Embracing Older Adults in Online Learning[1]

Ali Haydar BÜLBÜL
Department of Computer Education and Instructional Technologies, Faculty of Education, Anadolu University, Turkey
alihaydarbulbul@anadolu.edu.tr
ORCID: 0000-0002-0116-8070

Serpil GÜNAYDIN
Distance Education Application and Research Center, Balıkesir University, Turkey
sgunaydin@balikesir.edu.tr
ORCID: 0000-0001-6304-1107

Hatice Ferhan ODABAŞI
Department of Computer Education and Instructional Technologies, Faculty of Education, Anadolu University, Turkey
fodabasi@anadolu.edu.tr
ORCID: 0000-0003-4362-4609

ABSTRACT
Life expectancy at birth is the highest of all times and tends to increase. This leads to an older society and brings out various needs that are not taken into consideration before, one of which is the education of older adults. People usually get the idea that older adults cannot learn or do not feel the need to learn. However, learning is an integral part of life and need of learning never ends. Education in older adulthood leads to healthier and more personalized lives, thus, happier individuals in later ages. Older adult learners are not perceived as a burden by the rest of the society, on the contrary, they are considered as individuals who enrich the society with their knowledge and experience. Precautions of the Covid-19 Pandemic and current technological opportunities accelerated the substitution of face-to-face teaching and learning environments with digital ones. Nevertheless, older adults who already experience declines in cognitive, affective and psychomotor abilities, have been subjected to various technological barriers as well. Online education of older adults requires well-designed learning environments to maximize the efficiency of activities performed using computers or mobile devices. Considering that interface are the initiatives of communication between user and digital content, if designed with consideration of changing physical conditions, prior knowledge, habitudes and experiences of older adults, interface might become a mediator to increase the effectiveness of digital content. This study examines design-wise issues in online learning environments within the framework of gerontology and older adult education.
Keywords: Gerontology, Geragogy, Older adult education, ICT use of older adults, Online learning.

INTRODUCTION
Developments in science and technology have direct and indirect consequences on people and governments. One of the most discussed issues in the last decades has been the life expectancy of people affecting almost every area of life, socially and economically. The life span of people has never been as long as today owing to enhanced living conditions, preventative health care, and advancements in nutrition science. According to the Turkish Statistical Institute (TÜİK, 2020), life expectancy at birth in Turkey is reported as 78.6 and expected to increase continuously. This value is even higher in some other OECD countries. More than one-quarter of the population in most of OECD countries is projected to be over 65 years of age by 2050 (OECD, 2017) corresponding to about 2 billion in numbers all around the world. OECD use the term *elderly population* for people aged 65 or over (2021). However, in this chapter, we chose to identify people of age 65 or above as *older adults*.

Changes and developments carry the need of proper attitudes, perspectives and reactions together with them. The phenomenon of aging population also uncovers the learning needs of older adults and leads educators to rethink about habitual, instructional and design-wise strategies used within current technologies targeting relatively younger population. While Information and Communication Technologies (ICT) become more common for each individual of the society, practices tend to address younger population, often ignoring older adults by the idea that they have low ICT literacy and declining physical, cognitive and psychological abilities. However, ICT is becoming indispensable for older adults, especially with medical, social, economic and educational benefits. Despite older adults use technology less often than other age groups (Githens, 2017), considering the aging population, it is not hard to predict that they would be interacting with technology and become a larger consumer segment in the following years (Anagnostou, 2020; Czaja et al, 2019; Oñate et al., 2015; Vroman et al., 2015).

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Literature reveal that older adults use a variety of technological devices for various purposes –which will be covered in this chapter. Among these purposes, socializing and communicating with acquaintances take the lead, however, a significant number of older adults, on the other hand, use technology to seek information and to learn (Oñate et al., 2015). Learning is essential for older adults to maintain their health and self-integrity, and thus, lead a happy life and need healthcare services much later in their lives (Githens, 2007), what's more, integration of older adults in education has become a necessity for the societies. Younger generation has a lot to learn from older adults with years of first-hand experience. Combining today's scientific and technological knowledge with older adults' wisdom, a society can rear up socially, culturally and economically. Therefore, ICT plays an important role here because it facilitates reaching information and education, especially for financially or physically disadvantaged segments of society. Taking advantage of ICT, older adults can be served in terms of *true* information, *quality* education, and interaction with experts and younger generation leading to an affirmative society. On the other hand, relatively low ICT literacy levels and declining physical abilities of older adults emerge as an issue to focus in many situations. For an effective and sustainable learning; design, usability and accessibility of online learning environments must be reviewed, thus, embracing older adults in online learning. To reach a consensus of older adults and technology use, the concepts of lifelong learning, andragogy and gerontology should guide us. Under the guidance of these concepts, this chapter aspires to address key issues and give specific design suggestions to make online learning experiences indispensable for older adults.

LIFELONG LEARNING

Lifelong learning is a learner-centered perspective that removes boundaries such as age, socio-economic status and educational level of individuals who want to learn and improve independently from time and space (MEB, 2021). European Commission defines lifelong learning as all activities throughout an individual's life intending to improve knowledge, skills and competencies personally, socially and professionally (2002). Carrying learning out of school, lifelong learning strengthens social and professional aspects of learning (Güleç et al., 2012). Today, societies need individuals who are self-improving and have lifelong learning skills (Soran et al., 2006). Globalization and growing economics of information entail individuals improving knowledge and skills continuously to keep up with the times in both their professional and private lives (Ereş, 2019). This makes lifelong learning inevitable especially for older adults because the ways we produce, share and use information have already transformed into ways older adults are not familiar with, eventually hindering their professional lives and making them isolated from the society. Therefore, continuing education programs are a must for older adults to stay active and integrate into societies (Oñate et al., 2015).

Learning improves physical, cognitive and psychological health of older adults, providing them with joy of life, self-fulfillment, social involvement, self-reliance in social relationships, self-sufficiency, and coping strategies; helping them preserve cognitive functions, feel less tired, reduce social isolation level and dependency on others, increase psychological capital and sense of well-being; and introducing a more pragmatic way of using spare time, thus, maintaining and improving their quality of life (Aldridge & Lavender, 2000; Borkowsky, 2013; Boulton-Lewis et al., 2006; Boulton-Lewis, 2010; Dench & Regan, 2000; Formosa, 2012a; Githens, 2007; Merriam & Kee, 2014). A significant number of older adults find learning activities entertaining (Swindell, 2002). Nonetheless, there are also those refusing to learn or not having opportunity to learn because of financial, transportational or time-wise issues (Githens, 2007; OECD, 2010; Swindell, 2002). The former may be rooted to assimilation of declines in cognitive abilities or the fear of displaying them, especially if friends or family members are present in instructional environment (Billipp, 2001; Hale, 1990), and the solution may be ensuring their privacy and safety through online learning environments (Swindell & Thompson, 2000). For the latter, on the other hand, asynchronous learning activities that do not require physical existence is necessary, thus, no need to argue, the most pragmatic and economical solution is to learn via ICT. Keeping both issues in mind, online learning practices seem to be the best way for older adult education, considering those having financial issues, confined to the home or having transportation constraints; and physical and time-wise constraints of educational institutions. Older adults can be more motivated, productive, social, hence, happier if they are provided with well-designed online learning environments when lifelong learning is considered. Therefore, online learning environments should be designed taking into account of the attitudes, habitudes, qualifications and limitations of older adults. To understand their characteristics and the way they learn, we need to look through andragogy and gerontology.

ANDRAGOGY

Once authored in the second quarter of 19th century by Alexander Kapp, the concept of andragogy was not the favorite concern of educational scientists until the first quarter of 20th century (Henschke, 2011). However, the concept emerged as a scientific theory and discipline by the contributions of Knowles and Savicevic representing the science of how adults learn (Knowles 1970; Knowles, 1984; Savicevic, 1999). Since then, particularly because

of the increasing life expectancy of people and the idea of bringing the older segments of society into economy, andragogy has become a necessity for societies.

Adult learners differ from children in respect to having more experience, established learning habits and independence, hence, ability to make their own decisions and put new learnings into practice (Knapper & Cropley, 2000). Adults learn more self-directed distinguishing adult learning from school learning (Creech & Hallam, 2015). Adult learning may be more successful than school learning when assorted with learners' personal goals, leading us to the assumptions of andragogy that adults are problem-centered, self-directed, intrinsically motivated, pragmatic and experiential learners with high readiness level who bring their precious experiences to the educational settings (Knowles, 1980; 1984). Based on these assumptions, Knowles also introduces a seven-step process of guided instruction for best educational experiences:

- Create a cooperative learning environment
- Plan goals of instruction mutually
- Identify the needs and interests of the audience
- Help learners specify learning objectives based on their needs and interests
- Design sequential activities to meet these objectives
- Design instruction with favorable methods, materials and resources to achieve specified objectives
- Evaluate the quality of learning experience (1980).

Contributions of Knowles helps us understand how older adults learn to some degree. Nevertheless, this population is very heterogeneous with respect to their dynamically changing needs and abilities (Newel et al., 2002; Wagner et al.,2014). Therefore, we need to understand older adults' differentiating characteristics for best learning experiences.

GERONTOLOGY

It is known that people experience declines in physical, cognitive and psychological abilities in later ages, and design of online learning environments suitable for older adults requires consideration of these changes. Declines in psychomotor functions, vision, hearing and cognitive abilities are well-documented in the literature (Charness & Holley, 2004). Nonetheless, age-related practices are complex because aging is not a uniform process, on the contrary, individuals of the same age may be significantly different from each other (Kooij et al., 2008; Wagner et al., 2014). Therefore, it is important to make a consensus when talking about age and aging, especially if the older adults are the matter of subject. Sterns and Doverspike (1989) clarify this issue introducing five interrelated conceptualization of age:

- *Chronological age*, referring to the calendar age of an individual,
- *Functional age*, concentrating on biological and physical performance,
- *Psychosocial or subjective age*, the meanings attributed by others and self,
- *Organizational age*, focusing on professional and organizational life,
- *The life span concept of age*, advancing the possibility for behavioral change at any point in the life.

Studies on older adults will be more meaningful if these conceptualizations are taken into consideration. As individuals age, the significance of biological growth decreases while the importance of lives and experiences of individuals increases personally and socially (Doğru, 2020). Especially in older adulthood, past experiences and years occupy an important place. Older adulthood is not a defective or incomplete part of life cycle, on the contrary, individuals can maintain healthier, more active and productive if the societies give them the value they deserve, and suppress disadvantages they may experience. *Chronological aging* should not be necessarily accompanied by other concepts of aging aforementioned, leading us to the concept of active aging. WHO (2003;2020) defines active aging as *"the process of optimizing opportunities for health, participation and security in order to enhance quality of life as people age"* emphasizing the value of learning, growth and making decisions for a healthier life. The need and desire to learn are eternal, therefore, declining brain plasticity, brain's capacity to change as a result of experience (Pritchard, 2015), does not mean that older adults cannot learn. Their cognitive abilities and learning process are different in regards to younger people, therefore, teaching and learning practices must be adjusted according to the characteristics of older adults (Oñate et al., 2015).

Older adults desire to enjoy their times by establishing strong relationships and bonds with life, and they have a lot of time to actualize that (Boulton-Lewis, 2010). Nonetheless, most of them experience declines in physical, cognitive and psychological abilities, affecting their needs, learning process and ICT use significantly. John (1988) suggest that taking into consideration of physical characteristics, cognitive processes, socio-emotional

needs crucially contributes to the success of teaching older adults. Therefore, it is important to recall some age-related changes that older adults mostly face.

Cognitive Changes

Cognitive abilities change as a normal process of aging. Most older adults experience mild cognitive declines that do not interfere with daily functioning significantly, thus, contrary to the myths in society, they are capable to learn and develop new skills, although it is slower than younger people (APA, 2017; Findsen & Formosa, 2011). Supported by much research, cognitive abilities, such as conceptual and perceptional reasoning, memory, processing speed, selective and divided attention, concept formation, abstraction, mental flexibility, response inhibition, inductive reasoning, and reasoning with unfamiliar material, decline gradually over time (Harada et al., 2013). Older adults also experience declines in lexical decision and reading, while aging less likely to affect crystallized memory, problem-solving, language, visuospatial abilities, ability to appreciate similarities, and reasoning about familiar material (Charness & Holley, 2004; Harada et al., 2013). Some qualifications such as personality, wisdom and creativity, on the other hand, are not likely to change (APA, 2017), making them more self-directed and experiential learners.

Physical Changes

Some declining physical abilities with age reported in the literature are, but not limited to, motor functions, touch sensitivity, vision and hearing. Most older adults experience declines in psychomotor functions and touch sensitivity, not only stemming from medical history such as injuries from repetitive stress, arthritis and stroke but also as natural outcomes of aging (Charness & Holley, 2004; Schmall, 2000). Older adults experience motor skill changes such as decreasing movement speed and stride length; declining strength and endurance; changes in balance, coordination, and gait characteristics; minor extrapyramidal signs and flexed posture (American Academy of Neurology, 2012).

Aging causes deterioration of eye and eyesight. Common anatomical visual impairments can be summarized as decreased pupil size and reactivity, diminished lens elasticity, reduced clarity of lens and decline in numbers of rods and cones (American Academy of Neurology, 2012). Older adults may experience thickening and yellowing of the lens, or ocular diseases such as glaucoma, retinal detachment, macular degeneration, diabetic retinopathy and cataracts (Charness & Holley, 2004; Schmall, 2000). Most older adults have fairly good vision, nonetheless, a great number of them face decreases in light perception, sharpness of vision, color discrimination, size of visual field, near vision, contrast sensitivity, visual search and processing, and pattern recognition as well as declines in ability to focus, function in low light, adapt to dark, glare and judge distance, most of which have effects on technology access and use of older adults beyond mobility and orientation (American Academy of Neurology, 2012; Schmall, 2000; Zhou, 2001).

Hearing loss is considered as the most serious sensory impairment, being an individuals' so-called *social sense*, thus, and experiencing a slight loss can be emotionally upsetting (Schmall, 2000). A great number of older adults experience hearing loss to some degree, moderate or more severe, starting around middle age and progressing later on (Charness & Holley, 2004). Hearing loss may occur as a result of natural process of aging as well as because of medications, infections, prolonged or sudden extreme noise, and certain diseases (Schmall, 2000). Common hearing problems of older adults are decreased pure tone hearing, inner ear sounds, decline of speech discrimination level, difficulty to hear high-pitched sounds and high frequencies, making older adults more vulnerable to fast speech rate and background noise (American Academy of Neurology, 2012; Charness & Holley, 2004; Schmall, 2000).

Psychological Changes

Contrary to common sense, mental health is as important as physical health, being in bilateral relationships with all other aspects of health and facilitating well-being. Most older adults report good mental health, nonetheless, a quarter of the older adult population experience mental health problems such as depression, anxiety, schizophrenia and dementia (APA, 2017).

Mostly as a result of cognitive and physical changes, sense of loneliness and isolation, depression and withdrawal seem to be the most common psychological issues older adults have to cope with (Schmall, 2000). In fact, the number of older adults living alone increases with age, partly because of losing their spouse, child or a loved one, making the situation worse physically and emotionally (APA, 2017). Older adults tend to make use of ICT to fight with loneliness and isolation, paradoxically, they are not very likely to explore ICT self-initiatively and need support and encouragement of a partner or family member (Vroman et al., 2015). Keeping all in mind, we need to discuss how older adults learn, and how ICT becomes a part of this process.

GERAGOGY

Older adults engage in educational opportunities at different ages and for a variety of reasons such as personal growth and change, workforce training, learning in workplace and make good use of leisure time (Githens, 2007). Indeed, they are more willing to engage in learning activities when they are aware of their personal needs and potential benefits of technology on their life quality and living conditions make older adults more willing to learn and develop (Oñate et al., 2015). Social context of the learning environment, on the other hand, is usually more important than the subject matter for older adults (Creech & Hallam, 2015). The number of older adults seeking such opportunities increases every day, impelling educators to perform best practices for them.

Geragogy is described as continuous education of and by older adults, based social relations, well-being, self-actualization and talent development (Hartford, 1978; Lemieux & Sanchez Martinez, 2000). Some researchers also considered geragogy as a theory for teaching older adults based on common characteristics of older adults (John, 1988). Coinciding with the lines of the andragogy to some degree, assumptions of John's geragogy can be summarized as followings:

- Skills and resources that help maintaining *personal independence* should be the aim of learning
- Tasks must be meaningful for older adults, thus, *practical outcomes* must be highlighted
- Older adults may need *longer times* to complete a task and intend to revisit until they feel comfortable
- Instead of monotonous verbal presentations, *flexibility and variety of methods and techniques* are required, fulfilling *the needs and expectancies* of older adults such as pleasure, curiosity, communication and information seeking
- *Focus of topic* should be maintained clear, presenting limited number of ideas and avoiding irrelevant or distracting concepts
- *An approving, encouraging and embracing approach* should be adopted to stimulate engagement rather than a disciplined one
- *Past experiences, learnings and skills* should be valued and reviewed to allow them be creative and adopt best strategies for themselves (John, 1988).

Although John's assumptions of geragogy points out non-negligible gerontological hints for teaching older adults, it is criticized by some researchers as not being a comprehensive educational theory because it is teacher-centered and considers older adults as a homogenous group (Findsen & Formosa, 2011; Formosa, 2012b). This point of view convinces us to look through a critical approach embracing the heterogeneity in this group: Critical Geragogy (Findsen & Formosa, 2011; Formosa, 2002).

Critical geragogy finds its roots in critical gerontology, critical education and Battersby's (1987) view of geragogy, conceptualizing teaching and learning as a *collective and negotiated enterprise amongst older adults* (Formosa, 2011). Glendenning & Battersby (1990) criticized older adult educational programs –of the time- for being somehow ageist, disregarding learners' goals and their heterogeneity, and considering *any* type of education as liberating and empowering. Based on these concerns, Formosa (2002) introduced fundamental principles for practice of critical geragogy:

> *"1. Critical geragogy must be directed by a political rationale so as to highlight its commitment to the transformation of ageist social structures,*
> *2. Despite the diverse heterogeneity of older persons, critical geragogy must employ a communal approach towards the transformation of the ageist world,*
> *3. Critical geragogy refutes the myth that any type of education empowers older people, and is grounded on liberatory education,*
> *4. Critical gerogogists are not just facilitators; they take sides with and are committed to the sufferings of older people.*
> *5. The practice of critical gerogogy must not only occur within the walls of the older adult educational programme, but must reach out to all distinct segments of older persons.*
> *6. Critical gerogogy embraces a self-help culture towards a more decentralised and autonomous older adult education as power is shifted to older learners.*
> *7. Critical gerogogy must enable older adult education to take the role of a 'progressive' movement by engaging in counter-hegemonic activities."* (Formosa, 2002).

Maderer & Skiba (2006), in their framework for integrative geragogy, distinguish the objectives for active and inactive aged individuals, subdividing objectives of geragogy into three categories: person-centered, fellow-centered and matter-centered. The framework suggests that objective of geragogy differ for active aged and inactive aged persons in terms of these objectives. *Improvement of mental and physical competence, increase in*

behavioral independence, and development of hobbies and interest are person-centered objectives for active aged, while *conservation* of these and setting up of satisfactory living conditions are primary objectives for inactive aged. Fellow-centered objectives for active aged persons are reported as *engagement in social situations, taking responsibility for others, and enabling others to display their role in social situations*, while these become *attentive to social situations, recognizing others, finding interlocutors, and accepting social situations* for the inactive aged. Matter-centered objectives, on the other hand, should be *helping active aged individuals cope with new situations*, while objectives focus on *the differentiation of animate and inanimate, the fixing of personally important things, the differentiation of various materials, and the adequate usage of objects* for the inactive aged Maderer & Skiba (2006). Based on the categories of integrative geragogy, Creech & Hallam (2015) extract a theoretical framework for critical geragogy based on their qualitative inquiry (Figure 1). Their study suggests that developing a trusting interpersonal climate; valuing prior experiences and using these as a resource; guiding learners in setting learning goals; and recognizing the sustained importance of progression are crucial in practice of critical geragogy, nevertheless, reminding that any attempt to make a set of recommendations for facilitators of older adult learning poses the risk of disregarding their voice, as older adult learners are not a homogenous group.

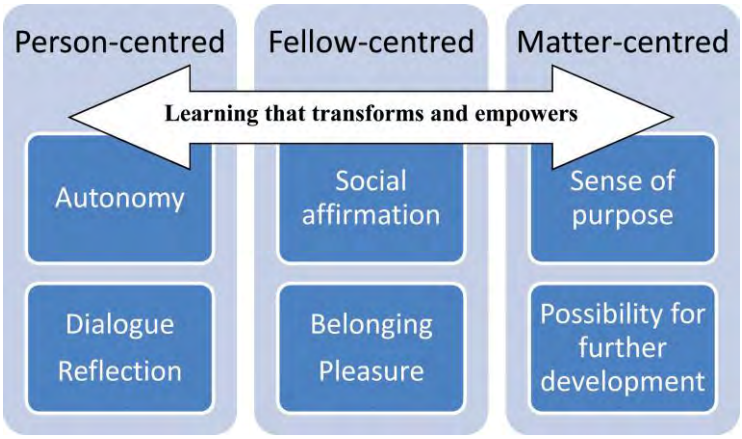

Figure 1. *Theoretical framework for critical geragogy (Creech & Hallam, 2015)*

Putting all together, older adult learning practices require meticulous planning and implementation, therefore, facilitators of older adult learning must devote time to understand their learners' needs, preferences, capabilities and all other characteristics. Although several studies make practical recommendations, one must approach those carefully as dynamics of the learning environments will never be same.

ICT AND OLDER ADULTS

"Older adult ICT consumers have age-specific needs, preferences, and predispositions that are distinctive." (Vroman, et al., 2015). It is almost impossible to precisely picture technological qualifications, habits and behaviors of older adults because this period of life comprise of a rich diversity of characteristics, abilities and backgrounds. This diversity makes it difficult to identify the target group in Human-Computer Interaction (HCI) studies on older adults, thus, it is necessary to investigate the perceived meaning of technology to understand their adoption of technology (Righi et al., 2017).

ICT, particularly Internet technologies, are considered substantial for older adults as ICT-based communication can enhance several forms of social capital: *network capital*, corresponding to the relations with acquaintances; *participatory capital*, taking part in organizations; and *community commitment*, a responsible sense of belonging (Blit-Cohen & Litwin, 2004). Nonetheless, current ICT preferably target younger population and seem to disregard and underestimate older adult users (Vroman et al., 2015), thus, digital divide between younger population and older adults continuously increases. Communication is a must for people regardless of age or conditions, not only with humans but also with machines, older adults falling behind with the latter (Charness & Holley, 2004). Therefore, integrating older adults in online learning requires an understanding of common factors that affect their adoption and use of ICT.

Barriers to and Enablers of

Older adults have an established hierarchy of needs and direct their resources primarily for things they perceive as most needed, ignoring the others, thus, they are open for technological innovations only when practical benefits are apparent, and perceived value is high; when resources or skills are not adequate, they prefer their comfort zone

(Giuliani et al., 2005). Therefore, it is crucial to understand the needs of older adults, and introduce technologies to them *emphasizing* practical use and advantages of these technologies.

ICT use has direct and indirect benefits for older adults, such as taking advantage of various network-based services, social interaction, information access, personal growth, coping with depression, increasing cognitive capabilities, decreasing isolation risks; and allowing to share their professional and personal knowledge and experience with others (Catteano et al., 2016; Cotton et al., 2013; Cotton et al., 2012; Hazzlewood, 2001; Shapira et al., 2007). Nonetheless, a significant number of older adults remain distant to and feel uneasy about ICT-based communication considering that it may decrease the level of face-to-face interaction (Heinz, 2013). Online activities, indeed, may result in less time devoted for daily activities and social interaction, on the other hand, they may also provide older adults with social involvement and sense of belonging (Swindell, 2002). What actually matters here appears to be the awareness of potential benefits of ICT, perceived usefulness and the purpose of use.

Older adults' adoption of ICT is influenced by personal and behavioral factors such as income, previous experience, educational level, access, ability, computer anxiety, self-efficacy, privacy and safety concerns, awareness of potential benefits, motivation, interest –or lack of interest; cognitive factors such as fluid and crystallized intelligence; and design-wise factors such as accessibility and usability (Charness & Holley, 2004; Czaja et al., 2006; Vroman et al., 2015; Wagner et al., 2010). In their multinational study, Oñate et al (2015) reveal that older adults are more enthusiastic about adapting new technologies in countries with higher economic level such as France and UK, possessing high ICT terminology and skills. In Spain, on the other hand, older adults are more reluctant to use technology and their technological knowledge is weak, nonetheless, specialized technology courses are desired by the most, which may also be considered as an indirect indicator of financial issues on ICT use.

Educational history of older adults has a significant effect on ICT use. Older adults with lower education levels are mostly non-users of ICT while those having a college education or above mostly use ICT at higher levels (Vroman et al., 2015). In addition, learning and ICT use seems to be in a bilateral relationship because while educational level somehow predicts ICT use in older adulthood, learning in later ages also leads to an increase in ICT use (Catteano et al., 2016). Previous experience also affects ICT use, as inexperience and misperceptions of older adults may lead to negative attitudes and emotions towards ICT while experienced ones perceive them as *comforting*, *satisfying* and *encouraging* (Vroman et al., 2015). Thus, making ICT available for older adults is never enough to help them adopt ICT and engage in online learning without making their first experiences encouraging (Aula, 2005). Therefore, it is crucial to guide non-users and moderate users properly in online learning environments.

Computer-related anxiety was reported as one of the most important factors for ICT use, carrying several psychological barriers with it. Older adults with high computer anxiety are less likely to use ICT (Czaja et al., 2006). ICT-related anxiety accompanies a low self-efficacy (Vroman et al., 2015), which is also considered as a significant barrier to ICT use on its own (Czaja et al., 2006), and what is worse, it may hinder older adults' ICT use causing self-imposed barriers (Marquié, Jourdan-Boddaert, & Huet, 2002). This makes older adults prone to underestimate their knowledge and abilities, and lose self-confidence, both of which are considered more powerful indicators of ICT use than actual technology knowledge (Mitzner et al., 2010). Together with these collateral effects, ICT-related anxiety seems to be the primary concern for older adults. To overcome computer anxiety and low self-efficacy, technical and emotional support of family members and friends play a significant role (Chu, 2010). Nevertheless, older population with low ICT literacy and lack of interest and motivation still exist, thus, all educational institutes should take on responsibility and adapt their services suitably for them (Oñate et al., 2015).

Older adults make use of TV (including a la carte TV services), tablet computers, mobile phones, laptops and desktop computers, at different rates of use and ownership, and varying with respect to personal and sociocultural characteristics (Oñate et al., 2015; Zickuhr, 2013), but only if the technology helps them reach their goals (Righi et al., 2017). In fact, to keep informed, older adults heavily rely on either TV or Internet services in accordance with their ICT skill levels: TV use is more common if ICT skill level is low, while higher ICT skill level leads to preference of online services (Oñate et al., 2015). Older adults tend to attribute specific purposes and meanings to the devices they use, and use them only for those purposes (Magsamen-Conrad et al., 2015). They may also attribute several purposes and meanings to the same kind of device (Righi et al., 2017).

Older adults mainly use ICT for being informed and entertainment (Oñate et al., 2015). Mobile devices are mostly used for entertainment, leisure time activities, information seeking, maintaining relationships, and style, on the other hand, computers are mostly preferred in learning activities (Magsamen-Conrad et al., 2015; Oñate et al.,

2015; Plaza et al. 2011). However, it is important to note that grounding on findings of any previous research on older adults' ICT use may misguide when designing online learning environments, thus, instructional designers and practitioners should recognize the technologies their audience use. Designing online learning environments with familiar technologies and interfaces may be functional, especially for novice older adult learners (Hollinworth & Hwang, 2011).

ONLINE LEARNING AND OLDER ADULTS

Benefits of learning for older adults have been summarized above. Online learning of older adults, on the other hand, is another matter. In fact, one of the problems seems to be adoption and participation of older adults in online learning settings. Nevertheless, as Chu (2010) reports, encouraging behaviors of family members facilitate older adults' adoption to online learning. Family support, both emotional and technical, self-confidence and motivation plays a significant role for older adults to use ICT and engage in learning, thus, in online learning (Chu, 2010).

Slegers et al. (2006) reveals that computer-based instruction leads to more positive changes in social functioning, life satisfaction and perceived autonomy of older adults. However, older adults learn more slowly and need enough time to learn, or else get discouraged, thus, proper design is inevitable (Aula, 2005; Chaffin & Harlow, 2005). Besides, most of older adults are self-learners (Oñate et al., 2015). Thus, instead of a linear and formalized structure, they prefer an informal one, so they can learn at their pace and have more control on their learning. It is important to include several tutors interacting *asynchronously* with older adult learners to give them enough time they need, as older adult learners may need differing practice times to complete an exercise (Trentin, 2004).

Older adults prefer interesting and engaging materials, and aesthetics is also important for them (Stoltz-Loike et al., 2005). They are inclined to make use of video tutorials, online conferences and specialized courses (Oñate et al., 2015). Nevertheless, Trentin (2004) notes that high ICT literacy is required for enjoyable activities in online learning process of older adults. They may experience discouraging usability problems because of text-based environments, and terminology and structure of the Web (Aula, 2005; Wright, 2016). Online learning environments that are heavily based on text may pose negative effects. Obviously, older adults who experience visual declines may face difficulties reading the content (VanBiervliet, 2004). Besides, some may prefer or are obliged to read printed text, therefore, if text-based materials are inevitable, interface designs must be print-friendly (Zaphiris et al., 2007). Older adults seeking information preferentially ask their friends or family first, and if the digital environments are the sole remedy, they prefer voice communication rather than written text (Giuliani et al., 2005). In online communication, they are not inclined to type when they can participate orally, which makes text-based communication ineffective for older adult learning (Righi et al., 2017).

Social interaction in online learning environments is crucial for older adult learners, particularly for those trying to deal with loneliness, to bond with others and feel the sense of belonging to a community (Swindell, 2002). "*Older adults value a learning environment where they have other older adults learning with them"* (Aula, 2005). Trentin (2004) remarks the positive effects of social interaction among older adult learners and tutors in online learning practices, emphasizing the use of freeware platforms allowing older adults keep in touch even after the course. In line with this, Swindell (2002) also reports that older adults have better learning experiences in socially interactive online learning environments, and keep their social connections after the course. Online learning of older adults is a community-based and self-directed process, therefore, learner satisfaction comes out as a more important factor, even more than the quality of instruction (Wang, 2003).

Swindell (2002) reports differing behaviors when it comes to communication groups: some older adult learners were more active in writing while others preferred to learn by actively observing, however, most of them liked to follow each other's messages and profiles. Social networks, in this respect, may serve as favorable learning environments for older adults, supporting social interaction and providing cognitively challenging activities, which are perceived as beneficial for health and well-being (Swindell, 2002).

Putting all together; (1) facilitating online learning communities or communities of inquiry, (2) taking advantage of audio-visual presentation and communication techniques that foster social interaction among older adults and tutors, and (3) giving them more control on their learning may be some effective solutions for most older adult learners in online learning environments. Nevertheless, considering diverse characteristics of older adults, it is not possible to introduce a universal set of principles. However, design suggestions/principles of previous research may help instructional designers and practitioners find out best solutions for their audience.

DESIGNING FAVORABLE ONLINE LEARNING ENVIRONMENTS FOR OLDER ADULTS

Age-related cognitive, physical and psychological changes in older adult learners necessitate essential adjustments in online learning environments. In fact, interface design, and thus, usability comes as one of the most important issues for older adults in digital settings as developers and service providers tend to address younger population ignoring older adult users. Nielsen (1993) argues that usability is rather interwoven than one-dimensional and has five facets: learnability, efficiency of use, memorability, few and non-catastrophic errors, and subjective satisfaction, where satisfaction is measured by the overall criteria. In accordance with this, ultimate goal of interface designers should be the satisfaction of user, in this case, older adults. Paying regard to the variety of devices and services they use, we intend to review design principles and suggestions in the literature discussing under physical, cognitive and psychological changes.

As stated earlier, older adults experience physical declines in sensory and psychomotor capabilities as a normal aging process, accordingly, has been one of the most investigated issue in usability studies. Considering the declines in vision, designing favorable online learning environments requires; easy to read fonts, larger fonts with antialiasing properties, possibility to change font size, colors other than violets, blues, and greens for fonts and fine detail, tools that convert text messages to voice format, increased brightness and contrast and/or controls to change these features, and using non-glare materials (Charness & Holley, 2004; de Almeida et al., 2015; Sulaiman & Sohaimi, 2010; Zaphiris et al., 2007).

Multimedia learning materials have been indispensable for online learning environments, thus, audial issues must also be taken into consideration. Online learning environments may take advantage of videos, animations, voice/sound recordings and sound effects, speech recognition utilities, so on. Older adults with hearing loss at varying levels may have difficulty to comprehend sounds and voices when studying on poorly designed audial or audio-visual materials. Keeping speech rate at a moderate speed, ensuring the clarity of speech, keeping noise and other extraneous sounds at minimum, and maintaining mid-frequencies facilitate comprehension and lessen the negative effects hearing loss (Charness & Holley, 2004).

Older adults mostly experience declines in motor functions including fine motor movements, finger precision and touch sensitivity, which requires consideration especially for designing mobile interfaces because use of handheld devices for information seeking and learning is common among older adults. In this sense, to lessen the effects of declines in motor functions, designers should

- Minimize keyboard usage
- Prefer simple gestures and avoid complex gestures that requires more than two finger or both hands
- Use generous spacing among interactive elements (but not too liberally)
- Keep tap and swipe target sizes large
- Avoid positioning interactive elements at the bottom edge of the screen
- Include visual, audial or haptic feedbacks on touch *(*de Almeida et al., 2015; De Barros et al., 2014; Leitao & Silva, 2012; Zaphiris et al, 2007)

Older adults may experience difficulties understanding the structure and hierarchy of an interface and easily experience disorientation, which eventually cause dissatisfaction (Li & Luximon, 2017; Li & Luximon, 2020; Wagner et al., 2014). Menu disorientation, in particular, is the most highlighted usability issue for older adults (Wagner et al., 2014) They are inclined to focus on the content in the middle of the screen, explore the interface linearly, prefer content-oriented searching, and follow a linear path when navigating (Castilla et al., 2016; DeStefano & LeFevre, 2007; Zhou et al., 2012), on the other hand, they have difficulty to comprehend complex and semantically distant icons, browse broad menus, switch between functions, and return to previous screens (Li & Luximon 2017; Li & Luximon, 2020; Zhou, et al., 2012). Using familiar interfaces when designing online learning environments can help these users (Hollinworth, & Hwang, 2011). Preferring vertical, simple and flat menu structures that shows the full context rather than deep and nested ones; designing easy-to-understand icons and buttons that includes text labels triggering same action; conforming older adults' vocabulary; fixing the positions of interactive elements at different pages; preferring simple and easily reversible actions, and placing a "return" or "back" function on an apparent area of the interface can help older adults feel more comfortable navigating on the online learning environment (de Almeida et al., 2015; De Barros et al., 2014; Hollinworth, & Hwang, 2011; Li & Luximon, 2017; Li & Luximon, 2020).

CONCLUSION

This report addresses basic considerations on older adults' adaptations to online learning environments in aging societies. Older adults experience physical, cognitive and psychological changes at varying levels as a natural outcome of aging or because of their medical history. Contrary to popular opinion, older adults *can* learn and

develop new skills if given equality in opportunities, nevertheless, they are mostly ignored when it comes to online tools and services. As ICT use is considered important for engaging online learning activities, and most older adults are inclined to use a variety of ICT for distinctive purposes; designers, educators and facilitators *have* to recognize the needs and capabilities of their older adult audiences to provide them with favorable online learning environments. However, aging is not a uniform process, thus, older adulthood is a heterogeneous age-group with distinctive characteristics, beliefs, attitudes, needs and preferences. Therefore, any effort to present a universal design for older adults will probably be unsatisfactory. Nonetheless, taking into consideration the facts represented in this report and showing regard to the specific needs and capabilities of their own target group, instructional designers should come up with best technological, instructional and methodological solutions.

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