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e-Health Literacy among Portuguese Older Adults: The DigiHealth Project

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Abstract

This study aims to compare the e-health literacy levels, before and after the implementation of a health education program, part of 'DigiHealth', an intergerational project focused on developing digital health literacy in the elderly. The program ran for nine months, with weekly sessions lasting two hours. Each older person was given a tablet for personal use during the program. The activities, implemented by Higher Education students, required the use of these digital devices and internet access and were focused on health promotion, the access to public health services and the participation in online social networks as mechanisms to combat social isolation and loneliness. The analysis of the program's impact was performed by comparing the levels of e- health literacy among a convenience sample of 25 elderly living in the north of Portugal, before and after the program implementation (pre-test and post-test). The participants were assessed before and after the program's implementation, using the Portuguese version of the e-Health Literacy Scale (EeLS), which integrates 3 sub-scales: Functional e-Literacy, Communicational e-Literacy and Critical e-Literacy. Although no statistically significant differences were found in the levels of health e-literacy between the pre-test and post-test, the results show a tendency for these levels to improve, not only when taking the total health e-literacy scale as a reference, but also in its dimensions. This study serves as an additional contribution to the mobilisation of community-based educational practices that enhance health literacy levels, thus contributing to the promotion of the well-being and health of older adults.

Keywords: digital, education, elderly, health, impact

1. Introduction

Just like in developed countries, Portuguese elderly people has been gradually increasing, and the country has had a negative natural balance since 2011. According to Portuguese demographics, in 2023, the ageing index, which compares the population aged 65 and over (elderly population) with the population aged 0 to 14 (youth population), reached a value of 188.1 elderly individuals for every 100 young people (184.4 in 2022) (Statistics Portugal, 2024), and this trend is expected to intensify over the coming decades. Promoting healthy ageing, making elderly people more active and helping to preserve their health, requires the

creation of conditions that enable them to make decisions to exercise active citizenship across various social contexts (Patrício & Osório, 2017). The use of digital devices connected to the internet provides access to services and activities that not only facilitate social participation but also contribute to psychological well-being, autonomy, and self-confidence (Mota, 2019). Empowering older adults with the knowledge and skills necessary to exercise their civic rights and duties, including access to and use of digital platforms, is a core aspect of digital literacy, which involves the critical capacity to understand and use information in different formats and from various sources (Gil, 2019). However, it is worth noting that the elderly population most excluded digitally is also the one with the lowest educational levels, which may pose challenges for both the use of technologies and the development of digital skills (Damas et al., 2023).

Most elderly people have lived most of their lives without access to digital technologies. In Portugal, although internet use by the elderly is growing, there is a significant gap compared to younger generations. According to data from the Survey on the Use of Information and Communication Technologies by Households (Statistics Portugal, 2019), internet usage rates drop significantly with age: among those aged 55 to 64, it is 59.4%, while for people aged 65 and over, it is only 34.1%. Overall, internet use to contact public services has been declining (61.3% in 2017, 55.2% in 2018, and 53.8% in 2019).

These statistics align with research (e.g., Oliveira, 2019), which indicates that the "young elderly," with an average age of 68, are those who use the internet most frequently, even though internet access is not included among the activities they consider most relevant in their routines. They primarily use the internet to access information, communicate with family and friends, and for entertainment, promoting self-esteem, leisure, autonomy, a sense of purpose, and citizenship. Digital competence is recognized as one of the eight essential skills for lifelong learning, involving the safe, critical, and creative use of Information and Communication Technologies (Patrício & Osório, 2017). To prevent the elderly from feeling digitally excluded, it is essential to adapt digital skills to their social, emotional, economic, and cultural contexts, helping them to understand the utility and functionality of technologies in their daily routines (Gil, 2019).

The National Strategy for Active and Healthy Ageing 2023-2026 (Resolução do Conselho de Ministros n.º 14/2024 da Presidência do Conselho de Ministros. 2024) emphasises that education and lifelong learning are essential elements for ageing well. This includes technological inclusion, health literacy, self-care, and the creation of (digital) environments that enhance integration and participation. The ability to use electronic devices is one of the factors influencing the level of health literacy in Portugal (Espanha & Mendes, 2023).

1.1 e-Health Literacy among Older Adults

E-health literacy is the skill of searching for, locating, understanding, and evaluating health information from digital sources, and using that information to manage a health-related issues and make informed health choices (Wu, 2021).

E-health literacy in older adults refers to actively seeking necessary health information through electronic media, sharing real-time information, and enhancing one's own health by using and disseminating that information (Jung et al. 2022).

A higher level of e-health literacy in older adults is connected to healthier behaviors and a stronger understanding of health information (Dong, 2023; Xie, 2022) Thus, assisting older adults in accessing the internet should help foster the preservation of functional literacy skills necessary for managing health during the ageing process (Kobayashi, 2015). Nevertheless, some studies, as the review presented recently by Aslan et al. (2024), put in evidence the

negative experiences and views of older adults on communicative e-health services, related with difficulties to engage with online services, low digital literacy, weak support networks and the complexity of application interfaces. Other studies (e.g., Aslan et al., 2024; Lee et al., 2022, Wilson et al., 2021), note a certain 'cbia' or higher levels of anxiety among older adults during the initial stages of learning in virtual environments, a tendency that gradually fades over time. Internet has not had a widespread effect on the ability of seniors to make informed health choices (Hallows, 2013).

To overcome this digital divide, is mandatory to offer suitable education and training to engage with e-health, tackle past negative experiences and misconceptions about digital health technologies and implement strategies to improve the perceived trustworthiness and credibility of e-health (Wilson et al. 2021). Intergenerational programs are proving to be a successful alternative, developing gains in cognitive abilities, mood, vitality, and self-perception of elderly. These gains enhance their autonomy, promote social inclusion, physical and mental well-being, and encourage digital learning and self-efficacy (Carvalho et al., 2022; Pourrazavi et al., 2020).

1.2 The DigiHealth Project

The aim of this project is to promote health literacy by fostering digital and media skills among the senior population, within the context of intergenerational learning in the digital era. At the same time, it seeks to empower young people to work with this population (supported by digital technologies) with a view to their own self-transformation, in alignment with the principles of solidarity and social justice.

Given that this is an intergenerational proposal - one that involves young people as transformative agents in the real-life contexts of senior adults - it equally equips them with skills aligned with the New European Youth Policy (2019-2027). This policy aims to develop new and innovative ways to meet priorities set in both national and European Union policies. Based on the priorities of “Engage, Connect and Empower” (European Union, 2018), the young people involved in this proposal will also have the opportunity to guide senior adults in making informed decisions about their health and actions related to adopting healthy behaviours, benefitting themselves as well as others.

The collaborative exchange and development of knowledge with young people fosters critical thinking in both age groups—an essential aim of the proposed project. This approach aligns with the Digital Transition Action Plan, Portugal’s guide to achieving the European digitalisation goals, by empowering people with digital skills that support sustainability, including in the area of health.

Topics and concerns in the health field, such as therapeutic adherence, physical exercise and falls prevention, nutrition, use of community facilities and services (e.g. online booking of medical appointments and exams), and online access to other health services, were included in the DigiHealth training program. Mental health will also be addressed, aiming to prevent loneliness and to strengthen virtual connections (using emails and social media), which are relevant factors in the depressive processes often associated with older age.

The program's implementation was guided by the principles of pedagogical diversity and flexibility, in terms of content, assessment and the management of learning times, rhythms and styles. Third-year nursing and physiotherapy students at the Polytechnic Institute Jean Piaget of North (Portugal) were trained to implement the program with the elderly people taking part in the project. The program was implemented during 2023/2024 school year. Forty older adults took part in 20 sessions, held weekly and lasting two hours, run by higher

education students. Each elderly person was given a tablet which they could use continuously throughout the program implementation period.

Considering the characteristics of DigiHealth, the aim of this study is to assess its impact on the levels of e-literacy in health among elderly, comparing these levels before and after the implementation of the program.

2. Methods

2.1 Sample

The study employed a non-random convenience sample consisting of 25 elderly individuals from three community organizations in Vila Nova de Gaia, Portugal (two senior universities and a humanitarian solidarity association). This sampling method was likely chosen due to practical constraints such as accessibility, willingness to participate, resources availability and the need for participants with reasonable autonomy and health. Particularly, the sample size was the restricted number of tablets available for the DigiHealth Project. Since each participant was assigned a personal tablet for the duration of the intervention, the number of devices directly constrained the number of participants. So, convenience sampling inherently limits generalizability, as the sample may not be fully representative of the broader elderly population in Portugal.

The participants are over 60 years old, retired, and present reasonable levels of autonomy and health for their age. Elderly people with severe physical or mental problems were excluded from the sample, as well those who are illiterate or those who, despite attending the education system, are considered functionally illiterate. The average age was 73 years old; the median was 74, the error of deviation was 6.886, the age range was 25, the minimum age was 60 and the maximum age was 85. In terms of gender, the sample included 19 women (76 per cent) and 6 men (24 per cent). In terms of level of education, one cannot read and write, 14 have completed the 1st cycle of basic education, 2 have completed the 2nd cycle of basic education, 4 have completed the 3rd cycle of basic education, 2 have completed secondary education and 2 have completed higher education. Eight elderly people live alone (32%) for an average of 2.44 years, 12 live only with their spouse (48%), 2 live with their spouse and other family members (8%), 2 live with other family members (8%) and 1 life as their carer (4%). About marital status, 14 are married (56%), 9 are widowed (26 %) and 2 are divorced (8 %).

2.2 Instrument

The e-Health Literacy Scale, developed by Silva and Jólluskin (2017), is an adaptation of a broader general health literacy assessment tool, focusing exclusively on items related to health e-literacy. This scale comprises 16 items divided into three sub-scales, evaluated on a 5-point Likert scale. Functional e-Literacy sub-scale Functional e-Literacy (with 1 to 6) assesses the perception of competence/difficulty in accessing information related to health and diseases through ICT. Communicational e-Literacy sub-scale (1 item) assesses the person's perception of their ability/difficulty in communicating and understanding health and disease-related information via the internet. Critical e-Literacy sub-scale (9 items) assesses the individual's perception of their ability to critically and reflectively use health and disease information they gather from the internet. Designed specifically for the Portuguese adult population, the instrument gathers data on individuals' perceived competence or challenges in using Information and Communication Technologies (ICT) to access health and disease-related information. It also examines their self-assessed ability to communicate and

understand such information via the internet, as well as their capacity to critically and thoughtfully engage with health-related information obtained online (Silva & Jólluskin, 2017).

The analysis of the scale's consistency points to a high level of fidelity for the scale (α=0.90), as well as for the functional e-literacy (α=0.94) and critical e-literacy (α=0.83) sub-scales. Internal consistency was not calculated for the communicative e-literacy subscale, as it only consists of one item.

The instrument's concurrent validity was good, with a statistically significant, positive, weak and moderate correlation between general health perception and general health e-literacy ($r=0.39$; $p<0.0001$), functional e-literacy ($r=0.45$; $p<0.0001$), communication e-literacy ($r=0.34$; $p<0.0001$), and critical e-literacy ($r=0.35$; $p<0.0001$).

Examining the correlation, adjusted for the overlap between the items and the sub-scales of the instrument, shows that the correlation is consistently higher between the items and their respective sub-scale (ranging from 0.19 to 0.86) compared to the correlation with other sub-scales, which supports the presence of strong convergent-discriminant validity.

In sum, e-Health Literacy Scale is a short instrument with solid psychometric qualities, which makes it a potentially effective evaluation tool in the e-health domain.

2.3 Procedures

Data collection was carried out in three Community Institutions supporting the elderly, comprising two Senior Universities and one Association for older adults. The information was gathered at the start of the intervention (pre-test) and after its conclusion (post-test).

This study was carried out as part of the DigiHealth Project, which received a favourable opinion from the Piaget Institute Ethics Committee (Reference: P44-566-11/10/2023). Throughout the process, all the ethical principles of research were respected, and the older adults were given free and informed consent. Participation was voluntary and they were guaranteed anonymity.

The data was analysed using SPSS software (version 29), employing suitable statistical tests to assess changes in health e-literacy before and after the program's implementation.

3. Results and Discussion

The statistical power of this study was likely compromised due to the small sample size (N=25), which limits the ability to detect significant differences between pre-test and post-test e-health literacy levels.. Initially, due to the small sample size, an analysis was conducted to verify whether the values obtained in the e-health literacy scale, as well as its subscales, followed a normal distribution, both in the pre-test and post-test. Once the assumptions of normality were confirmed, parametric methods were chosen for analysis. Table 1 presents the measures of central tendency for the values of the e-health literacy scale (and its respective subscales), both in the pre-test and the post-test.

Table 1. Descriptive paired samples statistics

		Mean	**N**	**Std. Deviation**	**Std. Error Mean**
Pair 1	Pre-test e-health literacy – Total score	33.72	25	12.595	2.519
	Pos-test e-health literacy – Total score	39.88	25	15.754	3.151
Pair 2	Pre-test Functional e-health literacy	14.44	25	5.839	1.168
	Pos-test Functional e-health literacy	17.2	25	9.478	1.895
Pair 3	Pre-test Communicational e-health literacy	2.44	25	1.474	0.295
	Pos-test Communicational e-health literacy	2.8	25	1.957	0.391
Pair 4	Pre-test Critical e-health literacy	16.84	25	6.536	1.307
	Pos-test Critical e-health literacy	19.88	25	7.933	1.586

Source: Authors

The results of the comparisons made between the pre-test and post-test, regarding the e-health literacy scale (and its subscales), can be seen in Table 2, as well the paired samples effects size, in Table 3.

Table 2. Paired Differences - Paired samples Test

					95% Confidence Interval of the Difference				**Significance**	
		Mean	*Std. Deviation*	*Std. Error Mean*	*Lower*	*Upper*	*t*	*df*	*One-Sided p*	*Two-Sided p*
Pair 1	Pre-test – Pos-test e-health literacy (total score)	-6.16	23.577	4.715	-15.892	3.572	-1.306	24	0.102	0.204
Pair 2	Pre-test – Pos-test Functional e-health literacy	-2.76	13.763	2,752	-8.441	2.921	-1.003	24	0.163	0.326
Pair 3	Pre-test – Pos-test Communicational e-health literacy	-0.36	2.956	0.591	-1.58	0.86	-0.609	24	0.274	0.548
Pair 4	Pre-test – Pos-test Critical e-health literacy	-3.04	9.462	1.892	-6.945	0.865	-1.606	24	0.061	0.121

Source: Authors

Given the high standard deviations observed in the study (e.g., 23.577 for total e-health literacy), the variation in participants' responses may have diluted potential effects, making it difficult to reach statistical significance despite a positive trend in post-test scores.

Table 3. Paired Samples Effects Size

					95% Confidence Interval	
			Standardizer[a]	*Point Estimate*	*Lower*	*Upper*
Pair 1	Pre-test – Pos-test e-health literacy (total score)	Cohen´s d	23.577	-0.261	-0.657	0.140
		Hedges' correction	24.348	-0.253	-0.637	0.136
Pair 2	Pre-test – Pos-test Functional e-health literacy	Cohen´s d	13.764	-0.201	-0.595	0.198
	Pos-test Functional e-health literacy	Hedges' correction	14.213	-0.194	-0.576	0.191
Pair 3	Pre-test – Pos-test Communicational e-health literacy	Cohen´s d	2.956	-0.122	-0.514	0.273
		Hedges' correction	3.053	-0.118	-0.498	0.264
Pair 4	Pre-test – Pos-test Critical e-health literacy	Cohen´s d	9.463	-0.321	-0.72	0.084
		Hedges' correction	9.772	-0.311	-0.698	0.082

a. The denominator used in estimating the effects sizes.

Cohen's uses the sample standard deviation of the mean difference.

Hedges' correction uses the sample standard deviation of the mean difference, plus a correction factor.

Source: Authors

The results show no statistically significant differences were observed between the pre-test and post-test concerning e-health literacy levels and its dimensions. However, as shown in Table 2, there is a tendency for higher e-health literacy values in the post-test.

In this study, the combination of a small effect size and a limited sample reduced the likelihood of achieving statistical significance, even if the intervention had some beneficial impact.

The results of this study, which indicate a positive trend in the participants' digital and health literacy, albeit without statistical significance, are in line with recent evidence highlighting the benefits of digital interventions in the elderly population. For example, the OITO project demonstrated that workshops with mobile devices can significantly improve digital proficiency and health literacy in middle-aged and older adults, promoting greater autonomy and digital inclusion (Quialheiro et al., 2023).

4. Conclusion

This study aims to assess the impact of a program implemented to promote elderly's e-health literacy – DigiHealth project - by comparing e-health literacy levels before and after the implementation of the program.

The results show that there is a tendency for levels of e-literacy in health to increase before and after the implementation of the program, although the differences are not statistically significant. Therefore, when reading the results obtained, the effect size must be considered, because the suggested small effect sizes, indicates that even if there were real differences, they might be too small to be detected with this sample size. In addition, high standard deviations suggest considerable individual differences in responses, which could further reduce the likelihood of obtaining statistical significance.

These results are in line with most studies that underline the benefits associated with these types of interventions (e. g, Damas, 2023), and particularly, with interventions supported on intergerational programs (Mota, 2019; Patrício, & Ósorio, A., 2017). Implementing practical and effective digital health literacy interventions is essential for utilizing modern digital information technology in managing the health of elderly individuals (Dong et al. 2023). Thus, it is important to motivate older adults to participate in specialized programs for seniors, as many do not possess the necessary skills to use their devices efficiently (Zaid et al., 2022).

This study has the particularity of overcoming limitations pointed out in a recent study, like ours, by Carrasco-Dajer et al. (2024). The authors mention that their digital literacy intervention did not include specific contents on physical health literacy, which may have been responsible for the fact that no significant results were found from the intervention in this dimension. They recommend the incorporation of those contents, as we did, and our results highlight the impact of the DigiHealth project on e-health literacy levels, albeit modest, for the reasons already mentioned.

In sum, the results of this study reinforce the importance of digital literacy programmes for the elderly population, highlighting the need for inclusive and adapted strategies that promote the autonomy, health and well-being of older people in the digital age.

Future studies should consider larger samples, alternative statistical methods, and longer follow-up periods to better capture the intervention's impact. They should also consider increasing equipment access or implementing alternative participation models (for instance, adopting a rotational usage model), allowing more participants to take part. Moreover, future research should explore long-term effects of digital health literacy interventions, using longitudinal studies to assess whether sustained engagement leads to lasting improvements. Given the small sample size and equipment limitations of this study, scalable solutions such as group-based digital training or community-led programs should be tested. Additionally, investigating psychosocial barriers like technophobia and digital anxiety (Aslan et al., 2024) could help tailor interventions to older adults' needs. From a practical perspective, policymakers should promote intergenerational learning models and public-private partnerships to expand digital health education. Finally, integrating AI-driven tools and voice-command technologies could enhance accessibility and usability of e-health resources for aging populations.

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