From Retirement to Reinvention: Never Too Old to Participate in Educational Technology Innovation: A Literature Review

Ismail[1] ID ✉
[1]Universitas Muhammadiyah Enrekang, Indonesia

ARTICLE INFO

ABSTRACT

The rapid development of educational technology demands inclusive innovation, including the involvement of the elderly as a potential resource in such innovation. The increasing population of the elderly globally encourages a new paradigm that views retirement not as the end of productivity, but as a momentum for self-reinvention to contribute to the development of educational technology. This literature review aims to examine the role of the elderly in educational technology innovation through the process of post-retirement self-reinvention and identify supporting and inhibiting factors for their involvement. The results of the study show that the elderly play a role not only as users of technology, but also as contributors of experiences and ideas that enrich digital learning innovation. Active participation of the elderly is supported by age-friendly technology training, community support, inclusive policies, and cross-generational collaboration. This involvement has been shown to improve cognitive function, psychosocial well-being, and strengthen the social networks of the elderly, while addressing the risks of isolation and the digital divide. However, major challenges such as the digital divide, age stereotypes, physical and cognitive barriers remain significant barriers to the participation of the elderly. Effective strategies to overcome these barriers include adaptive training, community mentoring, policies that support technology access, and sustainable technology-based reinvention programs. This study emphasizes the importance of a holistic approach that integrates aspects of technology, pedagogy, and learning content (TPACK) to empower the elderly in educational technology innovation. This study offers a conceptual foundation for formulating policies and programs that promote the active participation of older adults, enabling their optimal contribution to the advancement of educational technology and the enhancement of their quality of life.

Introduction

The development of educational technology is currently experiencing very rapid acceleration along with advances in digital technology and the need for more effective and innovative learning methods (Fischer, 2000; Mishra &

Koehler, 2006). Innovation in educational technology not only involves the younger generation or active workforce, but also opens up opportunities for individuals of all ages, including those who have entered retirement.

According to the United Nations Department of Economic and Social Affairs (2020), the elderly population worldwide continues to increase significantly. This has led to the emergence of a new paradigm regarding the role of the elderly in society, namely not merely as beneficiaries, but also as active agents of change and innovation(Rudnicka et al., 2020; UN ESCAP, 2022). The concept of active aging initiated by the World Health Organization emphasizes the importance of social participation, including in the realm of technology and education, for the elderly to maintain quality of life and psychosocial well-being (Organization World Health, 2015).

Retirement is often seen as a period when individuals stop contributing professionally. However, research shows that retirement can actually be a phase of self-reinvention, where a person can shift their focus to more creative and meaningful activities, such as participating in educational technology innovation. Self-reinvention in retirement refers to the process in which individuals redefine their roles, adapt to new environments, and pursue new opportunities that align with their evolving interests and capabilities. For older adults, this process can involve exploring new hobbies, contributing to societal progress through voluntary work, or, in the case of educational technology, leveraging their vast life experiences to inform technological

innovations (Bergström, 2020; Kim & Moen, 2002; Vroman et al., 2015).

Adaptation and Innovation in Educational Technology: As people transition into retirement, they are presented with a unique opportunity to adapt and engage in new areas such as educational technology. For older adults, educational technology innovation can be an exciting avenue for self-reinvention, as they utilize their accumulated knowledge to contribute to the development of learning tools and platforms that cater to a wider demographic, including their own age group (Fisk et al., 2019). By applying their knowledge in real-world contexts, retirees can help shape more inclusive, user-friendly educational tools that not only enhance learning for other seniors but also bridge the digital divide (Xie, 2003). A concrete example of this is the involvement of elderly individuals in co-designing learning platforms, such as educational apps that are more intuitive and accessible to older users (Schlomann, 2018). This involvement allows retirees to reinvent themselves as contributors to innovation rather than passive recipients of technology, emphasizing the value of their lived experiences in the creation of more inclusive technologies."

Practical Example: One specific example of self-reinvention is seen in community-driven digital literacy programs, where retirees, using their professional backgrounds, contribute to the design of training curricula or mentoring others in technology-related projects (Mitzner et al., 2008). Such programs allow the elderly to transition from mere consumers of technology to active participants and innovators in

educational technology, fostering both personal growth and societal benefit."

Active participation of the elderly in educational technology innovation also has significant social and cognitive benefits. A study by (Charness & Boot, 2009; Cosco et al., 2014; Jakovljevic et al., 2023) found that the involvement of the elderly in technological activities can improve cognitive abilities and reduce the risk of social isolation. Thus, integrating the elderly in the development and implementation of educational technology not only enriches the innovation process but also supports their mental and social health.

However, challenges such as the digital divide and ageism are still major obstacles to the involvement of the elderly in educational technology innovation (Friemel, 2016; Mubarak & Suomi, 2022; van Deursen & van Dijk, 2014). Moreover, the digital era has brought new risks such as the spread of misinformation and fake news, which disproportionately affect older adults. Studies indicate that older individuals are more likely to encounter and share false information online due to a combination of cognitive changes, reduced source memory, and lower digital literacy (Brashier & Schacter, 2020). This not only impacts their ability to evaluate content critically but also raises concerns about their exposure to manipulative or misleading information on social platforms.

Therefore, systematic and strategic efforts are required to overcome these barriers through appropriate training, social support, and inclusive policies, enabling the elderly to play an active role in the development of educational technology. Considering these facts, this article aims to examine how retirement can be a momentum for self-reinvention for the elderly to participate in educational technology innovation, as well as identify factors that support and hinder their involvement. This research is important to open a new perspective that age is not a limitation in contributing to the advancement of educational technology.

Literature Review

1. Educational Technology and Learning Innovation

The development of educational technology has brought about major changes in the teaching and learning process at various levels of education. Innovation in this field does not only focus on the use of technological devices, but also on the effective integration of technology, pedagogy, and learning content to create meaningful and adaptive learning experiences.

One of the main frameworks in this field is Technological Pedagogical Content Knowledge (TPACK) introduced by Herring et al. (2016); Koehler et al. (2013); Mishra & Koehler (2006). The TPACK model emphasizes that the success of technology-based learning innovation depends on the alignment and synergy between three main components: technology, pedagogy, and learning content.

Technology training initiatives for older adults conducted by educational institutions and communities have resulted in effective learning innovations in overcoming barriers to technology use. For instance, several age-friendly platforms and applications have been specifically designed to help older adults

become more proficient in using digital technology. One example is the *SeniorNet* initiative, which provides computer training for seniors and has successfully helped elderly participants develop digital skills, enabling them to engage more fully in online communication, social networking, and even remote learning (Fisk et al., 2019). Another notable example is the *TechBoomers* website, which offers free online courses that teach older adults how to use technology, including how to navigate social media, search the internet, and use online services like email and shopping websites (Schlomann, 2018). These platforms have proven successful in not only teaching technical skills but also in fostering social inclusion by bridging the digital divide."

A study conducted by AARP (Kakulla et al., 2025) on technology adoption among older adults highlights the success of technology training programs. One such program is the University of the Third Age, a global initiative that has provided tech education to seniors in over 40 countries. In the program, older adults learn how to use smartphones, computers, and tablets in interactive, age-appropriate classes. Participants not only acquire practical digital skills but also build a sense of community and social connectivity, which significantly contributes to their mental well-being and reduces isolation. AARP's recent research also underscores the untapped potential for age-tech— technologies designed to help older adults age in place. This includes technologies like medical alert devices, digital health monitors, and smart home technologies that provide increased independence and safety. The success of

these programs demonstrates the effectiveness of tailored technology training initiatives in overcoming barriers such as digital illiteracy, accessibility issues, and fears of technology (Kakulla et al., 2025).
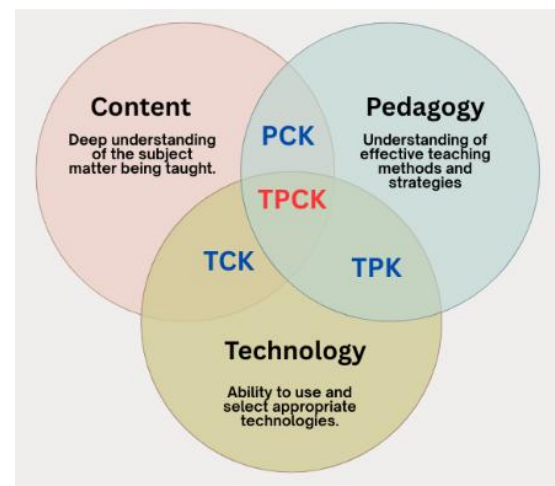
Figure 1. The Technological Pedagogical Content Knowledge (TPACK) Framework

The integration of these three aspects forms a holistic competency for educators and innovators in designing and implementing learning that is not only technology-based, but also pedagogical and content-relevant (Koehler et al., 2013; Mishra & Koehler, 2006). For example, innovations such as online learning platforms, augmented reality, and interactive applications must be tailored to learning objectives and student characteristics.

Subsequent research has expanded the TPACK model by incorporating socio-cultural contexts and learner characteristics (Archambault & Crippen, 2009; Dalal et al., 2017; Niess, 2011). This refinement is essential to ensure that the varying needs and capabilities of users across different age groups— including older adults with diverse technological backgrounds—are

adequately addressed in the design and implementation of educational technologies.

In addition, the concept of Integrative Learning Technologies (ILT) is the focus of educational technology studies. ILT emphasizes the development of adaptive, interactive, and personalized learning tools and methods to improve motivation and learning outcomes (Adams Becker et al., 2018; Johnson et al., 2016; Natanael Delgado Alvarado, 2024; Waycott & Vines, 2019). In the context of the elderly, innovation must consider sensory limitations, different learning styles, and comfort levels with digital technology (Fisk et al., 2019; Hope et al., 2014; Paul & Stegbauer, 2005).

Older adults serve not only as end-users of technology but also as valuable contributors of experiential knowledge and insight, which can enhance the inclusivity and relevance of educational innovation while fostering social and psychological well-being (Selwyn et al., 2003; Vroman et al., 2015). Nonetheless, effective technology integration for this demographic necessitates design approaches that emphasize usability, accessibility, and tailored, age-sensitive training. The application of Human-Computer Interaction (HCI) principles, adapted to the specific cognitive and physical needs of older users, is crucial to ensuring that technological innovations are both accessible and functional (Antona, 2016). Such measures are instrumental in facilitating their active engagement in educational innovation and digital learning environments (Fisk et al., 2019).

2. Demographic Changes, the Concept of Active Aging and Empowerment of the Elderly

Current global demographic changes show a very significant increase in the number of elderly people. Based on data from the (United Nations Department of Economic and Social Affairs, 2020), the number of individuals aged 60 years and over is projected to reach more than 2 billion by 2050, doubling from around 1 billion in 2019. This trend is also reinforced by the latest report from the World Health Organization (WHO, 2024) which states that by 2050, the world's elderly population will reach 2.1 billion people, with around 80% of them living in low- and middle-income countries. This figure confirms the acceleration of the rate of population aging which is much faster than in the past and is a major challenge for health and social systems around the world. Furthermore, WHO (2024) also noted that since 2020, the number of people aged 60 years and over has exceeded the number of children under 5 years of age. It is estimated that by 2030, one in six people in the world will be aged 60 years or over, increasing from 1 billion to 1.4 billion. In fact, the population of elderly people aged 80 years and over is expected to triple between 2020 and 2050, reaching around 426 million people. This demographic change is not only occurring in developed countries such as Japan, which already has 30% of its population aged over 60 years, but also in developing countries that are experiencing the most significant demographic changes (WHO, 2024).

This phenomenon of population aging brings various social and economic challenges, such as the increasing need

for intensive health services, economic dependency, the risk of social isolation, and age discrimination or ageism (Harper, 2014; Jakovljevic et al., 2023). However, the elderly are also a valuable resource who have great experience, knowledge, and capacity to contribute, if they are optimally empowered.

To address this challenge, Organization World Health (2015) introduced the concept of active aging as a strategic framework in improving the quality of life of the elderly. Active aging is the process of optimizing opportunities for the elderly to participate socially, economically, culturally, spiritually, and technologically with the aim of extending a healthy and meaningful life span. This concept emphasizes the importance of creating a supportive environment, access to adequate health services, lifelong education, and active involvement in various social and economic activities.

Various studies have shown that the application of the active aging principle has a positive impact on the physical, mental, and psychosocial health of the elderly. Active social participation can reduce the risk of depression and improve quality of life (Berkman et al., 2013; Depp & Jeste, 2006). In addition, empowering the elderly in the use of technology can also strengthen self-confidence, increase adaptability, and reduce the digital divide which has been a major barrier for the elderly in accessing technology (Charness & Boot, 2009; Fisk et al., 2019).

In the context of educational technology innovation, empowering the elderly through the active aging principle opens up opportunities for them to not only become technology users, but also active contributors to the development of inclusive and sustainable educational technology solutions. The elderly can utilize their professional experience and life knowledge to create innovations that are relevant and adaptive to the needs of various generations (Selwyn, 2004; (Selwyn et al., 2003; Vroman et al., 2015) et al., 2015). This approach supports the empowerment paradigm that emphasizes independence and meaningful social participation.

In addition, WHO (2024) emphasizes the importance of community adaptation to changes in the demographics of the elderly through the development of age-friendly environments, such as transportation planning, housing, and social services that support the independence and participation of the elderly in general. Thus, empowering the elderly in educational technology innovation not only contributes to educational progress, but also becomes part of the global effort to create an inclusive and sustainable society amidst rapid demographic changes.

3. Retirement as a Momentum for Self-Reinvention

Traditionally, retirement is considered as the end of productivity and withdrawal from professional activities. However, this paradigm has shifted with the understanding that retirement is a transitional period that opens up opportunities for self-reinvention (Kim & Moen, 2002).

Self-reinvention during retirement refers to the process of adaptation and transformation of identity and activities after stopping work. Individuals who successfully pass through this phase tend

to find new meaning through exploring opportunities, developing hobbies, and engaging in social activities and innovation (Mitzner et al., 2008; Pang et al., 2021). Life transition theory emphasizes the importance of flexibility and adaptability in dealing with changes throughout the life cycle (Schlossberg, 1981; Wang, 2005; Wang et al., 2011).

Kim & Moen (2002) emphasized that retirement is an important moment for psychological growth and the development of new, more meaningful roles. Through self-reinvention, the elderly can shift their focus from career to creative and social activities, such as contributing to the development of educational technology. Previous work experience and knowledge can be utilized for technology-based educational innovation.

In addition, self-reinvention contributes to the mental and emotional well-being of the elderly. Hansson et al. (2018); Pinquart & Schindler (2007) study showed that older adults who actively seek new roles after retirement have higher life satisfaction and psychological well-being, while reducing the risk of identity loss and depression during the retirement transition.

4. Elderly Involvement in Technology Use and Innovation

The active participation of older adults in the use of digital technology plays a critical role in enhancing their overall quality of life and promoting their empowerment within the context of the digital age. Empirical evidence presented by (Dewsbury et al., 2007; Fisk et al., 2019; Sarcar et al., 2023) demonstrates that such engagement contributes significantly to cognitive stimulation and

psychological well-being. Moreover, the involvement of the elderly facilitates the intergenerational transfer of tacit knowledge and lived experience, which holds considerable value in informing the design and advancement of inclusive and context-sensitive educational technologies.

Elderly people, with their life experiences and wisdom, provide unique perspectives that can encourage the creation of more inclusive and relevant innovative solutions. As an age group rich in experience, they are able to provide different insights, especially in the development of learning technology that is responsive to the needs of diverse users (Schlomann, 2018; Vaportzis et al., 2017). A participatory approach that involves the elderly as active contributors can enrich innovation by adjusting technological features to make them easier to use and acceptable to older age groups (Niehaves & Plattfaut, 2014; Selwyn et al., 2003; Tyler et al., 2020), 2004).

Discussion

1. Elderly Participation in Educational Technology Innovation

Elderly people are human resources rich in experience and knowledge, which can be optimally utilized in the development of educational technology. They are not only end users, but also innovation partners who provide deep insights into real needs, obstacles, and practical solutions in the use of learning technology (Pang et al., 2021; Sohier et al., 2021). Their professional and social experiences enable the contribution of critical perspectives that make innovation

products more inclusive, adaptive, and sustainable (Fisk et al., 2019; Xie, 2003).

The involvement of older adults also contributes meaningfully to intergenerational collaboration, serving as a catalyst for the co-creation of more innovative, effective, and contextually grounded solutions. Such collaboration leverages the complementary strengths of both groups—integrating the digital fluency and technological adaptability of younger individuals with the practical insight, critical reflection, and accumulated life experience of older adults (Schlomann, 2018; Vaportzis et al., 2017). This synergistic interaction fosters mutual learning, enhances design relevance, and supports the development of educational technologies that are both forward-looking and socially inclusive.

A concrete example is a program for developing learning applications based on local cultural experiences that involve the elderly as the main resource persons. In several communities, the elderly play a role in developing digital educational content that highlights local wisdom, history, and traditional values, which are integrated into interactive learning applications (Hope et al., 2014; Rebola & Jones, 2013; Rice & Alm, 2008; Selwyn et al., 2003; Vroman et al., 2015). The involvement of older adults in the design and testing of applications ensures that content is relevant, authentic, and accessible to all ages (Wilson et al., 2023).

Technology training initiatives for older adults conducted by educational institutions and communities have resulted in effective learning innovations in overcoming barriers to technology use. Through this training, older adults not only improve their digital skills but also contribute to the development of age-

friendly and accessible learning methods (Carstensen & Mikels, 2005; Charness & Boot, 2009; Sakaguchi-Tang et al., 2021).

Technology training initiatives for older adults conducted by educational institutions and communities have resulted in effective learning innovations in overcoming barriers to technology use. For example, *SeniorNet*, a global nonprofit organization, has provided computer and internet training to seniors for over 30 years. Through its online and in-person courses, *SeniorNet* helps older adults become more comfortable with digital technology by teaching them how to use the internet, email, and social media platforms (Fisk et al., 2019). Similarly, AARP's digital literacy programs have successfully assisted older adults in gaining digital skills for various purposes, including employment, by offering training on the use of workplace technologies and online tools. Similarly, AARP's digital literacy programs have successfully assisted older adults in gaining digital skills for various purposes, including employment, by offering training on the use of workplace technologies and online tools (AARP, 2020). In addition, AARP's *Empowering Independence With Technology Among Adults Age 50-Plus* study highlights the untapped potential of technology to meet the needs of older adults, especially in helping them age in place. The study emphasizes the role of *age-tech*, such as medical alert devices and smart home technologies, which are designed to support independence by ensuring safety and fostering social connections (AARP, 2025). These technologies, alongside communication tools and health-monitoring devices, help reduce isolation, enhance well-being, and

enable older adults to remain engaged in their communities, thus bridging the digital divide and empowering them to be active participants in the digital world.

Case Study. A relevant case study is the *University of the Third Age* (U3A) in the UK, which has been a successful model for empowering older adults through education. U3A provides technology-focused courses, such as using smartphones, tablets, and computers, specifically designed for the elderly. In a study conducted by *Schlomann* (2018), participants who engaged in U3A's digital technology programs reported increased confidence in using digital devices, improved cognitive abilities, and a stronger sense of social inclusion. Furthermore, these courses have been shown to reduce feelings of isolation by enabling participants to connect with peers through digital platforms, thereby enhancing their social networks (Schlomann, 2018). The success of this initiative highlights the importance of offering accessible, age-appropriate training to promote lifelong learning and digital literacy among older adults.

2. Cognitive, Psychosocial, and Social Benefits of Elderly Participation

Elderly involvement in innovation and utilization of educational technology has a comprehensive positive impact on various aspects of their lives. Cognitively, this activity stimulates brain functions such as memory, problem-solving skills, and critical thinking, which are important for slowing down the cognitive decline that is common in old age (Charness & Boot, 2009; Fisk et al., 2019). The use of technology also encourages lifelong learning, a crucial factor in maintaining mental and cognitive health.

From a psychosocial perspective, active participation in technological innovation increases the sense of self-esteem and achievement of older adults. They feel valued as productive individuals who are able to make meaningful contributions, which directly improves psychological well-being and reduces the risk of depression (Hansson et al., 2018; Pinquart & Schindler, 2007). This social recognition strengthens their motivation and maintains their quality of life. Socially, active use of technology helps to overcome isolation and loneliness, problems that are often experienced by older adults. Social media, communication apps, and online learning platforms allow them to expand their social networks, maintain interpersonal relationships, and strengthen their sense of social belonging—all important elements for social well-being (Berkman et al., 2013; Charness & Boot, 2009).

3. Barriers and Challenges

Despite the considerable potential of older adults to contribute to educational technology innovation, their actual participation remains constrained by a range of multifaceted and interrelated barriers. A comprehensive understanding of these challenges is imperative to inform the design of targeted, evidence-based interventions that can meaningfully enhance their engagement in digital environments and technology-driven educational initiatives.

Digital Divide and Technology Literacy in the Elderly

One of the main barriers is the digital divide which is still significant between the younger generation and the elderly (Friemel, 2016). This gap includes limited access to technological devices, inadequate internet connections, and especially low digital literacy among the elderly. The lack of ability to understand and use digital learning devices or applications reduces their self-confidence and motivation to be actively involved in technological innovation (Schlomann, 2018; Vaportzis et al., 2017). This creates a closed circle that hinders the opportunities for the elderly to learn and innovate digitally.

Age Stereotypes and Discrimination against the Elderly in Technology

Beyond technical limitations, negative age-related stereotypes—commonly referred to as ageism—constitute a substantial barrier to the participation of older adults in technological domains. These prejudicial assumptions often portray older individuals as lacking the capability or motivation to engage with emerging technologies, thereby restricting their access to digital training programs and innovation opportunities (Charness & Boot, 2009). Such discriminatory attitudes not only diminish the intrinsic motivation of older adults to participate but also contribute to psychosocial consequences, including feelings of marginalization and decreased self-worth, which in turn hinder their sustained engagement with technology.

Physical, Cognitive, and Social Barriers

In conjunction with socio-environmental constraints, intrinsic factors—particularly age-related physiological and cognitive decline—present additional challenges for older adults in utilizing digital technologies. Impairments in vision, hearing, and motor coordination impede their ability to navigate and operate digital devices effectively (Fisk et al., 2019). Moreover, cognitive changes such as diminished memory retention and slower information processing exacerbate the difficulty of adapting to new technological tools. From a social standpoint, experiences of isolation and the absence of adequate support systems—either familial or community-based—further limit the ability of older individuals to engage meaningfully in educational technology innovation (Berkman et al., 2013).

Efforts and Approaches to Overcoming Barriers

Overcoming these barriers requires a holistic approach that is age-friendly and contextual. Technology training programs should be designed with simple, easy-to-understand methods, and use clear and communicative language, while paying attention to the physical and cognitive needs of the elderly (Fisk et al., 2019). In addition, social support from family, peers, and the community is essential to strengthen motivation and provide practical assistance during the learning process. Furthermore, inclusive policies that encourage access to technology and training for the elderly should be a priority for the government and educational institutions. Regulations that

support the provision of technology infrastructure, ongoing training, and incentives for organizations that empower the elderly are essential to creating an inclusive and sustainable innovation ecosystem.

4. Strategies and Efforts to Support Elderly Participation

To optimize the contributions of older adults in educational technology innovation and reinforce their sustained engagement, it is essential to adopt a strategic framework that is targeted, inclusive, and sustainable. The following are four key strategies proposed to support this objective:

Age-Friendly Technology Training

Technology training for the elderly must be designed with an approach that takes into account their physical, cognitive, and psychological needs. Simple, interactive learning methods that use easy-to-understand language are essential to improving the digital literacy of the elderly (Fisk et al., 2019). Training materials need to focus on relevant and practical applications of technology in everyday life, such as the use of digital learning devices. Continuous training accompanied by mentoring is also very helpful in increasing the self-confidence and adaptability of the elderly to technological developments.

Community Support and Inclusive Policies

Communities play a vital role in encouraging the involvement of the elderly. Social support from family, peers, and community groups can strengthen the motivation of the elderly to continue learning and innovating. In addition, inclusive and pro-elderly public policies are needed to provide access to technology, supporting infrastructure, and affordable and easily accessible training programs (WHO, 2015). Governments and educational institutions must develop regulations and specific programs that accommodate the needs of the elderly, including providing incentives to organizations that actively empower the elderly through technology.

Technology-Based Reinventing Programs

Encouraging the elderly to reinvent themselves through programs that integrate technology opens up new opportunities for self-development and social contribution. These programs can take the form of digital entrepreneurship training, development of educational content based on life experiences, or participation in educational technology innovation projects (Kim & Moen, 2002; Neves et al., 2013). This approach not only improves technological skills but also strengthens the sense of self-esteem and social relevance of the elderly, which has a positive impact on their psychosocial well-being.

Cross-Generational Collaboration in Innovation Development

Collaboration between the younger generation and the elderly in educational technology innovation is an effective strategy that combines the technological expertise of the younger generation with the life experiences of the elderly. This cross-generational approach creates a mutually supportive and enriching learning environment, while accelerating innovation that is inclusive and responsive to the needs of all age groups (Vaportzis et al., 2017). Real examples of

the implementation of this strategy include mentoring programs, joint workshops, and innovation communities that involve both generations.

Conclusion

The elderly have great potential to play an active role in educational technology innovation, especially through the process of self-reinvention during retirement. The Technological Pedagogical Content Knowledge (TPACK) framework is an important foundation that integrates aspects of technology, pedagogy, and learning content synergistically to increase the effectiveness of innovation. The involvement of the elderly in educational technology innovation not only enriches the quality of the innovation but also has a positive impact on cognitive health, psychosocial well-being, and social networks of the elderly. Although there are various obstacles such as the digital divide, age stereotypes, and physical and cognitive limitations, the role of the elderly can be optimized through age-friendly training, inclusive policies, and structured and sustainable cross-generational collaboration.

Theoretically, this study broadens the understanding of the concept of active aging and self-reinvention in the context of educational technology, while emphasizing the importance of a holistic approach based on TPACK for empowering the elderly. Practically, the results of this study can be a basis for educational institutions, policy makers, and technology developers in designing more inclusive training programs and policies, as well as technology products that are responsive to the needs of the elderly.

Further research recommendations include developing and evaluating a technology-based reinvention program implementation model with concrete case studies in various elderly communities, as well as measuring the long-term impact on their well-being and social participation. Practitioners are advised to develop adaptive technology training and build a sustainable cross-generational collaboration ecosystem, while policymakers need to prioritize digital inclusivity as an integral part of national social and technological development strategies.

Funding

References

[1] AARP. (2020). *Digital Literacy for Older Adults: Bridging the Digital Divide*. Retrieved from https://www.aarp.org/technology/

[2] Adams Becker, S., Brown, M., Dahlstrom, E., Davis, A., DePaul, K., Diaz, V., & Pomerantz, J. (2018). *Horizon Report 2018 Higher Education Edition*. https://library.educause.edu/~/media/files/library/2018/8/2018horizonreport.pdf

[3] Antona, M. (2016). Universal Access in Human-Computer Interaction: Interaction Techniques and Environments. *Access to the Human Environment and Culture: 10th International Conference, UAHCI 2016*, *July*. https://doi.org/10.1007/978-3-319-40244-4

[4] Archambault, L., & Crippen, K. (2009). Examining TPACK among K-12 online distance educators in the United States. *Contemporary Issues in Technology and Teacher Education*, *9*(1), 71–88. https://doi.org/10.1080/0158791022000009213

[5] Bergström, A. (2020). Exploring digital divides in older adults' news consumption. *Nordicom Review*, *41*(2), 163–177. https://doi.org/10.2478/nor-2020-0021

[6] Berkman, L. F., Glass, T., Brissette, I., & Seeman, T. E. (2013). From social integration to health: Durkheim in the new millennium. *The Sociology of Health and Illness: A Reader*, *51*, 99–111. https://doi.org/10.4324/97813150130 15-18

[7] Brashier, N. M., & Schacter, D. L. (2020). Aging in an Era of Fake News. *Current Directions in Psychological Science*, *29*(3), 316–323. https://doi.org/10.1177/09637214209 15872

[8] Carstensen, L. L., & Mikels, J. A. (2005). At the intersection of emotion and cognitiom: Aging and the positivity effect. *Current Directions in Psychological Science*, *14*(3), 117–121. https://doi.org/10.1111/j.0963-7214.2005.00348.x

[9] Charness, N., & Boot, W. R. (2009). Aging and information technology use: Potential and barriers. *Current Directions in Psychological Science*, *18*(5), 253–258. https://doi.org/10.1111/j.1467-8721.2009.01647.x

[10] Cosco, T. D., Prina, A. M., Perales, J., Stephan, B. C. M., & Brayne, C. (2014). Operational definitions of successful aging: A systematic review. *International Psychogeriatrics*, *26*(3), 373–381. https://doi.org/10.1017/S1041610213 002287

[11] Dalal, M., Archambault, L., & Shelton, C. (2017). Professional Development for International Teachers: Examining TPACK and Technology Integration Decision Making. *Journal of Research on Technology in Education*, *49*(3–4), 117–133. https://doi.org/10.1080/15391523.201 7.1314780

[12] Depp, C. A., & Jeste, D. V. (2006). Definitions and predictors of successful aging: A comprehensive review of larger quantitative studies. *American Journal of Geriatric Psychiatry*, *14*(1), 6–20. https://doi.org/10.1097/01.JGP.000019 2501.03069.bc

[13] Dewsbury, G., Rouncefield, M., Sommerville, I., Onditi, V., & Bagnall, P. (2007). Designing technology with older people. *Universal Access in the Information Society*, *6*(2), 207–217. https://doi.org/10.1007/s10209-007-0079-7

[14] Fischer, G. (2000). Lifelong Learning-More Than Training Lifelong Learning Ñ More Than Training. *Journal of Interactive Learning Research*, *11*(3), 265–294. www.irnet.us.edu.pl

[15] Fisk, A. D., Czaja, S. J., Rogers, W. A., Charness, N., & Sharit, J. (2019). Designing for Older Adults: Principles and Creative Human Factors Approaches. In *CRC press*.

[16] Friemel, T. N. (2016). The digital divide has grown old: Determinants of a digital divide among seniors. *New Media and Society*, *18*(2), 313–331. https://doi.org/10.1177/14614448145 38648

[17] Hansson, I., Buratti, S., Thorvaldsson, V., Johansson, B., & Berg, A. I. (2018). Changes in life satisfaction in the retirement transition: Interaction effects of transition type and individual resources. *Work, Aging and Retirement*, *4*(4), 352–366. https://doi.org/10.1093/workar/wax0 25

[18] Harper, S. (2014). Economic and social implications of aging societies. *Science*, *346*(6209), 587–591. https://doi.org/10.1126/science.12544 05

[19] Herring, M. C., Koehler, M. J., & Mishra, P. (2016). Handbook of technological pedagogical content knowledge (TPACK) for educators: Second edition. In *Handbook of Technological Pedagogical Content Knowledge (TPACK) for Educators: Second Edition*. https://doi.org/10.4324/97813157713 28

[20] Hope, A., Schwaba, T., & Piper, A. M. (2014). Understanding digital and material social communications for older adults. *Conference on Human Factors in Computing Systems - Proceedings*, 3903–

3912.
https://doi.org/10.1145/2556288.2557133

[21] Jakovljevic, M., Kumagai, N., & Ogura, S. (2023). Global population aging–Health care, social and economic consequences, volume II. *Frontiers in Public Health*, *11*(3). https://doi.org/10.3389/fpubh.2023.1184950

[22] Johnson, L., Adams, B. S., Estrada, V., & Freeman, A. (2016). *Horizon Report 2016 Higher Education Edition*.

[23] Kakulla, Brittne, Laura Skufca, Patty David, Jessica Boothe, and Kristen Garrett. *Empowering Independence With Technology Among Adults Age 50-Plus.* Washington, DC: AARP Research, January 2025. https://doi.org/10.26419/res.00898.001
Kakulla, Brittne, Laura Skufca, Patty David, Jessica Boothe, and Kristen Garrett. *Empowering Independence With Technology Among Adults Age 50-Plus*. Washington, DC: AARP Research, January 2025. https://doi.org/10.26419/res.00898.001

[24] Kakulla, Brittne. *2025 Tech Trends and Adults 50+*. Washington, DC: AARP Research, December 2024. https://doi.org/10.26419/res.00891.001

[25] Kim, J. E., & Moen, P. (2002). Retirement transitions, gender, and psychological well-being: A life-course, ecological model. *Journals of Gerontology - Series B Psychological Sciences and Social Sciences*, *57*(3). https://doi.org/10.1093/geronb/57.3.P212

[26] Koehler, M. J., Mishra, P., & Cain, W. (2013). What is Technological Pedagogical Content Knowledge (TPACK)? *Journal of Education*, *193*(3), 13–19. https://doi.org/10.1177/002205741319300303

[27] Mishra, P., & Koehler, M. J. (2006). Technological Pedagogical Content Knowledge: A Framework for Teacher Knowledge. *Teachers College Record: The Voice of Scholarship in Education*, *108*(6), 1017–1054. https://doi.org/10.1177/016146810610800610

[28] Mitzner, T. L., Fausset, C. B., Boron, J. B., Adams, A. E., Dijkstra, K., Lee, C. C., Rogers, W. A., & Fisk, A. D. (2008). Older Adults' Training Preferences for Learning to Use Technology. *Proc Hum Factors Ergon Soc Annu Meet.*, *52*(26), 2047–2051. https://doi.org/10.1177/154193120805202

[29] Mubarak, F., & Suomi, R. (2022). Elderly Forgotten? Digital Exclusion in the Information Age and the Rising Grey Digital Divide. *Inquiry (United States)*, *59*, 1–7. https://doi.org/10.1177/00469580221096272

[30] Natanael Delgado Alvarado. (2024). *Fostering Language learning through a training model embedding Self-Regulated Learning (SRL) and Integrative Learning Technologies (ILT): Action-research at a Mexican University* [Doctoral Dissertation]. University of Southampton.

[31] Neves, B. B., Amaro, F., & Fonseca, J. R. S. (2013). Coming of (old) age in the digital age: ICT usage and non-usage among older adults. *Sociological Research Online*, *18*(2), 22–35. https://doi.org/10.5153/sro.2998

[32] Niehaves, B., & Plattfaut, R. (2014). Internet adoption by the elderly: Employing IS technology acceptance theories for understanding the age-related digital divide. *European Journal of Information Systems*, *23*(6), 708–726. https://doi.org/10.1057/ejis.2013.19

[33] Niess, M. L. (2011). Investigating TPACK: Knowledge growth in teaching with technology. *Journal of Educational Computing Research*, *44*(3), 299–317. https://doi.org/10.2190/EC.44.3.c

[34] Organization World Health, (WHO). (2015). *World report on ageing and health*. WHO Press. https://www.who.int/ageing/events/world-report-2015-launch/en/

[35] Pang, C., Collin Wang, Z., McGrenere, J., Leung, R., Dai, J., & Moffatt, K. (2021).

Technology Adoption and Learning Preferences for Older Adults: *In Proceedings of the 2021 CHI Conference on Human Factors in Computing Systems (Pp. 1-13).* https://doi.org/10.1145/3411764.3445 702

[36] Paul, G., & Stegbauer, C. (2005). Is the digital divide between young and elderly people increasing? *First Monday*, *10*(10). https://doi.org/10.5210/fm.v10i10.128 6

[37] Pinquart, M., & Schindler, I. (2007). Changes of Life Satisfaction in the Transition to Retirement: A Latent-Class Approach. *Psychology and Aging*, *22*(3), 442–455. https://doi.org/10.1037/0882-7974.22.3.442

[38] Rebola, C. B., & Jones, B. (2013). Sympathetic devices: Designing technologies for older adults. *SIGDOC 2013 - Proceedings of the 31st ACM International Conference on Design of Communication*, 151–155. https://doi.org/10.1145/2507065.2507 083

[39] Rice, M., & Alm, N. (2008). Designing new interfaces for digital interactive television usable by older adults. *Computers in Entertainment*, *6*(1), 1–20. https://doi.org/10.1145/1350843.1350 849

[40] Rudnicka, E., Napierała, P., Podfigurna, A., Męczekalski, B., Smolarczyk, R., & Grymowicz, M. (2020). The World Health Organization (WHO) approach to healthy ageing. *Maturitas*, *139*(February), 6–11. https://doi.org/10.1016/j.maturitas.20 20.05.018

[41] Sakaguchi-Tang, D. K., Cunningham, J. L., Roldan, W., Yip, J., & Kientz, J. A. (2021). Co-Design with Older Adults: Examining and Reflecting on Collaboration with Aging Communities. *Proceedings of the ACM on Human-Computer Interaction*, *5*(CSCW2). https://doi.org/10.1145/3479506

[42] Sarcar, S., Munteanu, C., Sin, J., Wei, C., & Sayago, S. (2023). Designing Conversational User Interfaces for Older Adults. *Proceedings of the 5th International Conference on Conversational User Interfaces, CUI 2023*. https://doi.org/10.1145/3571884.3597 438

[43] Schlomann, A. L. (2018). *Older Adults' Preferences towards Using Digital Technologies: Usage Patterns, Facilitators and Barriers for Long-term Use, Potential for Gerontological Research* [Doctoral Dissertation]. https://kups.ub.uni-koeln.de/8444/

[44] Schlossberg, N. K. (1981). A Model for Analyzing Human Adaptation to Transition. *The Counseling Psychologist*, *9*(2), 2–18. https://doi.org/10.1177/00110000810 0900202

[45] Selwyn, N., Gorard, S., Furlong, J., & Madden, L. (2003). Older adults' use of information and communications technology in everyday life. *Ageing and Society*, *23*(5), 561–582. https://doi.org/10.1017/S0144686X03 001302

[46] Sohier, L., Van Ootegem, L., & Verhofstadt, E. (2021). Well-Being During the Transition from Work to Retirement. *Journal of Happiness Studies*, *22*(1), 263–286. https://doi.org/10.1007/s10902-020-00228-6

[47] Tyler, M., De George-Walker, L., & Simic, V. (2020). Motivation matters: Older adults and information communication technologies. *Studies in the Education of Adults*, *52*(2), 175–194. https://doi.org/10.1080/02660830.202 0.1731058

[48] UN ESCAP. (2022). *Asia-Pacific Report on Population Ageing 2022*.

[49] United Nations Department of Economic and Social Affairs, P. D. (2020). World Population Ageing 2020 Highlights: Living arrangements of older persons. In *(ST/ESA/SER.A/451)*. http://link.springer.com/chapter/10.10 07/978-94-007-5204-7_6

[50] van Deursen, A. J. A. M., & van Dijk, J. A. G. M. (2014). The digital divide shifts to differences in usage. *New Media and Society*, *16*(3), 507–526. https://doi.org/10.1177/14614448134 87959

[51] Vaportzis, E., Clausen, M. G., & Gow, A. J. (2017). Older adults perceptions of

technology and barriers to interacting with tablet computers: A focus group study. *Frontiers in Psychology*, *8*(OCT), 1–11. https://doi.org/10.3389/fpsyg.2017.01687

[52] Vroman, K. G., Arthanat, S., & Lysack, C. (2015). "Who over 65 is online?" Older adults' dispositions toward information communication technology. *Computers in Human Behavior*, *43*, 156–166. https://doi.org/10.1016/j.chb.2014.10.018

[53] Wang, M. (2005). Profiling retirees in the retirement transition and adjustment process: examining the longitudinal change patterns of retirees' psychological well-being. *Journal of Applied Psychology*, *92*(2), 455.

[54] Wang, M., Henkens, K., & van Solinge, H. (2011). Retirement Adjustment: A Review of Theoretical and Empirical Advancements. *American Psychologist*, *66*(3), 204–213. https://doi.org/10.1037/a0022414

[55] Waycott, J., & Vines, J. (2019). Ageing and Digital Technology: Designing and Evaluating Emerging Technologies for Older Adults. *Ageing and Digital Technology. Springer*, 173–187. https://doi.org/10.1007/978-981-13-3693-5

[56] WHO. (2024). *Ageing and health*. https://www.who.int/news-room/fact-sheets/detail/ageing-and-health

[57] Wilson, G., Gates, J. R., Vijaykumar, S., & Morgan, D. J. (2023). Understanding older adults' use of social technology and the factors influencing use. *Ageing and Society*, *43*(1), 222–245. https://doi.org/10.1017/S0144686X21000490

[58] Xie, B. (2003). Older adults, computers, and the internet: Future directions. *Gerontechnology*, *2*(4). https://doi.org/10.4017/gt.2003.02.04.002.00