework to concrete real-world situations and subsequently examining the practical implications derived therefrom (Escudero & Cortez, 2018). On the other hand, the study was classified as non-experimental, as the investigated variables were not directly manipulated (Villasis-Keever et al., 2018).

Additionally, it was a cross-sectional correlational study aimed at identifying the relationship between the analyzed variables and the effect each exerts on the other. Due to time constraints, data collection and analysis were conducted at a single point in time, employing a cross-sectional design (Hernández-Sampieri & Mendoza, 2018).

Regarding the study population, it consisted of a set of elements, individuals, or measurements sharing common characteristics at a specific moment. In this research, the population comprised 9,198 older adults residing in the province of Ilo. The sample represents a specific and representative portion of this population (Hernández-Sampieri & Mendoza, 2018). Participants were selected using simple random sampling, calculated using formula 1 for finite populations.

$$n = \frac{N*Z^2*p*q}{e^2(N-1)+Z^2*p*q} \quad (1)$$

$$n = \frac{9198*1.96^2*0.5*0.5}{0.05^2(9198-1)+1.96^2*0.5*0.5} = 369$$

A survey was employed as the primary technique for collecting data relevant to the study topic, utilizing a questionnaire as the tool (Hernández-Sampieri & Mendoza, 2018). In this process, three instruments designed by Kuong and Chaparro (2025) were applied. The first instrument assessed 16 items distributed across two sections: personal-instruction competencies and social competencies, which together constitute the variable of service learning. Its measurement scale was classified into three levels: low (16-37), medium (38-59), and high (60-80).

The second instrument consisted of 21 questions to evaluate the variable of digital competencies, divided into the following dimensions: perceived usefulness, ease of use, facilitating conditions, social influence, and intention to use. Its measurement range was defined as low (21-49), medium (50-77), and high (78-105). Lastly, the third instrument, featuring 22 items, measured the variable of technological inclusion, organized into the dimensions of appropriate ICT inclusion, teaching-learning processes, and ICT appropriation, with established levels and ranges classified as low (22-51), medium (52-81), and high (82-110).

To ensure that the items were coherent, clear, and relevant to the study objectives, the instruments were validated by experts. Regarding reliability, the coefficients obtained for the variables demonstrate a high degree of internal consistency: technological inclusion (0.878), service learning (0.849), and digital competencies (0.920).

In terms of ethics, the following guidelines were strictly adhered to: informed consent was obtained from all participants, their identities were protected, and the confidentiality of their data was maintained.

Data processing and analysis were carried out in two fundamental stages. First, parameter and dimension matrices were constructed, applying descriptive statistical analysis that allowed for the observation of the behavior of quantitative responses through frequency and percentage tables. In the second stage, hypotheses were tested using inferential statistics. To determine the correlation between variables, the Kolmogorov-Smirnov normality test was conducted, the results of which led to the use of a non-parametric test, specifically the Spearman's Rho coefficient.

Results and discussion

The data were analyzed using descriptive approaches that facilitated a clear and detailed understanding of the information gathered. To support this analysis, the results are presented visually through bar graphs, percentages, and frequency tables, allowing for a more accessible and precise interpretation of the trends and patterns observed in the study.

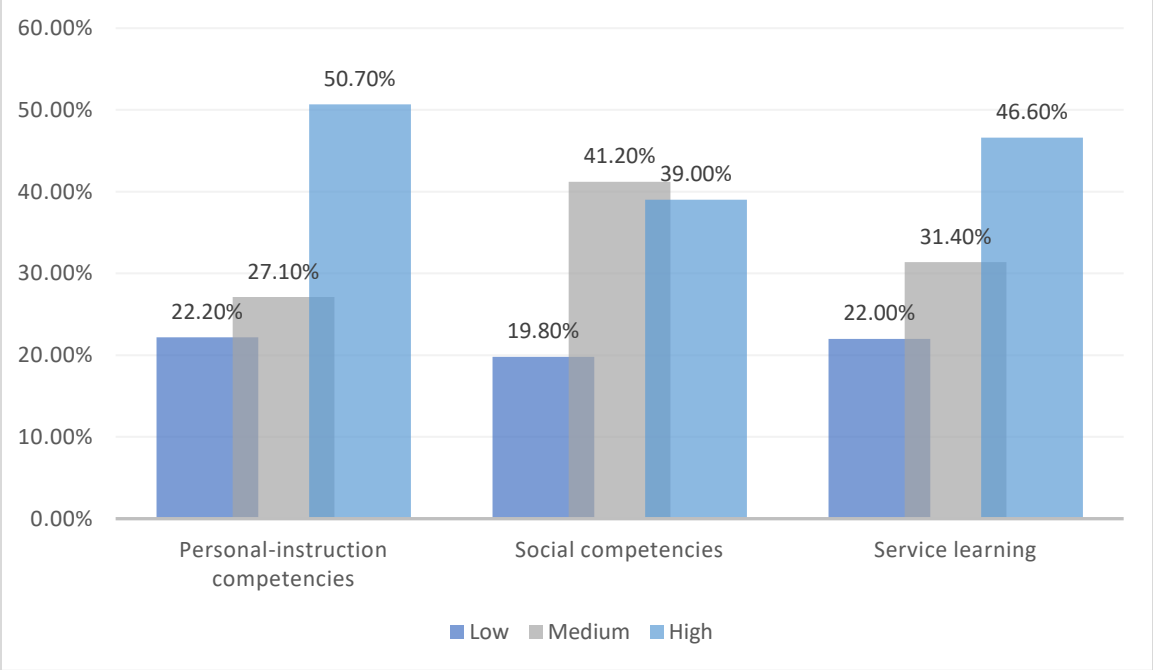
Table 1

Frequency and percentage of the service learning variable and its dimensions

Scale	Personal-instruction competencies		Social competencies		Service learning	
	F	%	F	%	F	%
Low	82	22.2%	73	19.8%	81	22.0%
Medium	100	27.1%	152	41.2%	116	31.4%
High	187	50.7%	144	39.0%	172	46.6%
Total	**369**	**100.0%**	**369**	**100.0%**	**369**	**100.0%**

Figure 1

Frequency and percentage of the service learning variable and its dimensions



In Table 1 and Figure 1, the results corresponding to the first variable and its dimensions are presented. Regarding personal-instruction competencies, 50.7% of older adults achieved a high level. Conversely, the level of social competencies was predominantly in the medium range, at 41.2%. Additionally, 46.6% of participants indicated a high level in service learning.

These results align with previous research, such as that conducted by Wiktorowicz (2018), who reported that individuals over 50 rate their personal and instructional competencies as average to good (between 60% and 90%), particularly highlighting skills such as self-organization and decision-making. This indicates that the findings of the present study are consistent with a positive trend in these competencies.

Regarding the medium level detected in social competencies, a significant percentage of older adults appear not to meet the established expectations in this area. This finding aligns with reports by Cai et al. (2024), who found that older adults exhibiting high levels of self-efficacy and emotional regulation tend to experience lower rates of loneliness.

Overall, the research conducted by Montesi et al. (2021) supports the idea that service learning programs contribute to the development of communicative skills in older adults, foster their awareness of the importance of inclusion, and consequently increase their well-being and social participation.

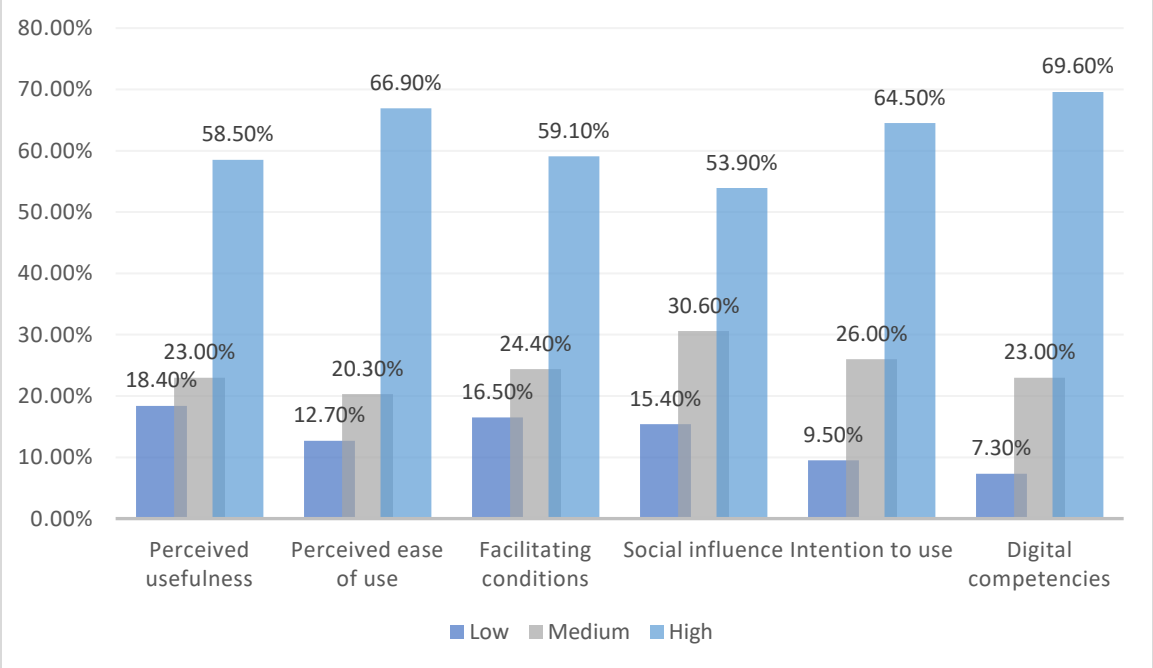
Table 2

Frequency and percentage of the digital competencies variable and its dimensions

Scale	Perceived usefulness		Perceived ease of use		Facilitating conditions		Social influence		Intention to use		Digital competencies	
	F	%	F	%	F	%	F	%	F	%	F	%
Low	68	18.4%	47	12.7%	61	16.5%	57	15.4%	35	9.5%	27	7.3%
Medium	85	23.0%	75	20.3%	90	24.4%	113	30.6%	96	26.0%	85	23.0%
High	216	58.5%	247	66.9%	218	59.1%	199	53.9%	238	64.5%	257	69.6%
Total	**369**	**100.0%**	**369**	**100.0%**	**369**	**100.0%**	**369**	**100.0%**	**369**	**100.0%**	**369**	**100.0%**

Figure 2

Frequency and percentage of the digital competencies variable and its dimensions



In Table 2 and Figure 2, the results for the digital competencies variable and its dimensions are presented. Regarding this variable, 69.6% of older adults achieved a high level of digital competencies. Specifically, 58.5% reported a high level in perceived usefulness, while 66.9% exhibited a high level in perceived ease of use. Additionally, the following dimensions recorded high levels: facilitating conditions (59.1%), social influence (53.9%), and intention to use (64.5%).

These findings are consistent with studies by Murciano et al. (2022), who, based on technology acceptance models, indicate that the desire to use technology increases significantly when users perceive clear benefits. Similarly, perceived ease of use is crucial for reducing anxiety and promoting effective and satisfying technology adoption. Furthermore, Murciano et al. agree that the social environment—composed of friends, family, and institutions—exerts a significant influence on older adults, underscoring the importance of social support in the technology adoption process.

In this sense, educational spaces and social support are key elements for digital inclusion. Martínez-Heredia (2020) emphasizes the relevance of resource availability, ongoing training, and technical assistance in creating facilitating conditions that favor this process. Finally, Tirado-Morueta et al. (2023) note that an active profile, along with training programs or prior experiences, significantly contributes to the development of basic digital skills in older adults.

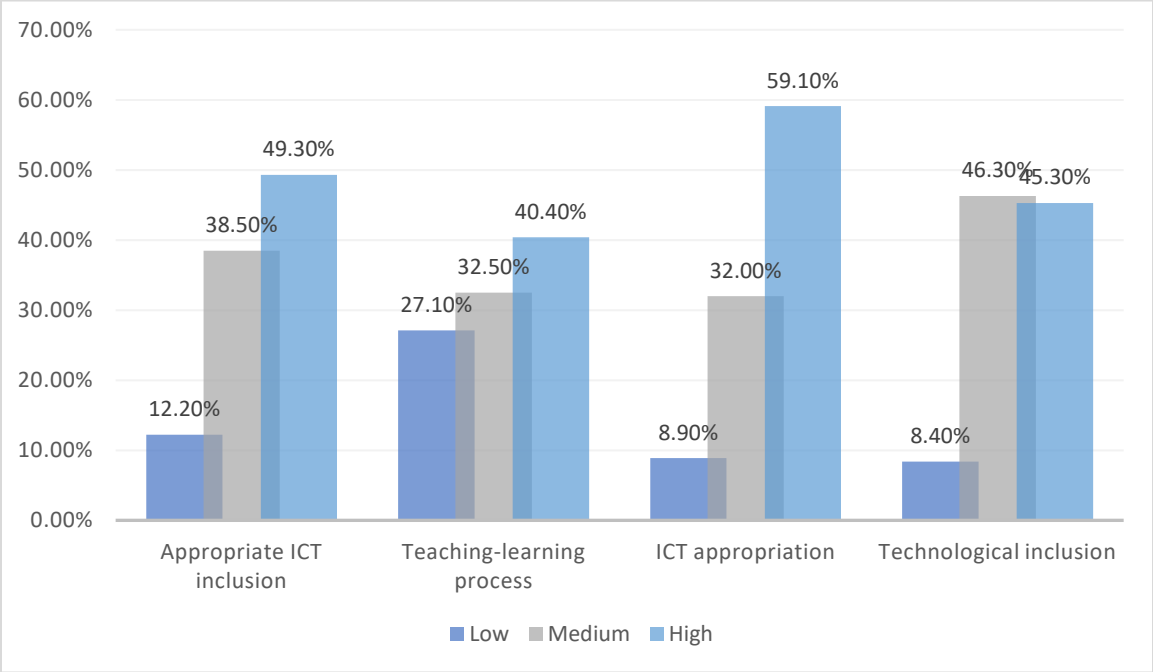
Table 3

Frequency and percentage of the technological inclusion variable and its dimensions

Scale	Appropriate ICT inclusion		Teaching-learning process		ICT appropriation		Technological inclusion	
	F	%	F	%	F	%	F	%
Low	45	12.2%	100	27.1%	33	8.9%	31	8.4%
Medium	142	38.5%	120	32.5%	118	32.0%	171	46.3%
High	182	49.3%	149	40.4%	218	59.1%	167	45.3%
Total	**369**	**100.0%**	**369**	**100.0%**	**369**	**100.0%**	**369**	**100.0%**

Figure 3

Frequency and percentage of the technological inclusion variable and its dimensions



In Table 3 and Figure 3, the results corresponding to the technological inclusion variable and its dimensions are presented. In relation to this variable, it is observed that 46.3% of respondents possess a medium level of technological inclusion. Specifically, 49.3% indicate a high level in appropriate ICT inclusion, 40.4% report a high level in the teaching-learning process, and 59.1% show a high level in ICT appropriation.

This interpretation is supported by the study of Íñiguez-Berrozpe et al. (2018), who note that internet usage decreases from 79% among individuals aged 65 to 74 years to 42% among those aged 75 years and older, suggesting that a medium level of inclusion reflects moderate usage patterns in older age groups. Additionally, this finding aligns with research by Méndez-Domínguez et al. (2023), which highlights that digital support services are better predictors of inclusion, although approximately 50% of older adults are fully integrated into the ICT environment.

It is also important to note that prior familiarity with ICT does not necessarily guarantee real inclusion, as some users retain low levels of appropriation even after having contact with these technologies (Schroeder et al., 2023). Moreover, Méndez-Domínguez et al. (2023) indicate that nearly 50% of individuals with higher income and educational levels develop solid digital skills and have greater access to technology.

Normality test

The Kolmogorov-Smirnov normality test was applied to evaluate the behavior of the collected data, allowing for the identification of whether it followed a normal distribution. This determination was crucial for selecting the most appropriate statistic, whether parametric or non-parametric, for the subsequent analysis of the hypotheses posed in the study.

Table 4

Normality test results

Variables/Dimensions	Kolmogorov-Smirnov[a]		
	Statistic	df	Sig.
Personal-instruction competencies	0.319	369	0.000
Social competencies	0.252	369	0.000
Service learning	0.296	369	0.000
Perceived usefulness	0.364	369	0.000
Perceived ease of use	0.410	369	0.000
Facilitating conditions	0.366	369	0.000
Social influence	0.336	369	0.000
Intention to use	0.397	369	0.000
Digital competencies	0.425	369	0.000
Appropriate ICT inclusion	0.311	369	0.000
Teaching-learning process	0.261	369	0.000
ICT appropriation	0.367	369	0.000
Technological inclusion	0.293	369	0.000

According to Table 4, the results of the normality test indicate that all values are statistically significant with a level of 0.000. This evidence suggests that the distribution of the study data is not normal, as the p-value is less than 0.05. Therefore, to evaluate the correlation proposed in the hypothesis, the Spearman correlation coefficient, a non-parametric statistical measure suitable for this type of data, was utilized.

Table 5

Correlation between service learning, digital competencies, and technological inclusion

Variables	*Rho*	*p*
Service learning Technological inclusion	0.928**	0.000
Digital competencies Technological inclusion	0.690**	0.000

According to Table 5, there is a high positive correlation (r = 0.928) between the service learning variable and technological inclusion, with a significance level just below the threshold of p = 0.05. Similarly, a moderate positive correlation (r = 0.690) is identified between digital competencies and technological inclusion. These results indicate that strengthening service learning and digital competencies is associated with a significant increase in the technological inclusion of older adults in the province of Ilo.

The results of the general hypothesis test confirm the strong correlation between service learning and technological inclusion, as well as the moderate connection between digital competencies and inclusion. This reaffirms that service learning has established itself as a prominent pedagogical approach within higher education, particularly due to its ability to meet the practical training needs in using various technological tools. Furthermore,

it helps bridge the digital divide among older adults, positioning itself as an effective method for education and social intervention, facilitating this population's participation in digital activities (Tipula, 2023).

The high level of service learning (46.6%) reflects an effective integration between the educational process and the execution of community services. This finding aligns with Molina-Luque and Tahull (2025), who argue that the service learning experience can be strengthened and given greater meaning by promoting innovative ideas in intergenerational education, a fundamental outcome for human sustainability.

Additionally, the high level of digital competencies (69.6%) indicates advanced proficiency in the use of technological tools for various activities. This data supports the thesis of García-Gutiérrez and Ruiz-Corbella (2020), who emphasize the importance of training in digital competencies to develop generalized skills. Incorporating technological components into instructional design aims to significantly transform and enhance educational outcomes, establishing a foundation for genuine innovation.

Finally, the medium level of technological inclusion (46.3%) relates to the need to ensure universal and non-discriminatory access to ICT. Kuong and Chaparro (2025) highlight the importance of older adults actively participating through technological practice and intergenerational interaction, as access to digital knowledge and experiences is crucial for acquiring competencies. Similarly, Colombo-Ruano and González-González (2024) assert that by adapting technology to the specific needs of older adults, they can develop the necessary digital skills for full inclusion.

Conclusions

The results obtained demonstrate that the development of digital competencies and technological inclusion among older adults is closely linked to service learning, as confirmed by the Spearman's Rho statistical test, which yielded a p-value of 0.000. This underscores that service learning is an effective strategy for familiarizing older adults with technology while strengthening the knowledge and overall skills of the involved students.

From a practical perspective, it is recommended that this methodology be incorporated into public policies and regional inclusion programs, as well as integrated into higher education curricula. Additionally, service learning emerges as a key tool for promoting digital equality, empowering vulnerable populations, and contributing to social cohesion, highlighting its social relevance.

Regarding future research directions, it would be beneficial to analyze how these educational experiences influence the digital autonomy of older adults over time, the durability of the acquired knowledge, and the role that new technologies could play in personalizing training. Furthermore, to design models applicable at the national level, comparative studies across different regions are suggested.

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AUTHORSHIP CONTRIBUTION:

1. Conceptualization: Luzmila Lourdes Garro-Aburto.
2. Data curation: María Asunta Kuong-Cuellas.
3. Formal analysis: María Asunta Kuong-Cuellas.
4. Funding acquisition: María Asunta Kuong-Cuellas.
5. Research: Luzmila Lourdes Garro-Aburto.
6. Methodology: María Asunta Kuong-Cuellas.
7. Project management: Luzmila Lourdes Garro-Aburto.
8. Resources: Luzmila Lourdes Garro-Aburto.
9. Software: María Asunta Kuong-Cuellas.
10. Supervision: Luzmila Lourdes Garro-Aburto.
11. Validation: María Asunta Kuong-Cuellas.
12. Visualization: María Asunta Kuong-Cuellas.
13. Writing – original draft: María Asunta Kuong-Cuellas.
14. Writing – proofreading and editing: Luzmila Lourdes Garro-Aburto.

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