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Gerontechnology for live tomorrow: Insights from Malaysia and an intergenerational choir bridging the young and the young at heart

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Abstract

Background: Ageing populations in Malaysia and globally face increasing challenges related to social inclusion, cognitive vitality, and intergenerational cohesion. Gerontechnology offers promising solutions to address these issues, yet limited knowledge exists on how older adults engage with technology in creative and intergenerational contexts. This study examines digital tool uptake in a Malaysian intergenerational choir, exploring intersections with musical collaboration to foster connection, learning, and well-being. The study also aims to explore how older adults experience and interpret the role of everyday technologies and how these tools facilitate social inclusion and connection across generations.
Method: A qualitative design was employed, involving pre- and post-event semi-structured interviews with 25 older adult participants from the intergenerational choir programme. Thematic analysis, guided by Practice Theory, examined the interplay of material tools, competence, and meaning in digital practices.
Results: Findings reveal four interrelated domains of technology use: (1) Digital Access and Emotional Entry which refers to technology mediated initiation of connection and rapport; (2) Technology in Independent Learning, which involves self-directed rehearsal and skill development through digital resources; (3) Technology in Social Maintenance which refers to supporting ongoing relationships via messaging, photo sharing, and interaction beyond the event; and (4) Technology as Intergenerational Bridge which facilitates mutual learning and cultural exchange across age groups.
Conclusion: Technology served as both a relational enabler and a cultural bridge, embedding musical collaboration within a digitally supported social fabric. The findings demonstrate that integrating gerontechnology into community arts initiatives can strengthen intergenerational reciprocity, reduce social distance, and sustain engagement beyond program boundaries. The study contributes to a paradigm shift from viewing technology as a tool for adoption to a medium for relational practice in later life.

Keywords: gerontechnology, intergenerational engagement, digital practice

Background

The global population is ageing rapidly, posing critical challenges for health systems, social protection, and economic sustainability. According to the World Health Organization, the number of people aged 60 and above is expected to more than double by 2050, surpassing two billion worldwide (Labay, 2020). According to a 2022 report by the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP), the Asia-Pacific region, home to 60% of the world's older population, is experiencing ageing at an accelerated pace compared to other regions (ESCAP, 2022). Countries such as Japan, China, and South Korea have already entered advanced stages of population ageing, while Malaysia is expected to become an aged nation by 2030 and a super-aged nation by 2044. By 2025, more than 11 percent of its population will be aged 60 or older (Rashid et al., 2016), indicating an urgent need to strengthen ageing-related policies, services, and innovations.

Gerontechnology, integrating gerontology and technology, has emerged as a response, providing interventions to enhance older adults' well-being across five domains: health and self-esteem, housing and daily living, mobility and transport, communication and governance, and work and leisure (Bronswijk et al., 2002). These align with Hsu's (2016) Sinophone framework, emphasizing functional, relational, and culturally grounded innovations (Huang & Oteng, 2023). In Malaysia, applications of gerontechnology have included mobile health monitoring, mental well-being apps, ride-booking services adapted for

older users, and retrofitting homes for safety and accessibility (Teh, 2019). Messaging platforms and video conferencing tools have also been leveraged for caregiving and social connectedness, reflecting a shift from infrastructure-driven to socially embedded practices (Teh, 2019).

The Gerontechnology Laboratory at Monash University Malaysia, established in 2016, advances interdisciplinary research and partnerships (Monash University, 2016). Early work by Teh (2016) explored ageing-technology-culture intersections, evolving toward community-anchored approaches. This mirrors Hsu's (2016) call for "last-mile" translation from research to real-world applications, recognizing technology as embedded in engagement, meaning, and relationships. This evolution reflects a growing recognition that technology is not simply an external tool but a relational infrastructure through which older adults sustain social ties, construct meaning, and adapt to their environments (Monash University Malaysia, 2025).

Despite these developments, a significant gap persists in the academic literature. The majority of research on gerontechnology remains focused on usability, device training, and cognitive support (Huang & Oteng, 2023). This emphasis often overlooks the broader sociocultural and relational contexts in which technology is used, neglecting affective connection, social inclusion, and intergenerational reciprocity (Huang & Oteng, 2023). Furthermore, digital engagement is frequently treated as an individual competency rather than a social practice shaped by relational routines and emotional investment (Kümmel et al., 2020). The problem is rooted in the dominant theoretical frameworks, which tend to be individualistic and deficit-oriented, portraying older adults as "non-adopters or laggards" who are "less digitally active" than younger cohorts (Lee & Coughlin, 2014). These frameworks, while useful in some contexts, have been criticized for failing to account for the complex social variables that influence technology adoption (Lee et al., 2025). Issues of intergenerational reciprocity, emotional connection, and digital practices embedded in everyday routines are underexplored. This signals a need to reconceptualise digital ageing as a socially situated process where technology mediates care, companionship, and cultural continuity. In this framing, technology becomes a site of human interaction, embedded in the routines, gestures, and affective tones that characterise everyday relational life (Tripathi, 2021).

Recent scholarship advocates a grounded understanding of digital ageing that focuses on routine integration, particularly how older adults incorporate everyday technologies into existing routines and relationships (Hülür & Macdonald, 2020). Mobile phones, messaging applications and video-sharing platforms are increasingly used by older adults, yet these engagements are often overlooked in gerontechnological research, which continues to emphasise formal instruction, adoption models, and deficit-oriented framings (Yu, 2020). In this context, intergenerational programmes provide valuable opportunities to reframe technology use in later life. These initiatives can reduce ageism, promote social inclusion, and foster mutual learning across generations (Jarrott et al., 2022), embedding digital interaction in co-creation and reciprocity (Huang & Lajoie, 2023). However, less attention has been given to how digital tools are appropriated within everyday social practices, informal and intergenerational interactions, particularly in non-Western contexts.

This study responds to these gaps by examining digital practices in the context of an intergenerational community choir initiative in Malaysia. Choir settings are culturally meaningful, socially embedded, and emotionally resonant (Lamont et al., 2018), making them an ideal site to observe how older and younger generations co-create shared experiences. Choral singing is both culturally embedded and socially collaborative, enabling older and younger participants to engage in artistic expression, cultural exchange, and digitally mediated interaction (Jang, 2020), and increasingly mediated by digital technologies. In this study, technology is understood as the application of knowledge to accomplish a task, the output of that application, a method to address challenges, and a framework through which problems are interpreted (Czaja et al., 2019). This framing moves beyond narrow definitions of technology use to emphasise its social, cultural, and cognitive dimensions. Unlike structured training programs, technology in this context was not explicitly taught but emerged as an organic part of the social fabric, supporting rehearsal, coordination, and post-event connection. This provides a unique opportunity to understand how older adults encounter and repurpose digital tools in lived, relational contexts rather than within pre-determined frameworks of instruction.

Guided by Practice Theory, the study explores how digital practices are shaped by the interplay of materials, competences, and meanings. Specifically, it focuses on the relational dynamics, emotional preparedness, and situated learning processes that support older adults' engagement with digital tools in intergenerational spaces.

Based on this framework, the study addresses the following research questions:

1. How do older adults experience and interpret the role of everyday technologies in an intergenerational community choir programme in Malaysia?

2. In what ways did digital tools enable the success of the initiative in fostering social inclusion, reducing age-related barriers, and supporting ongoing connection across generations?

By addressing these questions, this study contributes to broader discussions in gerontechnology and ageing studies. It highlights how digital engagement in later life can be effective, relationally sustained, and embedded within meaningful cultural practices. Rather than viewing older adults as technologically deficient, the study foregrounds their creativity, adaptability, and agency in appropriating tools that enhance intergenerational connection. In doing so, it offers fresh insights into how community-based programmes can leverage digital practices to support participation in the present, sustain engagement and reciprocity beyond programme boundaries.

Literature review

Gerontechnology domain

Gerontechnology is an interdisciplinary field that integrates gerontology and technology to enhance the quality of life of older adults. It addresses five key domains: health and self-esteem, housing and daily living, mobility and transport, communication and governance, and work and leisure. Each of these domains contributes to sustaining independence, dignity, and wellbeing in later life.

In the health and self-esteem domain, technological innovations aim to promote physical and mental health, preventive care, and resilience. Examples include telehealth systems, medical alert devices, wearable health monitors, and virtual reality applications for chronic disease management (Fozard, 2005). Beyond physical health, technologies such as mood-tracking apps, cognitive training platforms, and online mindfulness programmes support mental wellbeing, reducing loneliness, depression and anxiety among older adults (Atta et al., 2024). Their effectiveness depends on factors such as user acceptance, adaptability to individual needs, cultural fit and involvement of caregivers (Atta et al., 2024).

Housing and daily living technologies aim to create safe, accessible, and functional environments that enable ageing in place. This domain includes smart home systems with automated lighting, ambient assisted living sensors, fall detection devices, and voice-activated assistants (Colnar et al., 2020). These innovations are designed with ergonomic principles, minimal invasiveness, and age-friendly interfaces to help older adults remain in familiar settings, reducing the need for institutional care and preserving independence (Huang & Oteng, 2023). Emerging applications, such as AI-driven home monitoring, further personalize these systems by adapting to users' habits and predicting potential risks.

The mobility and transport domain addresses barriers to safe and inclusive movement, incorporating powered wheelchairs, adaptive walking aids, accessible public transport systems, and senior-friendly ride-hailing apps (Yaw et al., 2025). GPS-enabled devices and navigation apps play a key role in enhancing confidence and encouraging outdoor activities, mitigating fears of falling or disorientation (Anton et al., 2020). In urbanizing contexts like Malaysia, these technologies are important for maintaining community participation and social ties.

Communication and governance technologies facilitate social connectedness and access to essential services, including smartphones, video conferencing tools, social media platforms, digital banking, and e-government portals (Bronswijk et al., 2002). Participatory design approaches and digital literacy programs are important to ensure usability, particularly for reducing isolation and promoting autonomy (Merkel & Kucharski, 2019).

Finally, work and leisure technologies enable older adults to continue contributing to society through paid or voluntary roles, lifelong learning, and recreational activities. Remote work platforms, virtual volunteering opportunities, and online learning systems support active ageing while fostering cognitive stimulation and social engagement (Wong et al., 2025).

Taken together, these domains demonstrate how gerontechnology extends beyond assistive devices to encompass holistic approaches that support healthy, active, and socially connected ageing.

Practice Theory

Practice Theory provides a valuable framework for understanding how actions are embedded within social, material, and symbolic contexts. In sustainability studies, it has been used to examine consumption and resource use as socially shared behaviours (Corsini et al., 2019). In health, it highlights how behaviours are enacted through embodied routines and material environments, shifting attention from individual attitudes to everyday practices (Maller, 2015). In education,

particularly sustainable healthcare training, Practice Theory has informed curriculum design by showing how knowledge and values are enacted in practice (Huss et al., 2020).

Despite its relevance, Practice Theory remains underutilized in ageing and technology studies, where dominant paradigms often rely on adoption models like the Technology Acceptance Model or Senior Technology Acceptance Model, portraying older adults as reluctant or deficient users (Chen & Chan, 2014). These models overlook the relational, affective, and routine-based dimensions of technology engagement. Shove et al. (2012) offer a holistic framework by conceptualizing practices as the convergence of three elements: materials (e.g., technologies and infrastructures), competences (e.g., skills, know-how, and routines), and meanings (e.g., emotions, norms, and symbolic values). Applying this framework to gerontechnology enables a shift from viewing older adults as passive adopters toward recognising them as active participants whose practices are shaped by cultural context, social ties, and emotional investment.

Emerging evidence suggests that older adults engage with technology through gradual adaptation, familiarity, and appropriation (Morato Lara et al., 2021). However, most studies have examined structured interventions or long-term adoption, with limited focus on informal, affective, or time-bound contexts such as intergenerational exchange. Practice Theory thus offers richer insight into how digital tools become embedded in older adults' everyday lives, highlighting the importance of relational and symbolic dimensions in sustaining meaningful use.

Technology use, ageism, and intergenerational choir settings

Older adults' engagement with digital technology is often shaped by persistent stereotypes portraying them as disinterested, incapable, or technologically marginalised. These narratives, embedded in policy, media, and research, reinforce ageist deficit models that undermine older individuals' agency and adaptability (van Hees et al., 2021). Critical gerontology challenges these assumptions by foregrounding continuity, creativity, and resilience in later-life digital practices (Morato Lara et al., 2021).

Research has shown that older adults use digital tools for communication, information seeking, and creative expression, yet much of this work has focused on formal learning contexts, structured interventions, or digital literacy programmes (Morato Lara et al., 2021). Such approaches often understate the informal, affective, and relational dimensions of technology engagement. Similarly, intergenerational initiatives are frequently framed as structured mentoring, training, or co-creative projects (van Hees et al., 2021). While these initiatives can enhance confidence and foster cross-age understanding, they reveal little about organic and community-based contexts where technology emerges in support of shared cultural activities.

The intergenerational choir represents one such setting. Choir participation is collaborative, culturally embedded, and emotionally expressive, providing a distinctive context to observe intergenerational digital practices. In this space, technologies such as messaging applications, shared audio files, and digital recordings support rehearsal coordination, lyric sharing, and post-event connection (Belgrave & Keown, 2018). These tools foster interaction, sustain memory, and enhance relational continuity beyond the event itself. Yet such informal, everyday uses remain underexamined in gerontechnology research, which has tended to prioritise health-related interventions or structured training (Morato Lara et al., 2021).

Integrating Practice Theory into this context reframes digital ageing by focusing on the interplay of materials, competences, and meanings (Huss et al., 2020). As shown in sustainability and health education studies (Vidrevich et al., 2023), this lens highlights the relational, symbolic, and affective dimensions of practice. It positions older adults as active participants in socially and culturally meaningful contexts, thereby challenging reductive narratives of technological decline.

Methods

Sample

Purposive sampling was used to recruit 36 participants, comprising older adults aged 55 and above and younger individuals aged 18–30. The inclusion of older adults enabled the study to capture a range of intergenerational experiences, while younger participants contributed to examining cross-age dynamics in collaborative learning and social exchange. Participant demographics are summarised in *Table 1*.

Study design

This study received ethics approval from the University Human Research Ethics Committee (Reference: 2024-43436-109210). All participants provided informed consent, including permissions for audio recordings, photographs, and video documentation. The research design comprised three phases: a pre-event semi-structured interview to assess baseline technology use and expectations, a half-day intergenerational choir session, and a post-event interview to capture reflections on experiences. The event was con-

Table 1. Participants demographic

Characteristics		*N = 36*
Age (years)		
	18- 20	2
	21- 25	8
	26- 30	6
	55- 59	2
	60- 65	5
	66- 69	5
	70- 75	6
	76 and above	2
Gender		
	Male	9
	Female	27
Citizen		
	Malaysian	33
	Non – Malaysian	3
Ethnic groups		
	Chinese	27
	Malay	3
	Indian	1
	Others	5
Education level		
	Secondary school	5
	Diploma/Pre-U	6
	Degree/Professional	19
	Postgraduate	6
Status		
	Student	7
	Private sector employee	13
	Homemaker	1
	Private retiree	12
	Government retiree (includes pensioners)	2
	Others	1

ducted in collaboration with a local singing community and held in a private singing hall to provide a controlled and focused environment.

Participants were paired in mixed-age groups (see *Table 2*) and seated in a circular arrangement to promote equality and inclusivity. The session began with ice-breaking activities to build rapport, followed by collaborative rehearsals emphasizing mutual support and encouragement. The session concluded with a final performance and a structured reflection segment in which participants discussed their experiences. Visual documentation, including photographs (*Figure 1* a–c) and a video recording (available at https://www.youtube.com/watch?v=45zlFZGprco), was obtained with consent to illustrate engagement dynamics.

Qualitative analysis

The qualitative analysis was guided by a phenomenological approach, which centers on understanding the subjective experiences of the older adult participants. An overview of the analysis process is shown in the *Figure 2* below. Key steps included:

1. Horizontalization: Key statements were examined, with emphasis on those expressing cultural appreciation and shared understanding.

2. Theme Development: Responses were organised into themes that captured interactions with younger participants from diverse cultural backgrounds.

3. Textural and Structural Descriptions: Textural descriptions captured the essence of participants' experiences, while structural descriptions provided insight into the conditions under which these experiences unfolded.

4. Data were transcribed and analysed using NVivo. Following Moustakas' (1994) phenomenological approach, researchers applied epoché to bracket personal biases and maintain objectivity. Non-participant observation was employed to reduce researcher influence. Participants' accounts were synthesised to construct a holistic understanding of their experiences during the intergenerational choir singing event.

Results

Thematic analysis, informed by Practice Theory, identified four core themes reflecting the outcomes of the intergenerational choral singing event on older adults (*Figure 3*):

- Digital Access and Emotional Entry: Use of familiar technological tools supported emotional readiness and low-pressure social entry.
- Technology in Independent Learning: Digital tools supported self-paced rehearsal and sustained personal engagement.
- Technology in Social Maintenance: Messaging and media sharing sustained connections after the event.
- Technology as Intergenerational Bridge: Casual technology exchanges fostered mutual learning and relational closeness across generations.

Experiencing access and emotional entry

The accounts of older participants revealed that technology functioned not only as a tool for logistical coordination or rehearsal, but as a subtle infrastructure that enabled social comfort and emotional openness. While technologies such as WhatsApp and YouTube were never positioned as central features of the choir initiative, they emerged across the narratives as gentle supports that shaped how older adults entered and experienced the space. These technologies allowed participants to approach the musical and relational elements of the event at a pace and proximity that felt manageable, familiar, and safe.

Figure 1 (a), (b), and (c). The participants engaging in singing sessions.

The process of sharing contact information on WhatsApp became, for many, an early expression of social openness. One participant recounted the way phone numbers were exchanged among unfamiliar group members, saying, "We got their phone number. I got her [younger participant] phone number" (HS25). These interactions occurred within the relaxed atmosphere of the event but were often facilitated through the convenience and familiarity of WhatsApp. The decision to exchange numbers was not merely functional. It carried the implication that the event had created a bond worth carrying forward. The digital contact itself became a signifier of emerging trust and connection, despite the brevity of the encounter.

The use of technology also helped participants feel more prepared. Several spoke about how lyrics were circulated through group chats in advance of the session. These materials gave older participants the opportunity to familiarise themselves with unfamiliar content on their own terms. One explained, "She shared it the night before. I was in a group chat the night before. She shared it with us, and we listened a few times" (HS25). The quote reveals not only that the materials were shared but that they were listened to repeatedly, suggesting that older participants were already engaging with the musical content before stepping into the group setting. That advance engagement supported comfort and confidence, particularly when the material was perceived as challenging. "When we first heard it, I thought I couldn't sing it because it's a tune with a very short tempo and storyline" (HS08). The tools did not eliminate difficulty, but they reduced the intimidation of encountering the unfamiliar without preparation.

This sense of being supported without being directed was echoed in participants' descriptions of the social environment. Older adults consistently described the atmosphere as light-hearted, permissive, and emotionally safe. Rather than introducing pressure, the presence of technology appeared to lower the stakes of participation, allowing individuals to engage on their own terms. One participant reflected on the mood within the group, stating, "We all laugh, laugh, laugh… it's something you never tried before…so fun" (HS13). The humour and ease described in these accounts were not incidental. They were enabled by informal access to materials and communication, which allowed older adults to arrive prepared without needing to prove competence. This preparation, supported by familiar technologies, contributed to a space where the absence of judgment became a condition for genuine participation.

The atmosphere of ease was often amplified through humour and shared laughter. These moments of levity were not superficial. They reflected an environment in which participants felt sufficiently at ease to move, sing, and make mistakes without self-consciousness. The emotional tone of the event allowed older adults to engage fully without the need to perform or perfect. Through the steady presence of technology in the background through shared audio, circulating lyrics, and digital contact, participants could enter the event not as outsiders learning someone else's system, but as active contributors supported by tools they already understood.

Table 2. Pairing between older and younger adults

Pair	Older/younger participants	Age	Gender	Ethnicity
Pair 1	Older adult	76	Female	Chinese
	Older adult	57	Female	Others
	Younger people	30	Female	Malay
Pair 2	Older adult	74	Female	Chinese
	Younger people	29	Male	Malay
Pair 3	Older adult	72	Female	Others
	Older adult	55	Female	Chinese
	Younger people	25	Female	Chinese
Pair 4	Older adult	70	Female	Chinese
	Younger people	24	Female	Others
Pair 5	Older adult	69	Female	Chinese
	Younger people	25	Female	Malay
Pair 6	Older adult	66	Female	Chinese
	Younger people	23	Male	Indian
Pair 7	Older adult	66	Female	Chinese
	Younger people	22	Male	Others
Pair 8	Older adult	65	Female	Chinese
	Younger people	19	Female	Others
Pair 9	Older adult	65	Female	Chinese
	Younger people	18	Male	Others
Pair 10	Older adult	79	Female	Chinese
	Older adult	62	Female	Chinese
	Younger people	30	Male	Chinese
Pair 11	Older adult	74	Female	Chinese
	Younger people	28	Female	Chinese
Pair 12	Older adult	73	Female	Chinese
	Younger people	27	Female	Chinese
Pair 13	Older adult	71	Male	Chinese
	Younger people	28	Male	Chinese
Pair 14	Older adult	68	Male	Chinese
	Younger people	24	Male	Chinese
Pair 15	Older adult	67	Female	Chinese
	Younger people	23	Female	Chinese
Pair 16	Older adult	66	Female	Chinese
	Younger people	22	Female	Chinese

Practices of independent digital learning

Older participants described practices of learning that were deeply intertwined with everyday technologies. These technologies, such as mobile phones, audio recordings, and online video platforms, were not framed as external aids but as part of the learning environment they constructed for themselves. Rehearsal did not begin at the event, but instead it began at home, in the car, or in moments of quiet repetition. Technology enabled them to take ownership of that process and rehearse at a rhythm that matched their cognitive tempo and personal style. The process was not technical, instead it was familiar, embodied, and purposeful.

One participant described a routine that had become embedded in her day-to-day life. "Every time the choir rehearsal, I would record the songs and what the teachers say. Then I will play in the car my recording so that, you know, it's easy to go inside my brain" (HS13). The act of recording was not about retaining information passively. It was part of a deliberate effort to move material from exposure to integration. The recording became portable, repeatable, and embedded into daily commutes. Another participant described the consistency of this habit over time. "I really practiced one whole month in the car" (HS25). These accounts do not describe rehearsal as a burden. They describe it as a chosen rhythm of preparation, enabled by the portability and accessibility of mobile technology.

Repetition emerged as a central strategy, with participants repeatedly listening to recordings and online videos until familiarity was achieved: "We were told to listen to this song over and over again. We get a gist of it" (HS17). The language of repetition was echoed in descriptions of online search and video playback. "So I on it again yesterday, listen. It quite nice, you know" (HS13). This quote reflects the ease with which participants could access content, and the satisfaction that emerged from voluntary re-engagement. Digital platforms were not positioned as unfamiliar or intimidating. They were integrated seamlessly into how participants rehearsed, reflected and reinforced learning.

For some participants, these practices were tied not only to learning songs but to maintaining mental sharpness. The learning process was described as active, effortful, and personally significant. One participant reflected, "I'm forcing myself to use my memory, use my brain so that I'm still active and I think and keep away from dementia" (HS13). This statement was not made lightly. It reflects the conscious belief that rehearsal itself was a form of cognitive engagement. The tools that supported this process of recordings, lyrics, and videos were seen as essential in sustaining that engagement.

Through repetition, portability, and the ability to personalise rehearsal, older participants used technology to create conditions for learning that were flexible, meaningful, and embedded in their lives. These were not structured lessons delivered from above. They were self-initiated routines, developed through interaction with familiar tools, shaped by a desire to contribute and learn well, and grounded in the everyday spaces of older adults' lives.

Using technology for social maintenance

Participants highlighted how digital platforms extended the relational life of the choir well beyond the event itself. WhatsApp groups were spontaneously formed, enabling continued inter-

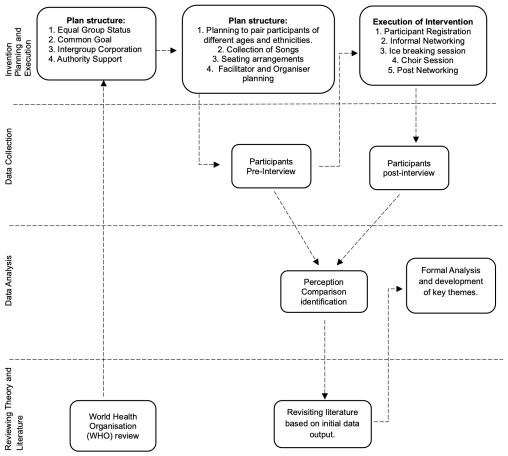

Figure 2. Data analysis overview

action, media sharing, and even informal social gatherings. The digital interactions that followed were not structured by organisers or formal follow-up. Instead, they emerged from participants' own initiative and sense of relational momentum. Technology served not only as a tool for messaging but as a medium through which emotional and social continuity was built.

Several participants recalled the moment when digital connections began to form. One explained, "We got to exchange contact numbers, exchange, we took photos together. I hope that we can keep in touch" (HS21). The phrasing of this account highlights a hopefulness that is rooted in interpersonal connection. Another participant described how digital messaging groups were spontaneously created. "We just form a WhatsApp group and then say, let's go eat!" (HS25). These exchanges reflected a desire to stay in contact, not for logistical coordination but to sustain the relational energy sparked during the choir event.

The use of WhatsApp was not limited to text. Participants also used the platform to share media that reinforced social ties and offered tangible reminders of the shared experience. One participant shared, "I've been already texting her, sending her edited photos which were a little bit blurred, so I edited it and sent it to her" (HS21). This quote speaks not only to the act of sharing but also to the care involved in making the photo clearer. The gesture was relational. It was an act of offering something meaningful, even after the event had concluded.

For those who had not yet received photos or videos, there was anticipation and a desire to see themselves as part of the captured memory. "Do we get to see the photos?... We want to see our photos as well and see how the whole thing is like" (HS09). The question is casual, but behind it is the importance of being remembered, of being part of the visual record, and of continuing to participate through shared reflection. This initiative reflected how participants used digital tools not only to maintain contact, but to circulate memories and reinforce social ties on their own terms.

The post-event interactions were not sustained through formal mechanisms, but rather emerged organically within the relational networks established during the choir. Platforms such as WhatsApp facilitated casual check-ins, photo sharing, and moments of humour and appreciation, enabling participants to re-engage with the emotional resonance of the experience. Technology did not recede following the event; instead, it served as a subtle yet persistent medium through which the social and affective dimensions of the choir were extended. These digital exchanges functioned not merely to maintain contact, but to embed the memory and emotional significance of the choir into participants' everyday routines through ongoing gestures of care.

Technology as a medium for intergenerational exchange

Finally, technology became a focal point for intergenerational learning, where older participants sought support from younger counterparts with openness and humour. These exchanges were not structured lessons or formal training sessions. They emerged organically during the choir programme, often prompted by everyday challenges such as navigating messaging apps, managing phone settings, or understanding unfamiliar media formats. What made these moments distinctive was not the complexity of the technology but the relational dynamic in which learning took place. Older adults did not express reluctance or discomfort in seeking help. Rather, they spoke of approaching younger people with openness, humour, and confidence. These intergenerational interactions were shaped not only by technical instruction but by warmth, patience, and a shared willingness to figure things out together.

Many older participants described initiating help-seeking themselves. One stated simply, "I bring my phone and I say, something went wrong. I'm trying to download these apps. Can you help?" (HS04). The tone is casual and assured. It does not reflect embarrassment, but a clear sense of agency. Another explained, "When I first go on WhatsApp and all those things also we need help from other people" (HS25). For some participants, support extended beyond troubleshooting

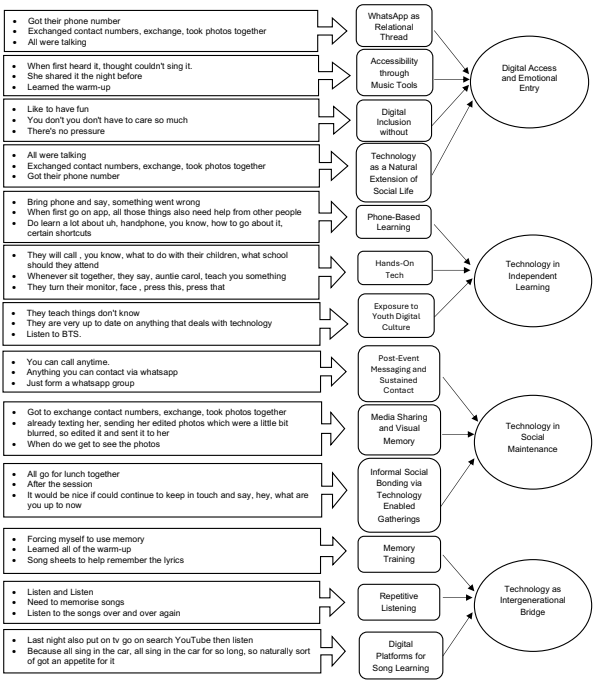

Figure 3. Thematic analysis

into a deeper understanding of how to navigate their devices. "I do learn a lot about handphone, you know, how to go about it, certain shortcuts. And yeah, they are very good" (HS24). The speaker recognises the skill of younger people, but the tone is appreciative rather than dependent. These reflections position digital learning not as a deficit to be corrected, but as part of ordinary relational interaction.

Participants described how younger individuals demonstrated tasks in a step-by-step manner, often using physical gestures to show them what to press, where to scroll, or how to repeat the action. One older adult described the clarity of this process: "They turn their phone, face me, press this, press that. Now, you practise in front of me" (HS04). Another recalled with humour and affection, "Auntie, I teach you something. You know, they'll take out the handphone and then it, I just, slow, slow, slow, you know" (HS24). These interactions were not described as impersonal or mechanical. They were full of care, paced according to the comfort of the learner, and delivered in ways that preserved dignity.

The reach of intergenerational learning extended beyond phone settings and app functions. Several participants spoke about being introduced to cultural practices that were embedded in digital environments. One participant described a playful exchange: "They teach me the moves... K-pop moves, I don't know how to do. They teach me. Very patient" (HS04). The teaching was embodied, rhythmic, and shared. Another described being guided through a social media trend. "They teach me things I don't know. Auntie, pose this way. We're doing TikTok. Okay, today we do boomerangs" (HS04). These encounters reveal a different kind of technological literacy, one rooted in movement, media participation, and cross-generational humour.

Across these accounts, what emerges is not just the acquisition of technical skills, but the cultivation of relational presence. Learning occurred through shared time, shared gestures, and shared laughter. It involved trust, mutual attention, and a willingness to shift roles. Older adults were not passive recipients of youth expertise. They were full participants in a learning exchange, one that was made possible through the use of everyday technologies and the relational generosity of the younger people around them. In this way, technology functioned not simply as a topic of learning but as a channel through which intergenerational respect and reciprocity came to life.

Discussion

This discussion engages the findings through the Relational Gerontechnology Practice Model developed in this study, which conceptualises digital engagement as emerging through the interplay of context, mechanism, and practice (*Figure 4*). The model begins with gerontechnology domains as socially situated entry points, proceeds through the structuring elements of practice theory comprising material, competence, and meaning, and culminates in four observable technology outcomes. As summarised in *Table 3*, this approach shifts attention from linear adoption to the ways digital interaction is shaped through emotional rhythms, relational routines, and embedded tools. The following sub sections examine each technology outcome, mapping how different domains are translated through practice theory mechanisms into lived digital participation.

Digital access and emotional entry

The outcome of digital access and emotional entry was enabled primarily through the domain of Communication and Governance. The use of everyday digital tools such as messaging applications, rehearsal links, and printable materials supported emotional orientation and a sense of familiarity prior to physical participation. These

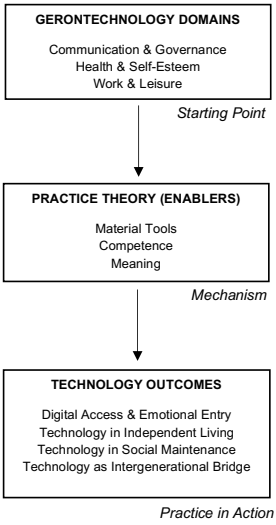

Figure 4. Relational Gerontechnology practice model

forms of preparatory access align with the Communication and Governance domain's emphasis on technologies that facilitate communicative inclusion and social connectedness in later life (Bronswijk et al. 2002). This domain has also been shown to support relational integration through accessible media environments (Merkel & Kucharski 2019).

The domain is translated into practice through mechanisms described by practice theory. Material artefacts included WhatsApp messages and digital rehearsal files. Competence was enacted not through learning new digital skills, but through the purposeful mobilisation of familiar technologies to foster confidence and preparedness (Tripathi 2021). Meaning was constructed through a sense of being already connected and socially positioned within the event's rhythm (Yu, 2020). These findings align with research highlighting how emotional readiness is a foundation for inclusive technology use in older adults (Huang & Oteng 2023). They also reinforce the view that inclusion is often achieved through ordinary, affectively charged digital routines rather than structured interventions (Jang 2020).

These practices reflect Reckwitz's (2002) theorisation of practice as routinised behaviour that integrates bodily and mental activities, material artefacts, know how, and emotional engagement. As conceptualised by Shove et al. (2012), practices emerge through the convergence of materials, competences, and meanings. In this case, the materials (mobile phones, printed lyrics), competence (platform familiarity), and meanings (confidence and ease) coalesced to produce emotional and social orientation. Rather than a one directional process of adoption, digital access emerged through routinised, low stakes engagement with already embedded tools. These engagements resulted in an outcome of emotional entry, in which participation was made possible not by novelty but by familiarity and affective readiness.

Technology in independent learning

Digital rehearsal and self-guided preparation practices drew upon intersecting contributions from the Work and Leisure domain and the Health and Self Esteem domain. The Work and Leisure domain promotes continued learning and cultural engagement, especially through technologies that support cognitive and expressive stimulation (Fozard, 2005). The Health and Self Esteem domain emphasises mental activation, confidence, and psychological resilience in ageing populations (Atta et al., 2024). Self-directed rehearsal using mobile recordings, YouTube links, and printed annotations exemplified how older adults integrated digital practices into everyday learning routines. These tools were already embedded in their daily environments and were appropriated in familiar, flexible, and affectively rich ways.

The translation into practice is seen through the use of material artefacts such as phones, song files, and printed lyrics. Competence was demonstrated through rehearsal repetition, annotation, and contextual adaptation, with learning emerging through performance rather than instruction. Meaning was shaped by autonomy, readiness, and personal satisfaction. These processes illustrate what Shove et al. (2012) describe as the patterned enactment of social practices through evolving arrangements. They also align with Reckwitz's (2002) notion of practice as the coordination of activity, attention, and cultural knowledge.

These findings support studies that emphasise older adults' agency in shaping digital interaction on their own terms (Morato Lara et al., 2021). The emphasis on mental stimulation and self efficacy reflects broader research showing that older adults value digital practices that sustain cognitive vitality and independence (Atta et al., 2024). The outcome of technology in independent learning demonstrates how digital tools become integrated into cultural rehearsal and self regulation practices that are emotionally resonant and socially motivated. They support confidence, reduce anxiety, and affirm one's role within a group through familiarity and contribution.

Table 3. Analytical framework of older adults' everyday digital engagement

Gerontechnology domain	Practice theory (mechanism in action)			Technology outcomes (practice in action)
	Material tools	Competence	Meaning constructed	
Communication and governance; health and self-esteem	WhatsApp threads, printed lyrics, rehearsal links	Navigating information, coordinating, rehearsing at one's own pace	Feeling prepared, emotionally at ease, included before arrival	Digital access and emotional entry
Work and leisure; health and self-esteem	Personal devices, YouTube, printed lyrics, mobile recordings	Repetition, annotation, self-directed rehearsal, memorisation	Confidence in contribution, ownership of preparation, cognitive activation	Technology in independent learning
Communication and governance; work and leisure; health and self-esteem (indirectly)	Messaging apps, shared photos and media, group chat archives	Initiating contact, sharing media, sustaining casual conversation	Reinforced belonging, humour, social continuation beyond the event	Technology in social maintenance
Communication and governance; work and leisure; health and self-esteem	Smartphones, digital photo features, short-form media cues	Observational learning, mimicking gestures, informal digital exchange	Mutual recognition, responsiveness, softened generational boundaries	Technology as intergenerational bridge

Technology in social maintenance

Technology supported social maintenance was shaped primarily by the Communication and Governance and Work and Leisure domains. Post event interaction via messaging platforms, photo sharing, and casual updates facilitated the continuation of affective connection and relational belonging. The Work and Leisure domain includes co participation and shared cultural practices, particularly in ways that promote expressive communication (Belgrave & Keown, 2018). The Communication and Governance domain again provided the infrastructure for affective contact and emotional reinforcement (Yu, 2020).

These domains were translated into practice through accessible materials such as messaging platforms and shared media. Competences included conversational rhythm, selective sharing, and the maintenance of affective tone. Meaning was constructed through humour, memory, and sustained belonging. These practices emerged informally and were not contingent on programme facilitation. They demonstrate how relational inclusion is often enacted through small, routinised gestures that carry significance because of their ordinariness.

These insights affirm work in digital sociology and ageing that conceptualises everyday media use as a form of relational care (Tripathi 2021). The findings highlight how social presence can be maintained asynchronously through low effort, high affect interactions. In line with Shove et al. (2012), the coalescence of material, competence, and meaning in these informal interactions produced stable practices of emotional continuity. The outcome of technology in social maintenance reveals how gerontechnology extends relational bonds and sustains identity through routine digital connection beyond formal events.

Technology as an intergenerational bridge

Informal exchanges that spanned generational lines drew upon overlapping contributions from the Communication and Governance, Work and Leisure, and Health and Self-Esteem domains. Shared photo taking, light-hearted media engagement, and spontaneous improvisation provided moments where digital interaction transcended generational asymmetry. The Work and Leisure domain encourages shared identity expression and creativity, visible in co-created gestures and cross-generational humour (Gr, 2000). The Health and Self-Esteem domain played a role in supporting confidence and emotional experimentation, particularly in relation to performance and participation (Belgrave & Keown, 2018). The Communication and Governance domain provided the digital platforms through which interaction could take place (Jang, 2020).

These domains were translated into practice through shared mobile devices and youth-oriented platforms (material), informal mimicry and role switching (competence), and meanings of

joy, mutual recognition, and relational attunement. Competence was not defined by control or mastery, but by responsiveness, openness, and humour. These practices illustrate a form of relational digital literacy grounded in co-navigation, shared experimentation, and embodied trust (Huang & Lajoie, 2023).

These exchanges support research indicating that intergenerational interaction around technology can reflect reciprocity rather than one-way teaching (Jarrott et al. 2022). Drawing on Reckwitz (2002), these interactions are understood as socially situated performances embedded in cultural understanding and bodily rhythm. The outcome of technology as an intergenerational bridge demonstrates how technology becomes a site of shared play, co-presence, and reciprocal recognition. Rather than reinforcing generational roles, these practices allowed older adults to participate in moments of mutual digital engagement on equal ground.

Conclusion

This study introduced the Gerontechnology in Practice Model to explain how digital engagement in later life is shaped not by one-directional adoption or training, but through the situated translation of gerontechnology domains into meaningful social practices. By tracing the flow from context to mechanism to practice, the model demonstrates how domains such as Communication and Governance, Work and Leisure, and Health and Self-Esteem are activated through combinations of materials, competences, and meanings. These mechanisms result in four distinct technology outcomes: digital access and emotional entry, technology in independent learning, technology in social maintenance, and technology as an intergenerational bridge.

Theoretically, the study contributes to gerontechnology literature by positioning practice theory as a useful lens for understanding how older adults engage with technology in everyday life. Rather than viewing digital participation as a binary measure of access or literacy, this perspective conceptualises technology use as relational, affectively embedded, and dynamically sustained. The model shifts focus away from individualistic or deficit-based framings and instead highlights the importance of routine, co-presence, and emotional attunement in shaping digital inclusion.

From the practical viewpoint, the findings suggest that gerontechnology initiatives should prioritise emotionally resonant and socially embedded forms of engagement. Building on this, the Relational Gerontechnology Practice Model offers a framework for informing both the design and evaluation of future gerontechnology interventions and can also be understood as a gerontechnology model grounded in everyday-life values. Specifically, the model foregrounds how value formation in later life emerges through lived routines, relational interactions, and culturally situated practices, rather than through abstract notions of efficiency or technological competence alone. Rather than beginning with technology selection or skills training, intervention design can start by identifying the gerontechnology domains being activated (e.g. communication and governance, work and leisure, health and self-esteem) and intentionally embedding digital tools within existing social routines, cultural practices, and emotionally meaningful activities. The model also provides guidance for evaluation by shifting attention away from narrow indicators such as technology uptake or proficiency, toward practice-based outcomes including emotional readiness, continuity of engagement, relational maintenance, and intergenerational reciprocity. In this way, the model supports the development of interventions that are assessed not only by whether older adults use technology, but by how digital practices become sustained, relationally embedded, and meaningful in everyday life, thereby aligning intervention success with the everyday values and lived priorities of older adults.

A key limitation of this study is its focus on a single site and specific community context, which may constrain generalisability. The participants shared a common intergenerational project that may not reflect broader digital realities in more isolated or less supported settings. Additionally, the study was not designed to assess longitudinal change or the durability of digital practices over time.

Future research could expand this model by exploring how different gerontechnology domains operate in diverse cultural or infrastructural contexts. There is also scope to apply this framework in studies of digital disengagement, where the breakdown of routine or relational support may reveal inverse mechanisms of exclusion. Further exploration of the role of humour, improvisation, and emotional regulation in digital ageing could also extend theoretical insights on practice and inclusion.

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References

Anton, S., Cruz-Almeida, Y., Singh, A., Alpert, J., Bensadon, B., Cabrera, M., ... & Pahor, M. (2020). Innovations in geroscience to enhance mobility in older adults. Experimental Gerontology, 142, 111123. https://doi.org/10.1016/j.exger.2020.111123

Atta, M., Shaala, R., Mousa, E., El-Monshed, A., Fatah, N., & Khalil, M. (2024). Exploring the mediating influence of acceptance of change: A study on gerontechnology acceptance, mental well-being, and urban-rural disparities among older adults. Geriatric Nursing, 58, 324–335. https://doi.org/10.1016/j.gerinurse.2024.06.006

Belgrave, M., & Keown, D. (2018). Examining Cross-Age Experiences in a Distance-Based Intergenerational Music Project: Comfort and Expectations in Collaborating With Opposite Generation Through "Virtual" Exchanges. Frontiers in Medicine, 5. https://doi.org/10.3389/fmed.2018.00214.

Bronswijk, V., Bouma, H., & Fozard, J. (2002). Technology for quality of life: An enriched taxonomy. Gerontechnology, 2, 169–172. https://doi.org/10.4017/GT.2002.02.02.001.00

Chen, K., & Chan, A. H. S. (2014). Gerontechnology acceptance by elderly Hong Kong Chinese: a senior technology acceptance model (STAM). Ergonomics, 57(5), 635–652. https://doi.org/10.1080/00140139.2014.895855

Colnar, S., Dimovski, V., Grah, B., Rogelj, V., & Bogataj, D. (2020). Gerontechnology: Literature review and research agenda. 2020 59th Annual Conference of the Society of Instrument and Control Engineers of Japan (SICE), 391–396. https://doi.org/10.23919/SICE48898.2020.9240225

Corsini, F., Laurenti, R., Meinherz, F., & Stål, H. I. (2019). The advent of practice theories in research on sustainable consumption: Past, current and future directions of the field. Sustainability, 11(2), 341. https://doi.org/10.3390/su11020341

Czaja, S. J., Charness, N., & Boot, W. R. (2019). Designing for Older Adults: Principles and Creative Human Factors Approaches (Third edition). CRC Press. https://doi.org/10.1201/b22189

Fozard, J. (2005). Impacts of technology interventions on health and self-esteem. Gerontechnology, 4, 63–76. https://doi.org/10.4017/GT.2005.04.02.002.00

Gr, J. (2000). Gerontechnology: Creating enabling environments for the challenges and opportunities of aging. Educational Gerontology, 26, 331–344. https://doi.org/10.1080/036012700407820

Hsu, Y. (2016). A Chinese response to the aging society. Gerontechnology, 14, 187-190. https://doi.org/10.4017/gt.2016.14.4.011.00.

Huang, G., & Oteng, S. (2023). Gerontechnology for better elderly care and life quality: A systematic literature review. European Journal of Ageing, 20.

Huang, X., & Lajoie, S. (2023). Social emotional interaction in collaborative learning: Why it matters and how can we measure it?. Social Sciences & Humanities Open. https://doi.org/10.1016/j.ssaho.2023.100447.

Hülür, G., & Macdonald, B. (2020). Rethinking social relationships in old age: Digitalization and the social lives of older adults.. The American psychologist, 75 4, 554-566 . https://doi.org/10.1037/amp0000604.

Huss, N., Brorson, S., & Rosén, M. A. (2020). Education for sustainable health care: From learning to professional practice. Medical Teacher, 42(10), 1084–1090. https://doi.org/10.1080/0142159X.2020.1796941

Jang, S. (2020). Intergenerational Choir: A Qualitative Exploration of Lived Experiences of Older Adults and Student Music Therapists.. Journal of music therapy. https://doi.org/10.1093/jmt/thaa012.

Jarrott, S., Leedahl, S., Shovali, T., De Fries, C., DelPo, A., Estus, E., Gangji, C., Hasche, L., Juris, J., MacInnes, R., Schilz, M., Scrivano, R., Steward, A., Taylor, C., & Walker, A. (2022). Intergenerational programming during the pandemic: Transformation during (constantly) changing times. The Journal of Social Issues. https://doi.org/10.1111/josi.12530.

Kümmel, E., Moskaliuk, J., Cress, U., & Kimmerle, J. (2020). Digital Learning Environments in Higher Education: A Literature Review of the Role of Individual vs. Social Settings for Measuring Learning Outcomes. Education Sciences. https://doi.org/10.3390/educsci10030078.

Labay, L. (2020). Toxicology of the Elder, Geriatric Forensic Medicine and Pathology, 486-494. https://doi.org/10.1017/9781316823040.028.

Lamont, A., Murray, M., Hale, R., & Wright-Bevans, K. (2018). Singing in later life: The anatomy of a community choir. Psychology of Music, 46, 424 - 439. https://doi.org/10.1177/0305735617715514.

Lee, A. T., Ramasamy, R. K., & Subbarao, A. (2025, January). Understanding psychosocial barriers to healthcare technology adoption: A review of TAM technology acceptance model and unified theory of acceptance and use of technology and UTAUT frameworks. In Healthcare 13(3). https://doi.org/10.3390/healthcare13030250

Lee, C., & Coughlin, J. F. (2015). Perspective: Older adults' adoption of technology: An integrated approach to identifying determinants and barriers. Journal of Product Innovation Management, 32(5), 747-759. https://doi.org/10.1111/jpim.12176

Maller, C. (2015). Understanding health through social practices: Performance and materiality in everyday life. Sociology of Health & Illness, 37(1), 52–66. https://doi.org/10.1111/1467-9566.12167

Merkel, S., & Kucharski, A. (2019). Participatory design in gerontechnology: A systematic literature review. The Gerontologist, 59, e16–e25. https://doi.org/10.1093/geront/gny034

Monash University. (2016, March 9). Monash Malaysia launches Gerontechnology Lab. https://www.

monash.edu/news/articles/monash-malaysia-launches-gerontechnology-lab
Monash University. (2025, April 11). GTLab. https://www.monash.edu.my/business/research/our-research/gerontechnology-lab
Morato Lara, J. L., Amado-Salvatierra, H. R., & Villalobos, J. (2021). Sustainable technologies for older adults. Sustainability, 13(4), 2090. https://doi.org/10.3390/su13042090
Rashid, S., Ghani, P., Daud, N., Hilmi, Z., Azemi, S., Wahid, S., & Razak, M. (2016). Malaysia's Ageing Population Trends. , 981-990. https://doi.org/10.1007/978-981-10-1458-1_88.
Reckwitz, A. (2002). Toward a theory of social practices: A development in culturalist theorizing. European journal of social theory, 5(2), 243-263.
Shove, E., Pantzar, M., & Watson, M. (2012). The dynamics of social practice: Everyday life and how it changes. Sage Publications.
Teh, P. (2019). 158 Is it Just an Idea…Or More? Gerontechnology Research in Monash University Malaysia. Age and Ageing, 48. https://doi.org/10.1093/ageing/afz164.158.
Teh, P. L. (2016). New Gerontechnology Laboratory in Malaysia. Gerontechnology, 14(4), 248–249. https://doi.org/10.4017/gt.2016.14.4.006.00
Tripathi, S. (2021). Living in today's world: Reflections on the interactions between technology and human relational patterns. Technology in Society, 67, 101706-101706. https://doi.org/10.1016/j.techsoc.2021.101706.
United Nations Economic and Social Commission for Asia and the Pacific. (2022). Asia-Pacific report on population ageing 2022: Trends, policies and good practices regarding older persons and population ageing. https://www.unescap.org/sites/default/d8files/knowledge-products/AP-Ageing-2022-report.pdf
van Hees, S., Horstman, K., Jansen, M., & Ruwaard, D. (2021). Valuation in health and ageing innovation practices. Ageing & Society, 41(8), 1833–1851. https://doi.org/10.1017/S0144686X20000056
Vidrevich, M., Aslanov, R., & Zhirkova, N. (2023). Higher education for sustainable environment: From theory to practice. E3S Web of Conferences, 423, 03006. https://doi.org/10.1051/e3sconf/202342303006
Wong, K. P., Ewe, S. Y., Teh, P. L., Witvorapong, N., & Hill, K. D. (2025). Thai Older Saleswomen's Digital Empowerment: CapCut Impact on Outcomes. Activities, Adaptation & Aging, 1–34. https://doi.org/10.1080/01924788.2025.2493393
Yaw, X. E., Teh, P. L., Lim, W. M., & Lee, S. W. H. (2025). Indoor mobility challenges among older adults: A systematic review of barriers and limitations. PLoS One, 20(6), https://doi.org/10.1371/journal.pone.0325064
Yu, R. (2020). Use of Messaging Apps and Social Network Sites Among Older Adults: A Mixed-Method Study. International Journal of Communication, 14, 21.