

Bridging the Digital Divide: A Conceptual Understanding of Assistive Technology for Elderly People

Razieman Mohd Yusoff^{1,*}, Fairuz Ramli¹, Madiha Badrol Kamar¹, Nurazlina Samsudin¹

¹ Faculty of Business and Management, Universiti Teknologi MARA Cawangan Johor Kampus Pasir Gudang Jalan Purnama, Bandar Seri Alam 81750 Masai Johor, Malaysia

ARTICLE INFO

ABSTRACT

Article history:

Received 2 July 2023
Received in revised form 11 September 2023
Accepted 19 October 2023
Available online 3 November 2023

Keywords:

Elderly mobility; assistive technology;
digital divide; technology anxiety; quality
of life; literature review

An overview of prior studies on older people using assistive technology is provided in this article in which the digital divide and technological anxiety are the two key themes that stand out from the earlier works released on elderly-related topics. The findings of this review draw attention to these difficulties in preserving elderly people's quality of life. According to the theory behind it, assistive technology makes daily tasks easier for the elderly by offering aid within the context of the usage for technological gadgets. Flexible, easy-to-use, perceptible information, high error tolerance, low physical effort, size and space for approach and use are all desirable qualities in technological progress. Within the context of this review, it is addressed how important it is to put in place the proper strategy for introducing older people to technology. In order to close the discussed gap in the digital divide, it is suggested that digital familiarization be an appropriate solution for the elderly.

1. Introduction

In the age of technological advancement, the society shifted towards a knowledge-based economy where the economy is accompanied by information technology advancement [12]. The evolution of digital technology is easily accepted in the younger generation, but the elderly has been left out from the storyboard when it comes to technology adoption. It remains as one of the major challenges to integrate a suitable usage of technology into the lives of the elderly (Kim et al., 2016).

In the work of Özsungur [16], ageing is defined as a process where the lack of skills of learning reflexes and intelligence occurs. On top of that, ageing has caused impairments such as sensory problems, motor/movement problems, and cognitive problems [8]. These impairments should be considered as factors influencing design of mobile application for elderly. Social sustainability has become new challenges, thanks to current trends of global aging [12]. The same author suggested one of the several ways of keeping elderly healthy, independent and active at work or in their community is by having access to social infrastructure and services.

* Corresponding author.

E-mail address: razieman@uitm.edu.my (Razieman Mohd Yusoff)

Meanwhile, as evident in the past research [1,2,6,7,17], it was found that technology able to solve the gap between the wishes of the elderly and their needs, increasing quality of life and reducing the cost of social care [8]. Interestingly, older adults were found increasingly adopting and adapting to information and communication technologies [3]. This situation can be seen in Sarcar *et al.*, [18] where smartphone ownership among elderly has significantly risen in recent years.

However, the main challenge of ensuring quality of life for elderly lay in surging situation of digital divide, a condition which can be explained as having limited access to technology and low technological literacy. These are the main reasons that refrained and excluded elderly from being fully engaged in the digital world [12]. As digital divide comes in two levels; first level owns the technology and second level is technological knowledge and usage skills.

On top of that, assistive technology should be able to give contextual experience for elderly through equitable use, flexibility in use, simple and intuitive use, and perceptible information, tolerance for error, low physical effort, size and space for approach and use [14]. Technology, especially mobile devices has become more important in daily life, yet it seemed to be too complex especially for elderly [8]. When complexity becomes part of the adopting experience, it will lead to a feeling of anxiety, and it is known as technology anxiety.

Even though technology has become staple these days, being accessible to the most appropriate assistive technology can be a challenge and difficulties are abound when it does not properly fulfil the user's special needs [4]. One of the challenges for assistive technology is accessibility to the suitable assistive technology, despite the fact it has the potential to improve people's live [4].

Digital divide and technology anxiety hinders elderly to enjoy successful aging and to ensure successful aging, key determinants such as high physical and mental functional capacity, poor prospects for disease and active participation are important [16]. Hence, this warrants a need to delve into past literatures to gain various perspectives about the role of assistive technology for elderly and potential research avenue will be put into the light at the end of this paper.

2. Review of Existing Literature

Based on the United Nation, the universally chronological definition of elderly was regarded as people aged 60 or above [11]. This age group is considered as less knowledgeable, with fewer operational skills such as scrolling and clicking with less experience in operating systems and software [8].

The contextual understanding for assistive technology in this review is defined as technology design to increase, maintain or improve the functional capabilities of elderly and its evolution is capable for solving the gap between the wishes of elderly and their needs [8]. In the context of assistive technology, it can be interpreted as any piece of technology that is designed to increase, maintain, or improve functional capabilities of people with disabilities, older adults, or people with chronic health conditions [4].

In regards to mobile device's technology, it has become more important in daily life, yet it seemed too complex especially for elderly because this age group is considered as less knowledgeable, equip with fewer operational skills such as scrolling and clicking, and with less experience in operating systems and software [8]. The integral relationship between mobile device with elderly can be seen through four main functions; voice calling, basic functions, internet-based functions and media player [15].

In designing assistive technology towards elderly should be based on four user-centred principles; user experience, the need of physical emotional and cognitive support and guidance,

economic aspects and social aspects [19]. As design level of mobile technology can bring a higher level of acceptance and use of technology for elderly [8].

In the context of aging population and increase in technology advancement, the need for assistive technology happens when elderly suffers declining tendency of physical and cognitive functions due to disease and aging [16]. In order to maintain elderly health, elderly need to be independent and active at work or in their community by ensuring accessibility to social infrastructure and services [12].

Based on all acceptance models, [10] found personal factors; technical factors and environmental factors are the most important factors that influence technological usage among elderly. On the contrary, the common reasons technology is not widely adopted among elderly are lack of home access to internet, low awareness of technology offerings, insufficient marketing, unsuitable design and anxiety [8].

Majority of studies conducted in technology acceptance factors for aging in place were in the pre-implementation stage [13]. These factors affecting elderly decision to use technology were found to be perceived benefits of use, subjective norm, perceived behavioural control, perceived usability, affections and socio-demographic factors [13].

Another finding mentioned age, gender, education, self-efficacy and anxiety, and health and ability characteristics and facilitating conditions affected technology acceptance among elderly in Hong Kong [5]. It is worth to mention that elderly and technology adoption studies can be narrowed down into three classifications: development of new technologies or systems, understanding users, and methods for working with older people [17].

In the light of elderly technological adoption research, eight major topics found: mobility and way finding, communication and social interaction, interaction with technology, using the web, access to and exploration of information, education, support for daily living, and games and play [17].

3. Discussions

Technology anxiety can be reduced through training and familiar interfaces. Familiarity in the context of this review is defined as how frequently user uses certain technological product and repeated experience of using any sort of devices. The right approaches to familiarised technology with elderly were found to be by using social cognitive theory by implementing observational training [12]. It was proven to improve technological knowledge, self-efficacy, outcome expectations, and sense of social connectedness by incorporating technologies.

Most common technology adopted by elderly were mobile apps for transportation such as route-planning using transportation information app, entertainment for example play a movie with video player on the tab, social communication to have conversation with family members using communication app, and health care and monitoring purposes like heart rate measurement using health monitoring app [13].

Based on association of elderly and technology, an acceptance model based on elderly was developed by Kim *et al.*, [9]. This model is known as Senior Technology Acceptance Model (STAM) and derived from previous acceptance model, Technology Acceptance Model (TAM) and Unified Theory of Acceptance and Use of Technology (UTAUT). STAM aims to explain elderly mobile phone adoption by relying on three dimensions: objectification (the phase in which the user forms an intention to use a device based on his/her and social context and on perceived usefulness), incorporation (the experimentation and exploration phase that helps in validating the ease of use and usefulness) and adoption per se.

On the contrary, Charness and Walter [20], found age is not a strong predictor of technology use. Hence, the uniqueness of this result should be explored as a new research gap in elderly mobility research.

4. Conclusions

Discussion about quality aging should be discussed more in terms of operationalization of the terms for digital divide and technology anxiety. The majority of the literature suggested improvement should be included in designing assistive technology specifically for elderly. As the elderly have a tendency to adopt assistive technology, provided sufficient training and explanation of each function provided.

Potential research on elderly mobility should investigate several premises such as technology acceptance model to suit current needs or ensuring elderly to have access to latest technology to ease their daily errands. Factors such as perceived benefit of use, subjective norms, perceived behavioral control, perceived usability, affections, and socio-demographic factors needs to be explored further in an effort to ensure elderly ability to enjoy social inclusion and achieve quality aging.

Based on the broad discussion discussed about the elderly and the role of technology in their lives, it is appropriate to highlight that by educating and familiarizing them with the usage of these gadgets will help them improving the quality of life. This can be achieved by understanding the underlying concept for each technology, then deciding the suitable device such as hearing aid, sensory light or automated wheelchair to ease their tasks in daily lives.

References

- [1] Akatsu, Hiroko, Hiroyuki Miki, and Naotsune Hosono. "Design principles based on cognitive aging." In *Human-Computer Interaction. Interaction Design and Usability: 12th International Conference, HCI International 2007, Beijing, China, July 22-27, 2007, Proceedings, Part I 12*, pp. 3-10. Springer Berlin Heidelberg, 2007.
- [2] Broady, Tim, Amy Chan, and Peter Caputi. "Comparison of older and younger adults' attitudes towards and abilities with computers: Implications for training and learning." *British Journal of Educational Technology* 41, no. 3 (2010): 473-485.
- [3] Buccoliero, Luca, and Elena Bellio. "The adoption of" silver" e-Health technologies: first hints on technology acceptance factors for elderly in Italy." In *Proceedings of the 8th international conference on theory and practice of electronic governance*, pp. 304-307. 2014.
- [4] Buehler, Erin, Stacy Branham, Abdullah Ali, Jeremy J. Chang, Megan Kelly Hofmann, Amy Hurst, and Shaun K. Kane. "Sharing is caring: Assistive technology designs on thingiverse." In *Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems*, pp. 525-534. 2015.
- [5] Chen, Ke, and Alan Hoi Shou Chan. "Gerontechnology acceptance by elderly Hong Kong Chinese: a senior technology acceptance model (STAM)." *Ergonomics* 57, no. 5 (2014): 635-652.
- [6] Fang, Yu-Min, Yi-Jhen Huang, Bo-Cheng Chu, Chao-Wei Hsu, Chien-Cheng Chang, and Meng-Hsien Hsun. "A New Smart Wearable Device Design Based on the Study of the Elderly's Mental Perception and Reading Usability." In *HCI International 2014-Posters' Extended Abstracts: International Conference, HCI International 2014, Heraklion, Crete, Greece, June 22-27, 2014. Proceedings, Part II 16*, pp. 288-293. Springer International Publishing, 2014.
- [7] Huh, Jun-Ho, and Kyungryoung Seo. "Design and Implementation of the Basic Technology for Solitary Senior Citizen's Lonely Death Monitoring System using PLC." *Journal of Korea Multimedia Society* 18, no. 6 (2015): 742-752.
- [8] Iancu, Ioana, and Bogdan Iancu. "Designing mobile technology for elderly. A theoretical overview." *Technological Forecasting and Social Change* 155 (2020): 119977.
- [9] Kim, Sunyoung, Krzysztof Z. Gajos, Michael Muller, and Barbara J. Grosz. "Acceptance of mobile technology by older adults: a preliminary study." In *Proceedings of the 18th international conference on human-computer interaction with mobile devices and services*, pp. 147-157. 2016.

- [10] Kuerbis, Alexis, Adina Mulliken, Frederick Muench, Alison A. Moore, and Daniel Gardner. "Older adults and mobile technology: Factors that enhance and inhibit utilization in the context of behavioral health." (2017).
- [11] Leung, Mei-yung, Qi Liang, and Jon Pynoos. "The effect of facilities management of common areas on the environment domain of quality of life of older people in private buildings." *Facilities* 37, no. 3/4 (2019): 234-250.
- [12] Ma, Qi, Alan HS Chan, and Pei-Lee Teh. "Bridging the digital divide for older adults via observational training: Effects of model identity from a generational perspective." *Sustainability* 12, no. 11 (2020): 4555.
- [13] Ma, Qi, Ke Chen, Alan Hoi Shou Chan, and Pei-Lee Teh. "Acceptance of ICTs by older adults: A review of recent studies." In *Human Aspects of IT for the Aged Population. Design for Aging: First International Conference, ITAP 2015, Held as Part of HCI International 2015, Los Angeles, CA, USA, August 2-7, 2015. Proceedings, Part I 1*, pp. 239-249. Springer International Publishing, 2015.
- [14] Mustaquim, Moyeen M. "A study of universal design in everyday life of elderly adults." *Procedia Computer Science* 67 (2015): 57-66.
- [15] Nimrod, Galit. "The hierarchy of mobile phone incorporation among older users." *Mobile Media & Communication* 4, no. 2 (2016): 149-168.
- [16] Özsungur, Fahri. "Gerontechnological factors affecting successful aging of elderly." *The Aging Male* 23, no. 5 (2020): 520-532.
- [17] Petrie, Helen, Bláithín Gallagher, and Jenny Darzentas. "Technology for Older People: a critical review." In *HCI International 2014-Posters' Extended Abstracts: International Conference, HCI International 2014, Heraklion, Crete, Greece, June 22-27, 2014. Proceedings, Part II 16*, pp. 310-315. Springer International Publishing, 2014.
- [18] Sarcar, Sayan, Cosmin Munteanu, Jussi PP Jokinen, Antti Oulasvirta, Chaklam Silpasuwanchai, Neil Charness, Mark Dunlop, and Xiangshi Ren. "Designing mobile interactions for the ageing populations." In *Proceedings of the 2017 CHI Conference Extended Abstracts on Human Factors in Computing Systems*, pp. 506-509. 2017.
- [19] Wilkinson, Christopher, and D. Ghandi. "Future proofing tomorrow's technology: UX for an aging population." *User Experience Magazine* 15, no. 1 (2015).
- [20] Charness, Neil, and Walter R. Boot. "Aging and information technology use: Potential and barriers." *Current directions in psychological science* 18, no. 5 (2009): 253-258.