Luis Fernando González-Beltrán
(Organizador)

# Educação no Século XXI:

## Perspectivas Contemporâneas sobre Ensino-Aprendizagem

VOL VII

EDITORA ARTEMIS
2026

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## PRÓLOGO

La educación del siglo XXI se desarrolla en un escenario atravesado por transformaciones profundas, incluso por una pandemia que aceleró la adopción de nuevas tecnologías, en el que las instituciones, los docentes y los estudiantes enfrentan desafíos cada vez más complejos. Las nuevas demandas sociales, tecnológicas, culturales, ambientales y éticas han ampliado el modo en que comprendemos los procesos de enseñanza-aprendizaje, invitando a repensar no solo qué se enseña, sino también cómo, para quién, con qué recursos, desde qué perspectivas y con qué finalidades formativas.

En este contexto, el volumen ***Educação no século XXI: Perspectivas Contemporâneas sobre Ensino-Aprendizagem VII*** reúne un conjunto diverso de trabajos que dialogan con problemas centrales de la educación contemporánea. Los capítulos que integran esta obra permiten observar la amplitud del campo educativo actual, en el que conviven investigaciones sobre trayectorias estudiantiles, formación docente, inclusión, interculturalidad, tecnologías digitales, inteligencia artificial, metodologías activas, lectura, escritura, sostenibilidad, ética y transformación institucional.

La organización de este volumen se pensó a partir de una lógica progresiva, estructurada en seis ejes temáticos. El primer eje se orienta al diagnóstico institucional, las trayectorias estudiantiles y los ambientes de aprendizaje. Los trabajos reunidos en esta sección destacan la importancia de conocer las condiciones socio-pedagógicas, académicas e institucionales que influyen en la permanencia, el desempeño y la experiencia educativa de los estudiantes. Asimismo, subrayan la necesidad de contar con información pertinente para orientar decisiones, diseñar intervenciones tempranas y fortalecer los procesos de acompañamiento educativo.

La formación docente, la profesionalización y la ética educativa se abordan en el segundo eje. Aquí se reflexiona sobre los trayectos formativos del profesorado, los programas de iniciación y regularización docente, la transformación de las prácticas educativas y la responsabilidad ética en la formación superior. Estos temas evidencian que la docencia no puede entenderse como una actividad estática, sino como una práctica en permanente construcción, que exige actualización, pensamiento crítico, compromiso institucional y sensibilidad frente a las transformaciones sociales y culturales de nuestro tiempo. No podemos olvidar la “transformación de valores en la sociedad”, que nos permita transitar de la visión neoliberal de la educación como un servicio y verla como un derecho.

El tercer eje se centra en la inclusión, la diversidad y el aprendizaje a lo largo de la vida. Desde esta perspectiva, la educación aparece como un derecho que debe responder a realidades múltiples, considerando condiciones de discapacidad, interculturalidad,

diversidad lingüística, envejecimiento, brechas digitales y participación social. Los trabajos reunidos en esta sección abordan desafíos relacionados con la educación inclusiva, la promoción de los derechos de las personas con discapacidad, la formación docente para la preservación de lenguas y culturas indígenas, así como el desarrollo de competencias digitales y de pensamiento crítico en distintas etapas de la vida. En conjunto, estas contribuciones invitan a comprender la inclusión no solo como acceso al sistema educativo, sino también como la construcción de condiciones efectivas para el reconocimiento de la diversidad cultural y lingüística, la participación activa, la autonomía y el desarrollo integral de las personas y comunidades.

El cuarto eje reúne investigaciones vinculadas a tecnologías digitales, inteligencia artificial e innovación pedagógica. En este conjunto, se analizan las competencias docentes necesarias para integrar herramientas tecnológicas en los contextos educativos, así como el papel de las TIC, la gamificación, el pensamiento computacional y la realidad virtual inmersiva en la transformación de las prácticas de enseñanza-aprendizaje. Más allá de la incorporación técnica de recursos digitales, estos trabajos ponen en evidencia la necesidad de diseñar experiencias pedagógicas intencionadas, éticas, críticas y orientadas al desarrollo de aprendizajes significativos. Los autores destacan cómo la formación debe incluir un proceso de crítica y, sobre todo, de reflexión.

Las prácticas didácticas, la lectura, la escritura, la creatividad y los enfoques STEAM se ven representados en el quinto eje. Los capítulos aquí reunidos muestran que la innovación educativa también se expresa en propuestas concretas de aula; en recursos didácticos; en experiencias de lectura; en estrategias de escritura académica y en actividades que integran juego, arte, geometría, arquitectura y pensamiento interdisciplinario. Estas contribuciones resaltan el valor de las metodologías activas y expresivas para fortalecer la comprensión, la participación y la construcción de conocimiento.

Finalmente, el sexto eje aborda la educación ambiental, la sostenibilidad y la ciudadanía ecológica. En esta sección, la obra se aproxima a uno de los grandes desafíos educativos contemporáneos: formar sujetos capaces de comprender la crisis ambiental, actuar responsablemente frente al uso de los recursos naturales y participar en la construcción de comunidades más sostenibles. La educación ambiental aparece, así, como una dimensión transversal que interpela a las instituciones, los currículos, las prácticas docentes y las formas de habitar el mundo.

En conjunto, este volumen evidencia que enseñar y aprender en el siglo XXI implica mucho más que transmitir contenidos. Requiere construir ambientes de aprendizaje inclusivos, fortalecer la formación docente, incorporar críticamente las tecnologías,

reconocer la diversidad de los estudiantes, promover prácticas didácticas innovadoras y asumir una responsabilidad ética y socioambiental frente al futuro. La educación se presenta, por tanto, como un espacio de transformación, diálogo y compromiso colectivo. Incluso puede notarse en cada capítulo cómo la investigación sobre el proceso educativo abarca el papel del maestro como uno de los actores, y simultáneamente como una unidad de estudio de sí mismo, donde la subjetividad tiene un lugar central.

Esperamos que ***Educação no século XXI: Perspectivas Contemporâneas sobre Ensino-Aprendizagem VII*** contribuya al debate académico y pedagógico sobre los desafíos actuales de la enseñanza y del aprendizaje. Que los trabajos aquí reunidos inspiren nuevas investigaciones, nuevas prácticas docentes y nuevas formas de pensar la educación como un proceso vivo, situado, inclusivo y profundamente vinculado a las necesidades de nuestro tiempo.

**Dr. Luis Fernando González Beltrán**
Universidad Nacional Autónoma de México (UNAM)

## SUMÁRIO

### DIAGNÓSTICO INSTITUCIONAL, TRAYECTORIAS ESTUDIANTILES Y AMBIENTES DE APRENDIZAJE



### FORMACIÓN DOCENTE, PROFESIONALIZACIÓN Y ÉTICA EDUCATIVA

# CAPÍTULO 9

## DIGITAL COMPETENCIES, COMPUTATIONAL THINKING AND CRITICAL THINKING AS ENABLERS OF OLDER ADULTS' INTEGRATION INTO THE SILVER ECONOMY

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**ABSTRACT:** Background: The silver economy reframes demographic ageing as an economic opportunity, yet the digital inclusion of older adults remains an underexplored prerequisite for their effective participation in this emerging sector. Objective: This pilot study examines the associations among computational thinking (CT), critical thinking (CrT), and digital competencies (DC) in older adults, and analyses how these interrelated skill sets support their integration into the silver economy. Methods: A mixed-methods, exploratory-descriptive research design was applied to a convenience sample of 53 adults aged 55 years or older, affiliated with three retiree associations in the Bethania district of Panama City, Panama. Two validated questionnaires were administered to characterize the population, assess technology attitudes, and measure CT, CrT, and DC levels. Association analyses were conducted using a variation-search comparative method. Results: Strong positive associations were found between the four CT pillars (decomposition, abstraction, pattern recognition, and algorithms) and key CrT skills such as interpretation, logical reasoning, and decision-making. Virtually all DC sub-competencies showed high association scores with the CT pillars. Approximately 84% of participants reported feeling comfortable or very comfortable using digital devices, and communication with family and friends was the most valued technology benefit. Creative thinking and self-regulation showed weaker associations with CT, suggesting domain-specific developmental pathways. Conclusions: Fostering CT and CrT skills constitute a strategic lever for strengthening DC and, consequently, for promoting the digital inclusion, autonomy, and quality of life of older adults within the silver economy. Tailored lifelong learning programmes that integrate these competencies are recommended.

**KEYWORDS:** silver economy; computational thinking; critical thinking; digital competencies; older adults; digital inclusion; lifelong learning.

## COMPETENCIAS DIGITALES, PENSAMIENTO COMPUTACIONAL Y PENSAMIENTO CRÍTICO COMO HABILITADORES DE LA INTEGRACIÓN DE LOS ADULTOS MAYORES EN LA ECONOMÍA PLATEADA

**RESUMEN:** Antecedentes: La economía plateada reencuadra el envejecimiento demográfico como una oportunidad económica; sin embargo, la inclusión digital de los adultos mayores sigue siendo un prerrequisito poco explorado para su participación efectiva en este sector emergente. Objetivo: Este estudio piloto examina las asociaciones entre el pensamiento computacional (PC), el pensamiento crítico (PenC) y las competencias digitales (CD) en adultos mayores, y analiza cómo este conjunto de habilidades interrelacionadas apoya su integración en la economía plateada. Método: Se utilizó un diseño de investigación de métodos mixtos, de alcance exploratorio-descriptivo, aplicado a una muestra por conveniencia de 53 adultos de 55 años o más, afiliados a tres asociaciones de jubilados en el corregimiento de Bethania, Ciudad de Panamá. Se administraron dos cuestionarios validados para caracterizar a la población, evaluar las actitudes hacia la tecnología y medir los niveles de PC, PenC y CD. Los análisis de asociación se realizaron mediante un método comparativo de búsqueda de variaciones. Resultados: Se encontraron asociaciones positivas sólidas entre los cuatro pilares del PC (descomposición, abstracción, reconocimiento de patrones y algoritmos) y habilidades clave del PenC como la interpretación, el razonamiento lógico y la toma de decisiones. La totalidad de las sub-competencias digitales mostraron altas puntuaciones de asociación con los pilares del PC. Aproximadamente el 84% de los participantes se declaró cómodo o muy cómodo usando dispositivos digitales; la comunicación con familiares y amigos fue el beneficio tecnológico más valorado. El pensamiento creativo y la autorregulación mostraron asociaciones más débiles con el PC, lo que sugiere vías de desarrollo específicas para cada dominio. Conclusiones: Fomentar las habilidades de PC y PenC constituye un factor estratégico para fortalecer las CD y, en consecuencia, para promover la inclusión digital, la autonomía y la calidad de vida de los adultos mayores en la economía plateada. Se recomiendan programas de aprendizaje permanente diseñados a medida que integren estas competencias.

**PALABRAS CLAVE:** economía plateada; pensamiento computacional; pensamiento crítico; competencias digitales; adultos mayores; inclusión digital; aprendizaje permanente.

### 1. INTRODUCTION

Accelerated population ageing constitutes one of the most significant demographic transformations of the 21st century, posing simultaneous challenges and opportunities for labour, healthcare, and social security systems globally (Dueñas, 2024). Traditional narratives frame older populations as a social burden; however, the concept of the silver economy challenges this perspective by reconfiguring ageing as an economic opportunity (European Commission, 2018). The silver economy encompasses the market for goods and services directed at individuals aged 55 and above, contributing

to the strengthening of national economies by enlarging market size and stimulating new industries (Krzyminiewska, 2019).

Latin America and the Caribbean face a particularly acute demographic transition. Jiménez et al. (2021) report that 11% of the region's population already exceeds 60 years of age, while Okumura et al. (2020) and Pestieau (2022) observe a sustained increase in life expectancy attributable to improvements in basic services. Projections by the United Nations (2022) and the World Health Organization (2019) suggest that this region will experience the highest rate of population ageing, placing significant strain on existing economic ecosystems. Martin et al. (2022) warn that declining birth rates in Central America will further compound these pressures, amplifying social and economic tensions.

Within this context, digitalization emerges as an essential – yet challenging – prerequisite for older adults' participation in the silver economy (Jiménez et al., 2021). The educational sector plays a pivotal role by developing training models, workshops, and lifelong learning initiatives that promote active ageing through the adoption of technological solutions (Harper, 2016; Klein, 2015). The geron-technology domain further illustrates how contemporary technology -health monitoring devices, virtual assistants, and smart home systems – can significantly improve older adults' quality of life and open new business opportunities (Huang & Oteng, 2023; Zambrano et al., 2024).

To fully benefit from these innovations, older adults must develop a constellation of competencies that Díaz et al. (2020) classify across four domains: knowledge, action, identity, and coexistence. Among these, computational thinking (CT), critical thinking (CrT), and digital competencies (DC) are considered foundational (Wing, 2006; Robles, 2019; Gallistl & Rohner, 2020). CT equips individuals with problem-solving, data analysis, and systematic reasoning skills (Wing, 2006). CrT supports the evaluation and adaptation of technology to personal needs (Robles, 2019). DC, in the European Parliament's conceptualization, involves the safe and critical use of information and communication technologies (ICT) for managing, producing, and sharing information within collaborative networks (European Parliament & Council, 2006). Digital literacy has evolved beyond mere technological access to encompass the effective use of digital tools for knowledge construction, multimedia expression, and contextualized communication (Esteve & Gisbert, 2013).

Despite growing scholarly interest in digital inclusion and ageing, the specific interrelationships among CT, CrT, and DC in older adult populations – particularly within Latin American contexts – remain insufficiently explored. This pilot study addresses that gap by empirically examining these associations in a sample of older adults affiliated

with retiree associations in Panama City, and by analyzing how this skill cluster facilitates integration into the silver economy. The findings are intended to inform policymakers, educators, and technology developers in designing evidence-based interventions that enhance the autonomy, social inclusion, and quality of life of older populations.

## 2. THEORETICAL FRAMEWORK

### 2.1. THE SILVER ECONOMY AND OLDER ADULTS

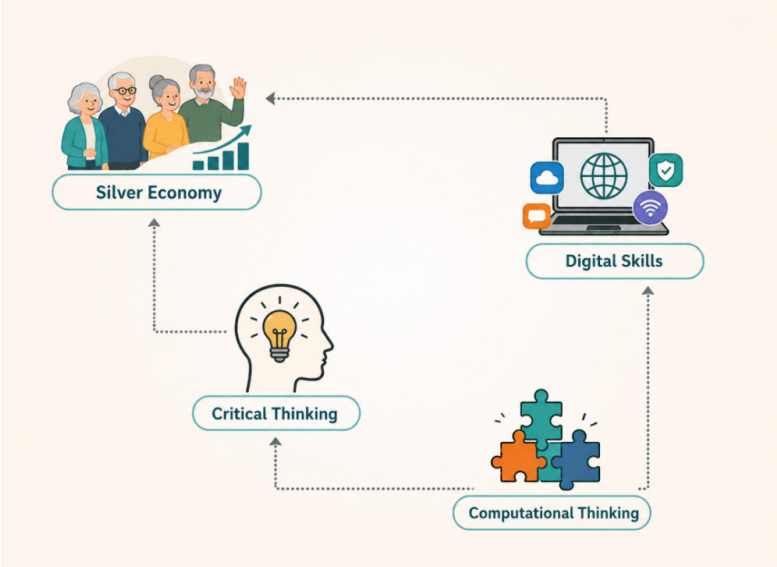
The European Commission (2018) defines the silver economy as a market centered on goods and services targeting older people, representing a significant economic opportunity in an ageing world. Briñez (2024) extends this conceptualization by emphasizing the role of social innovation in creating new forms of participation and empowerment for older adults, including community programmes, flexible employment, and volunteering opportunities tailored to their capabilities. Figueroa et al. (2021) further underscore the importance of social networks and community engagement as protective factors against cognitive decline and social isolation.

Krzyminiewska (2019) identifies three interrelated pillars of the silver economy: the silver industry, social innovation, and geron technology. Together, these pillars suggest that economic participation by older adults is not simply a matter of consumption but also involves active co-creation of products, services, and social value. Chen and Schulz (2016) demonstrate that technology adoption improves independence and social connectedness among older adults, effectively reducing isolation – a critical prerequisite for economic engagement. (Figure 1.)

### 2.2. COMPUTATIONAL THINKING

Wing (2006) introduced CT as a universal problem-solving approach grounded in computer science principles, comprising four core pillars: (1) decomposition – breaking complex problems into manageable sub-tasks; (2) abstraction – identifying and filtering the essential features of a problem; (3) pattern recognition – identifying regularities and trends in data; and (4) algorithmic thinking – formulating step-by-step solution sequences. In the context of older adults, these pillars translate into practical digital skills: decomposition facilitates learning to use a smartphone by dividing the process into discrete tasks; abstraction helps distinguish relevant emails from spam; pattern recognition enables identification of online fraud; and algorithms guide device configuration or document creation (Martínez & Herrera, 2019).

Figure 1. Relationship between Computational Thinking, Critical Thinking, Digital Competencies and Economics Silver.




Source: Own elaboration.

## 2.3. CRITICAL THINKING

Ennis (1987) conceptualises CrT as a reflective and evaluative process essential for decision-making and problem-solving. Martínez (2007) emphasises that CrT – encompassing interpretation, evaluation, inference, explanation, and metacognition – is a cornerstone of systematic analysis, directly supporting the application of CT principles. Goleman's (1995) work on emotional intelligence highlights that self-regulation, a dimension of CrT, is foundational to self-awareness and motivation, even if its direct association with CT pillars is weaker than more technical CrT skills.

## 2.4. DIGITAL COMPETENCIES

The European Parliament and Council's (2006) recommendation on key competencies for lifelong learning identifies digital competence as one of eight essential competencies, encompassing the safe and critical use of ICT. Ferrari et al. (2012) present a multi-dimensional framework that includes information management, communication, content creation, safety, and problem-solving. Esteve and Gisbert (2013) add that digital literacy now extends to multimedia expression and networked collaboration. Area Moreira (2014) notes that foundational digital literacy and digital culture require less CT and more practice-based pedagogical approaches grounded in repetition and experiential learning, suggesting differentiated instructional strategies are needed.

## 3. METHOD

### 3.1. RESEARCH DESIGN

A mixed-methods design of exploratory-descriptive scope was adopted (Clunie et al., 2023). The exploratory phase characterised the population's CT, CrT, and DC skills and their attitudes toward technology. The descriptive phase provided an in-depth characterisation of participants' current skill levels and identified competency requirements for integration into the silver economy. The analytical method employed was a variation-search comparative approach, which examines the diversification of variables and tests for systematic differences across observed results, thus preserving the rigour and validity of the data and enabling future comparative studies.

### 3.2. RESEARCH OBJECTIVE

To examine the associations between CT skills, CrT abilities, and DC in older adults, and to discuss how these competencies support their integration into the silver economy.

### 3.3. POPULATION AND SAMPLE

The target population comprised adults aged 55 years or older belonging to three retiree associations located in the Bethania district of Panama City, Republic of Panama. A non-probabilistic convenience sample of 53 older adults who met the study's eligibility criteria was selected. Participation required active membership in one of the three associations, residence in the Bethania district, possession of an intermediate-to-high-range communication device, and access to the internet (mobile data, Wi-Fi, or equivalent).

### 3.4. DATA COLLECTION INSTRUMENTS

Two questionnaires previously validated in Clunie et al. (2023) were employed:

**Instrument 1 – Technology Attitude Profile:** A two-stage questionnaire collecting demographic information and measuring attitudes toward technology use, including perceived usefulness, comfort, and motivation.

**Instrument 2 – Critical Thinking Skills Inventory:** Designed to conduct an initial exploration of CrT skills relevant to digital literacy. The instrument operationalised eleven CrT sub-competencies: analysis, problem-solving, metacognition, evaluation, open-mindedness, interpretation, effective communication, reflective critical analysis, inference, observation, and deduction.

The integration of both instruments enabled a systematic analysis of CT–CrT–DC associations. Observational follow-up of participants' social, cultural, and economic activities within the associations provided complementary qualitative data.

### 3.5. VARIABLE COMPARISON PROCEDURE

Association scores between variable pairs were calculated and graphically represented on a scale from 0 (no association) to 1 (perfect positive association). Three pairwise analyses were conducted: (a) CT pillars and CrT skills; (b) CT pillars and DC sub-competencies; (c) CrT skills and DC sub-competencies. This allowed a multidimensional mapping of competency interrelationships.

### 3.6. ETHICAL CONSIDERATIONS

All participants provided written informed consent prior to data collection. Anonymity and confidentiality were strictly maintained throughout the study. Participation was entirely voluntary, and participants retained the right to withdraw at any stage without consequence.

### 3.7. STUDY LIMITATIONS

Several methodological limitations should be acknowledged. First, the small, non-probabilistic sample restricts the generalisability of findings to wider older adult populations. Second, the association analyses are approximations grounded in conceptual definitions and participant experiences; causal inference is not warranted. Third, the scarcity of prior literature on CT and the silver economy constitutes both a limitation and a gap that this study begins to address. Future experimental studies with larger, stratified samples are warranted.

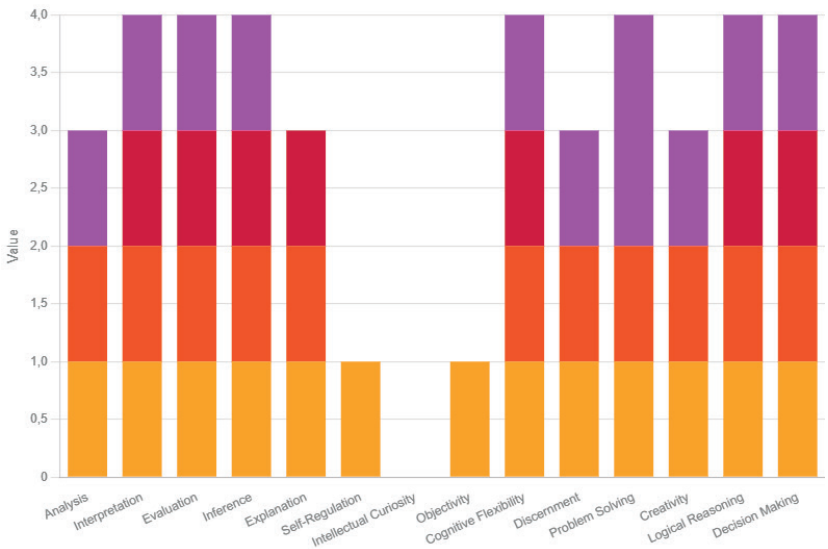
## 4. RESULTS

### 4.1. ASSOCIATIONS BETWEEN CT PILLARS AND CRT SKILLS

The association analysis (Figure 2) revealed that CrT skills differ substantially in their relationship with the four CT pillars – decomposition, abstraction, pattern recognition, and algorithmic thinking. Skills such as self-regulation, intellectual curiosity, and objectivity showed weak associations (< 0.40) across CT pillars. This pattern is theoretically coherent: these skills are primarily oriented toward self-knowledge, motivation, and impartiality – domains crucial for personal development and decision-making but not directly applicable

to CT techniques. As Goleman (1995) argues, self-regulation serves as a foundation for managing emotions and behaviours, which, while essential for personal wellbeing, does not directly engage CT-based processes.

Figure 2. Distribution of Critical Thinking by Category.




Source: Own elaboration.

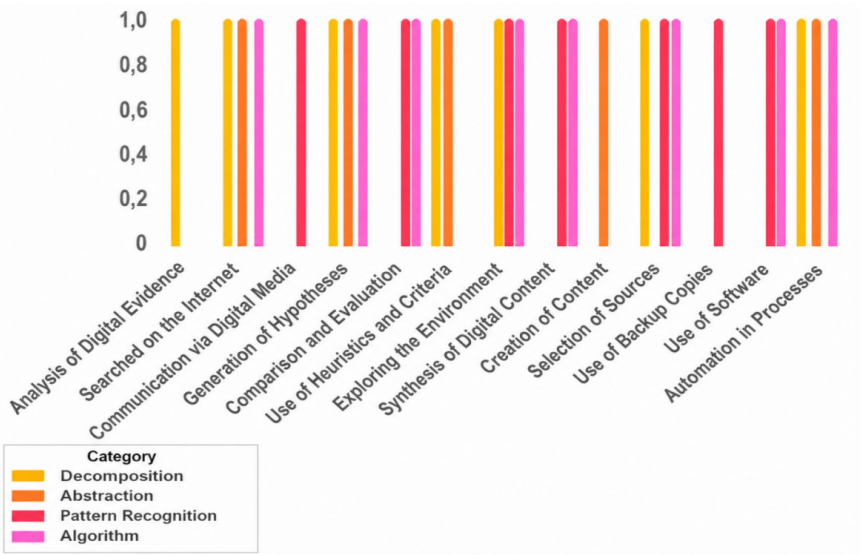
In contrast, skills such as interpretation, evaluation, inference, problem-solving, logical reasoning, and decision-making demonstrated strong positive associations (approaching or equal to 1.0) with all four CT pillars. This outcome is consistent with Wing's (2006) theoretical argument that CrT is one of the abilities fostered by CT, and with Ennis's (1987) definition of CrT as a reflective process underpinning decision-making and problem-solving. Martínez (2007) further corroborates this finding by positioning CrT – particularly interpretation and evaluation – as central to the systematic analysis characteristic of CT.

## 4.2. ASSOCIATIONS BETWEEN CT PILLARS AND DIGITAL COMPETENCIES

The association analysis (Figure 3) demonstrated that all DC sub-competencies assessed – ranging from basic digital literacy and online security to health management, continuous learning, and adaptation to new technologies – were strongly associated (scores approaching or equal to 1.0) with all four CT pillars. This finding suggests that CT constitutes a pervasive cognitive infrastructure underpinning the full spectrum of digital competence.

Decomposition emerged as especially relevant when older adults learn to use new technologies – for instance, segmenting the process of learning to operate a smartphone into discrete, manageable sub-tasks (Wing, 2006). Abstraction was associated with information management tasks such as distinguishing between important communications and spam. Pattern recognition supported the identification of online fraud or social media trends. Algorithmic thinking guided participants in device configuration and the execution of sequential tasks such as online transactions (Martínez & Herrera, 2019).

Figure 3. Distribution of Digital Competency Skills.




Source: Own elaboration.

Competencies such as online security, information management, and adaptation to new technologies require a convergent application of all CT pillars. Area Moreira (2014) notes, however, that foundational digital literacy and digital culture require less CT engagement and benefit more from practice-based pedagogical methods – a finding that implies differentiated instructional approaches for basic versus advanced DC development.

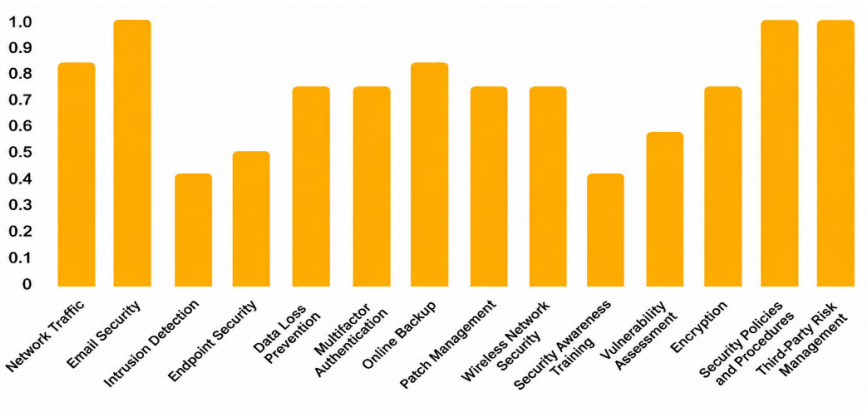
## 4.3. ASSOCIATIONS BETWEEN CRT SKILLS AND DIGITAL COMPETENCIES

The average association scores between CrT skills and DC (Figure 4) revealed that interpretation, logical reasoning, and decision-making achieved perfect positive associations (1.0) with the DC sub-competency set. Interpretation enables older adults to comprehend digital interfaces and evaluate the reliability of online information (Sánchez &

Gómez, 2020). Logical reasoning supports troubleshooting and informed decision-making regarding digital security. Decision-making is foundational for selecting technologies, managing privacy, and engaging in digital activities that enhance quality of life.

Several CrT skills showed intermediate association values (0.40–0.80), including evaluation (0.77), discernment, and cognitive flexibility. The relatively lower score for evaluation may reflect age-related cognitive changes, limited familiarity with technology, information overload, or underdeveloped CrT skills, consistent with the literature on digital ageing. Creative thinking registered the lowest average association (0.48), which the authors interpret as reflecting the multidimensional and highly contextual nature of creativity. García and Morales (2020) recommend psychometric tools assessing ideational fluency, originality, flexibility, and elaboration; yet for older adults, creativity may manifest through everyday activities such as hobbies, writing, or problem-solving, making standardized measurement particularly challenging. A multi-method, individualized approach to creativity assessment is therefore advised.

Figure 4. Distribution of critical thinking skills.

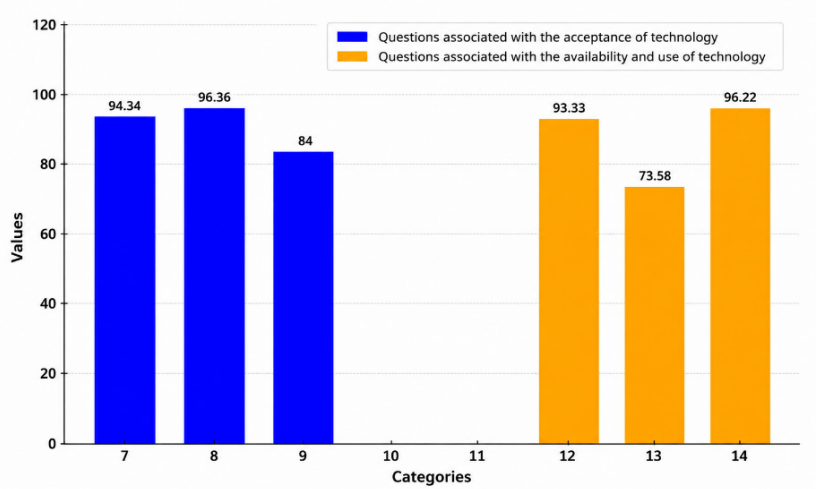



Source: Own elaboration.

## 4.4. TECHNOLOGY ATTITUDES AND COMFORT LEVELS

Instrument 1 data (Figure 5) indicated strong positive attitudes toward technology across the sample. Category scores ranged from 73.58 to 96.36 on acceptance and usage subscales, reflecting both openness to and active use of digital devices. The Figure 6 shows that approximately 84% of participants reported feeling comfortable or very comfortable using technologies such as mobile phones, computers, and tablets, while only 7% reported discomfort. These findings are consistent with Chen and Schulz's (2016) observation that technology acceptance among older adults improves quality of life, strengthens DC, and promotes independence and connectivity.

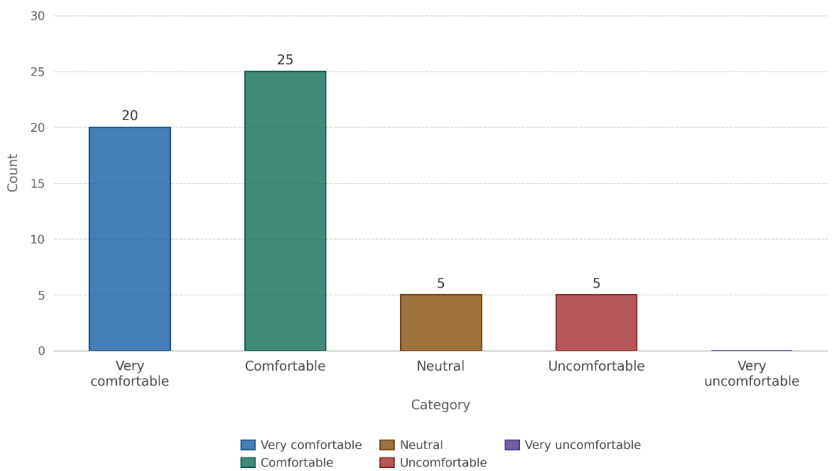
Figure 5. Levels of attitude of older adults towards the use of technology.




Source: Own elaboration.

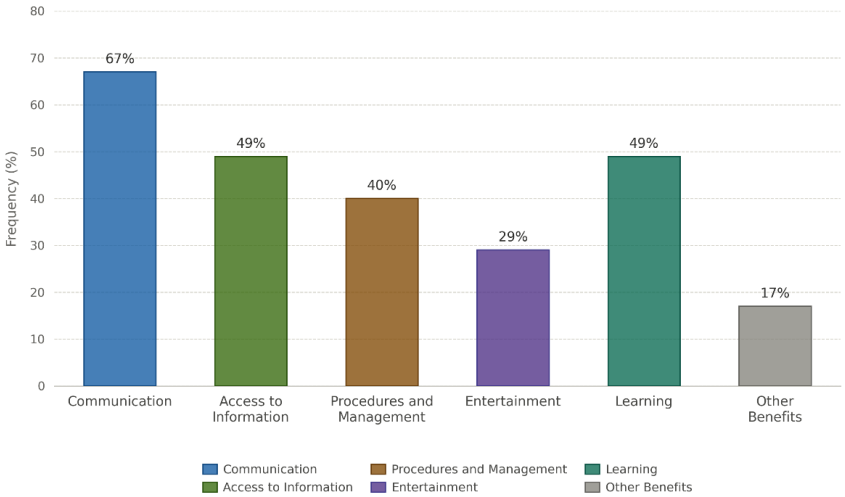
Regarding perceived benefits of technology use (Figure 7), participants most frequently identified communication with family and friends, access to updated information and news, learning new skills and knowledge, and efficient management of administrative procedures. Entertainment was rated as the least important benefit – a finding with implications for silver economy ventures, suggesting limited market potential for entertainment-oriented offerings targeting this cohort in Panama.

Figure 6. Distribution of comfort level in the use of technology.




Source: Own elaboration.

Figure 7. Benefits of using technology.



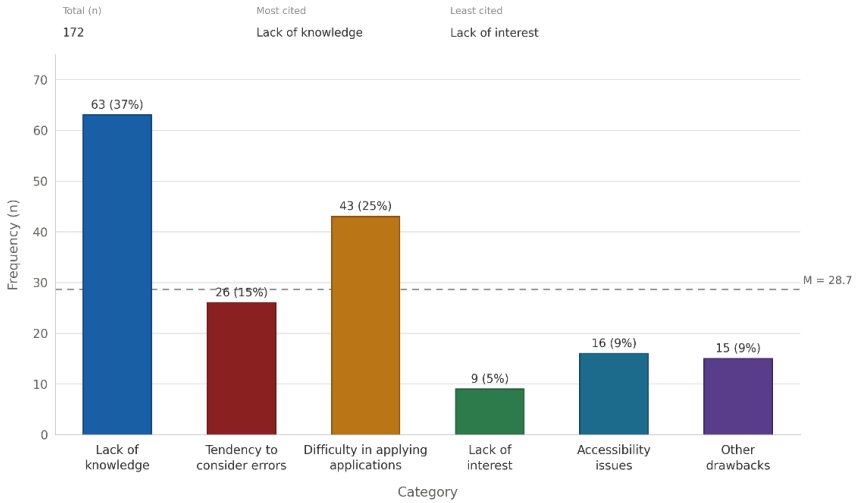

Source: Own elaboration.

Communication as a primary benefit reflects an informed, values-driven decision-making process: participants weighed ease of use, accessibility, efficiency, and social efficacy in selecting digital tools to maintain interpersonal relationships. Accessing current information involves the evaluative capacity to assess source quality and distinguish accurate from misleading content – an application of CrT in digital contexts.

## 4.5. TECHNOLOGY DIFFICULTIES AND CRT AS A MEDIATOR

Figure 8 reveals that the primary difficulties reported by participants were lack of knowledge, fear of making errors, difficulty understanding applications, lack of interest, and accessibility issues. These barriers align with broader literature on digital exclusion among older adults (Czaja et al., 2006). Critically, CrT – particularly logical reasoning and problem-solving – was identified as a key mediator for overcoming these barriers, supporting the implementation of programmes that integrate technical skills with analytical thinking.

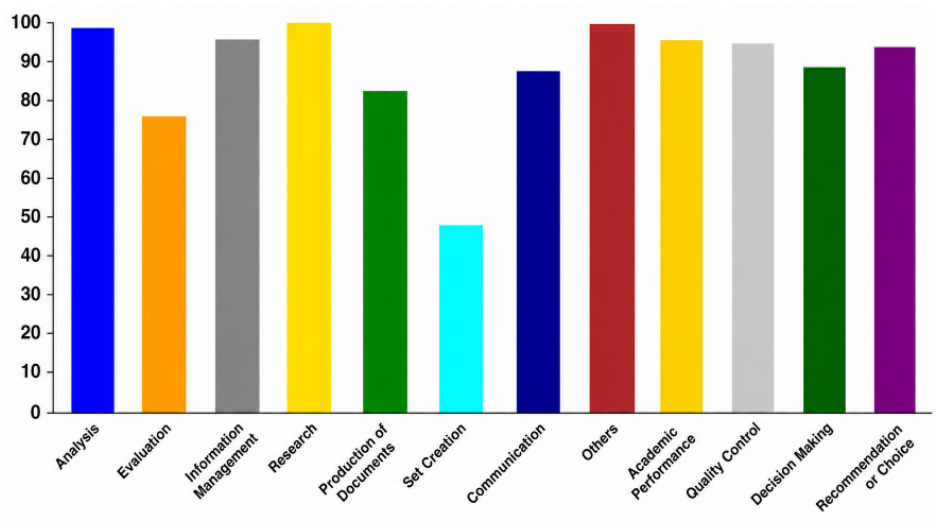
Figure 8. Difficulties in the use of technology.




Source: Own elaboration.

Figure 9 presents the full CrT skill profile of the sample. Analysis and interpretation achieved the highest scores (near 100%), while self-regulation and cognitive flexibility showed moderate values, and creative thinking was lowest. These results suggest that whilst participants demonstrate solid foundational analytical competencies, higher-order and affective CrT dimensions remain underdeveloped – a critical insight for curriculum design in digital literacy programmes targeting older adults.

Figure 9. Critical Thinking Skills.




Source: Own elaboration.

## 5. DISCUSSION

The findings of this pilot study offer several theoretical and practical contributions to the growing literature on digital inclusion, ageing, and the silver economy. At the theoretical level, the results provide empirical support for Wing's (2006) proposition that CT fosters CrT, and extend this framework to include DC as a third, interconnected component of a competency triad relevant to older adult populations. The virtually universal strong associations between CT pillars and DC sub-competencies suggest that CT may function as a meta-cognitive scaffold underlying digital performance – a proposition warranting further experimental investigation.

The pattern of weak associations for self-regulation, objectivity, and creative thinking with CT pillars partially challenges the assumption that CT drives all dimensions of CrT. Instead, these findings suggest that certain CrT dimensions are more closely tied to socio-emotional and dispositional factors (Goleman, 1995), while others – particularly those with analytic and inferential content – are more tractable to CT-based pedagogy. This distinction has direct implications for curriculum design: training programmes should integrate both CT-focused activities (e.g., problem decomposition exercises, algorithmic task planning) and broader CrT development strategies (e.g., reflective discussions, case analysis) to address the full CrT spectrum.

The high levels of technology comfort and acceptance reported by participants contrast with stereotypical representations of older adults as reluctant technology adopters. These findings are consistent with more recent evidence (Czaja et al., 2006; Chen & Schulz, 2016) showing that positive attitudes – particularly when technology is perceived as instrumental to valued social goals – are strong predictors of DC development. The prioritization of communication over entertainment further suggests that silver economy interventions in Panama should emphasized socially connected, utility-driven digital services.

From a policy perspective, these results reinforce the case for sustained public investment in tailored digital literacy programmes for older adults. Such programmes should be designed in close collaboration with retiree associations, leverage the existing high levels of technology acceptance, and progressively build from foundational DC towards more complex competency domains including pattern recognition, algorithmic reasoning, and critical information evaluation. The creation of digital platforms specifically designed for older adults – covering training, technical support, secure communication, and e-governance – represents a set of concrete silver economy opportunities identified by this study.

The limitations of this pilot study – particularly its small convenience sample, cross-sectional design, and reliance on association rather than causal analyses – constrain the scope of the conclusions. Future research should employ larger, stratified samples representative of diverse older adult populations; longitudinal designs to track competency development over time; experimental or quasi-experimental designs to test the causal effects of CT-focused training on CrT and DC outcomes; and mixed-methods approaches combining quantitative measures with qualitative accounts of lived experience.

## 6. CONCLUSIONS

The following conclusions emerge from this pilot study:

- CT and CrT are foundational to digital literacy in older adults. Developing these competencies enables effective technology use, cognitive stimulation, and meaningful participation in a digitalized society.
- The sample demonstrated satisfactory levels of CrT, which facilitates digital inclusion. Future experimental studies should investigate whether these levels are attributable to prior formal education or professional trajectories.
- Strong associations between CT pillars, CrT skills, and DC confirm that these competencies constitute an integrated triad. Strengthening any one component creates positive spillovers for the others, amplifying overall competency development.
- Promoting lifelong learning in DC enhances financial independence and market participation for older adults, directly contributing to the growth of the silver economy.
- The associations reported are theoretically grounded approximations; the pilot nature of this study means results should be interpreted as exploratory and directional rather than definitive.
- Effective lifelong learning for older adults requires purpose-designed educational programmes that address CT and CrT in tandem, producing more robust and durable DC outcomes.
- This study opens avenues for future innovation in the silver economy and for additional research on the digital divide affecting older adult populations in Latin America and the Caribbean.

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## CONFLICT OF INTEREST

The authors declare no conflict of interest.

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