
COGNITIVE LEARNING APPLIED TO OLDER ADULT LEARNERS AND TECHNOLOGY

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This article addresses the needs of older adults learning computer skills and the place of technology, especially the computer, in enhancing their lives. A model is discussed that illuminates the process used by older adults to learn computer skills. The model may be used to analyze and provide specific aid for common difficulties of the aged. Suggestions and recommendations are proposed that facilitate the older adult learner's use of computers. One of the underlying assumptions for the model is that the fundamental interests of the learner can be discerned and, with careful preparation by the teacher, motivation will follow.

Personhood and its potential are continuously unfolding and technology can become a major source of its realization. As individuals progress toward autonomy, they choose the goals they want to achieve, and decide what activities and which ways of being have meaning for them and which do not. Rather than moving blithely through this process, autonomy is typically achieved with caution and some trepidation, often with no confidence at first (Rogers, 1961). As we age, maintaining control over hard-earned autonomy is constantly challenged by age-related physical, cognitive, and environmental changes. Today, communicating about one's needs and maintaining one's autonomy can be enhanced if older adults learn and use computer skills.

According to McConatha (2002), one of the most important factors determining our place in a social environment is our perception

of control. To control their own fate and their own environment as they age, older adults are learning computer technology at a pace faster than any other age group (Beisgen & Kraitchman, 2003, McConatha, 2002). Computer skills and use of the Internet give them control over one of the primary threats to their physical and psychological well-being: social isolation. Isolation often results from retirement, loss of a spouse, children living far away, moving to a retirement center, or becoming homebound due to age-related illnesses. Experts recommend that, in designing interventions for socially isolated older adults, the focus needs to be on ways to improve communication and increase contact with others (McConatha, 2002).

Enter technology and the empowerment of computer skills. Although older learners can learn computer skills as well as young students, they learn slower (Tomprowski, 2003). Aging causes physiological changes that slow the learning process. Sensory changes also impact ability to learn, yet the motivation of older people to learn about computers is very strong (Purdie and Boulton-Lewis, 2003). In this article a model of cognitive learning is presented to identify and describe factors involved in the learning of new practices—in this case technology.

A growing number of older adults have a title: the vulnerable elderly. They are at greater risk than younger age groups for developing age-related health problems. Although they desire independence in their later years, health problems often force them to become dependent and homebound. This raises the question of how to keep older Americans connected to the world around them.

A RAPIDLY EXPANDING POPULATION

An estimated 35 million people aged 65 years and older lived in the U.S. in 2000, and accounted for 13% of the total population (Nahm & Resnick, 2001). By the year 2020, 20% of Americans are expected to be over 65 years old. U.S. Census Bureau (2000) population projections show that there will be 70.3 million older adults age 65 and older by 2030, or double the number today. By 2050, they are expected to number 82 million (Wetle, 2002).

Older adults are a rapidly growing population. Baby Boomers, born from the late 1940s to the mid-1960s, are the youngest segment (Beisgen & Kraitchman, 2003). Another segment, people 65 and older, is also a rapidly growing population (Nahm & Resnick, 2001). The number of people 85 and older is expanding at a rate

six times that of the young people in the U.S. (Callen & Wells, 2003).

People are living longer. Those 85 and older, the fastest growing segment in the older population (Callen & Wells, 2003), are most at risk for disease and disability. Yet their numbers are currently rising faster than the elderly population as a whole, thus illustrating their increased longevity. There are 4 million people age 85 and older in the U.S.; by 2030 that number is expected to double. By 2050, it is projected that the number of people age 85 and older could soar to at least 19 million, and might even be as high as 27 million or more (Wetle, 2002). People in the U.S. over 100 years old numbered about 68,000 in 2000, with projections that by 2050 they will number over 1 million (Beisgen & Kraitchman, 2003).

There are marked differences in older adults over age 65 as a group compared to those under 65. Each group has its own characteristics. The younger group is healthier, very focused on slowing the aging process, and is characterized by an independent spirit that is a product of the greatest era of social change ever experienced in the U.S. (Kressley & Huebschmann, 2002). The older age group is moving into, or has already arrived at, the life phase of having predictable age-related health problems, is immersed in the aging process, and is a product of economic hard times and the challenges of world wars (Beisgen & Kraitchman, 2003). Older Americans are typically self-sufficient and self-reliant as a result of their life experiences and the history of their times. When problems arise, they initiate searches for information or answers; for example, online searches for health information.

AGEISM

Despite the interest of many older adults in learning computer skills, there is a subtle belief in American society that old people are unable to do much. This type of prejudiced thinking is ageism and includes assumptions about ailments or frailty caused by age (Palmore, 2001, Cohen, 2001, Levy, 2001). **Ageism is a systematic stereotyping and pervasive negative view of older persons** (Palmore, 2001). Ageism emphasizes the failing of physical and mental capabilities among the old. It calls attention to the potential limitations of the elderly while ignoring the positive potential that comes with experience and further learning. What is particularly insidious is that the negative sloping of human potential represented by ageism may well form the image that the elderly themselves **internalize**. If ageism is the lens

by which society views the elderly and, in turn, the elderly view themselves, **then life opportunity becomes significantly reduced.** Moreover, **a great deal of human potential is never realized.**

For example, Rowe (1995) has written of the care given to some older adults in England, and has noted that not infrequently a pattern of care can be observed that promotes an image of the passive, infirmed older adult. Called the “old dears,” the older adults are cared for by staff who create a proper public image for them by doing the following.

The staff know that the old dears have lost interest in everything and do not need to be entertained . . . they (the old dears) sit in chairs set in schoolroom rows with the television in front. The function of the television is to suggest to visitors that the old dears are getting the stimulation that misguided geriatricians and psychologists say they need . . . foolish people who say that old people in their chairs should be arranged in groups so they can talk to one another, or at least see one another. Staff know that the old dears don’t need this. After all, if you can’t see or hear properly, can’t enunciate clearly, and have trouble remembering, you’re not much of a conversationalist (Rowe, 1995, p. 74).

When hospitalized or admitted to care centers, older adults are often plagued with questions such as, Where am I? What will happen to me? It is no surprise, then, that older adults have high mortality rates. Half of postmenopausal women with fractured hips die from complications of blood clots, pneumonia, and infections within twelve months of the accident; older men have a high rate of death from suicide (Rowe, 1995). The expectations that society has of older adults greatly affects personhood and the type of life available to them. Having reached a certain age does not constitute a plateau that then descends; if seen correctly, achieving a certain age allows a continual process of problem solving and discovery of knowledge derived from living.

Ageism is, then, discrimination against old people. Purdie and Boulton-Lewis (2003) caution that ageism is a dominant view of the elderly that undercuts the potential vitality and activity of the older adult learner. At any age we are not totally independent. We rely more than we realize on friends, the community, social and environmental arrangements (helpers), and professionals. Few of us cut our hair or make our own clothes. We rely on others. In fact, we often think of the availability of these people as options.

Independence is a matter of degree, but a realistic assessment of the barriers presented as life choices can actually enhance independence.

For example, an 86-year-old woman independently made her own doctor's appointments, and also scheduled transportation to her appointments using a free, city-sponsored ride service for frail seniors. Unfortunately, she was left at the doctor's office for five hours one day due to miscommunication between drivers. She experienced severe hip pain during the five-hour ordeal because she was unable to lie down, as was her custom throughout the day. Her daughter intervened and agreed to take her mother to future appointments with the doctor so there would be no waiting and no pain. The two also agreed to eat at a restaurant after the appointments. This allowed the older woman to enjoy the addition of more social time with her daughter. Her independent decision to schedule a doctor's appointment was preserved and balanced by her willingness to be dependent on her daughter for transportation.

Rowe has noted that as age creeps in, control over one's life may well decrease (1995). Accordingly, independence and dependence are not absolute conditions. **Independence increases as accommodations and resources are introduced into the capacity of older adults to handle their circumstances.** Computer technology brings with it a broad set of resources that can provide older adults with new ways of addressing life problems.

A woman in her 80s, who was homebound and in a wheelchair, used an e-mail device to communicate with family and friends. She found out that she could order from a large grocery chain using e-mail and, for an additional five dollars, the groceries would be delivered to her door. She lived in a senior residence where three meals were served daily, but her diet restrictions often limited her ability to eat the food that was served. By shopping for items on her diet and having them brought to where she lived, she could keep appropriate foods in an apartment-size refrigerator and cook using a microwave oven. She often took her own food to the dining room at meal times, and was able to eat and enjoy the company of her tablemates.

In the past, much of the gerontology literature adopted a "loss" view of aging rather than a 'gains' view (Purdie & Boulton-Lewis, 2003). However, the notion that older persons lose their place in society is being replaced by the view that all individuals, regardless of age, **can maintain active lifestyles and can contribute meaningfully to their families and society.**

The World Health Organization's guideline recently described health in old age as "a state of complete physical, mental, and social

well-being, not merely the absence of disease or infirmity” (Beisgen & Kraitchman, 2003, p. 163). Central to healthy aging is the capacity to regulate behaviors that derive contentment from life. Aging is now seen as an essential and natural part of the cycle of life—a period in which people continue to learn and also pass on knowledge to others. Active older adults are the norm (Tomporowski, 2003).

People in Western cultures have begun to realize that the culture itself serves to limit older adults’ potential for learning. Rather than seclude older adults from opportunities to learn, it is important that they continue to be active, to persist in maintaining their ability to acquire new knowledge, and to manage their own goals for learning. The result is positive emotions (Tomporowski, 2003). Assumptions that were central to the early twentieth-century labor force (such as the necessity for mandatory retirement) and the limits of older adults’ abilities, skills, and performance, are being challenged. While the idea of the vulnerable older adult is still accurate, the pendulum is swinging toward an optimistic view of old age (Tomporowski, 2003), and a growing number of older adults are optimistic about computers.

THE e-QUALITY THEORY OF AGING

McConatha (2002) has proposed a theory of e-Quality for older adults. It is based on the premise that access to Internet-based technological advances can enhance the condition of older adults in contemporary society. It posits that as older adults use the electronic environment of the Internet, they benefit themselves (McConatha, 2002). One older adult joyfully commented, “I installed the computer myself . . . Wow . . . You won’t believe that, but all the plugs are color-coded and I followed the directions . . . I can communicate with others . . . it (the computer) gives me a purpose in life and it makes me feel not so alone myself . . . it keeps my mind active and challenged . . . I wonder if I would feel that way if I didn’t have a computer” (Clark, 2002, p. 120). Hardware and software are important; but more important is the way that older adults learn to use computers so they can be successful when seeking the information they need.

How do older adult learners best learn to use a computer? It is a process of cognitive change that begins with their own art and culture, includes the efforts of the person teaching computer technology, and ends with the ability to e-mail, word process, and surf the Internet. A model of this process shows why the learning needs of older adults require a unique approach (See Figure 1).

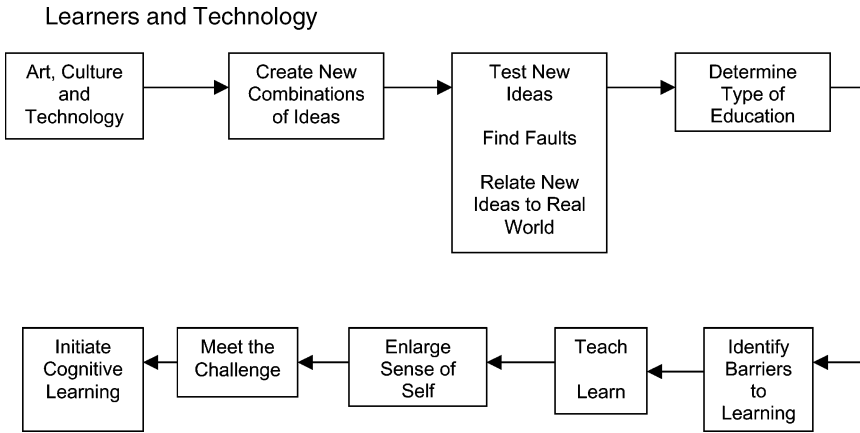


Figure 1. The Chaffin-Harlow model of cognitive learning applied to older adult learners and technology.

THE ROLE OF ART, CULTURE AND TECHNOLOGY

Contributions from art, culture, and technology guarantee the transfer of what an individual needs to function in society. How do these three factors influence older adults?

Art

There is always the odd mixture of the way things used to be with the surrounding culture. It has been found that when older learners have ways of accessing events and issues, they are eager to integrate the new with their perspectives (Wright, 2000).

Dewey (1980) reminds us that art is a form generated as we interact and reflect upon life experiences. Dewey describes the human creative form this way:

In an experience, things and events belonging to the world, physical and social, are transformed through the human context they enter, while the live creature is changed and developed through its intercourse with things previous external to it (p. 246).

Accordingly, art is transformative through the force of the person. Now elements and events become integrated into a growing personhood. To Dewey, education is equivalent to growth in personhood.

As Noddings (1995) noted, Dewey insisted that experience is educative only if it produces growth—if, that is, students leave the experience more capable or interested in engaging in new experience.

Beisgen and Kraitchman state, “Art is a bridge across generations. Sharing one another’s arts, stories, song, dance, and music is a way to connect the generations within families and communities” (2003, p. 107). Every person is a repository of memory and story. The elderly, as is true of all, need a medium to express their stories and connect with other generations. Word processing, chat rooms, and e-mails provide the perfect vehicle for older adults who want to express a greeting, a story, their history, or an opinion.

Culture

With the infusion of information technology and the World Wide Web, older Americans are no longer bound by the four walls of where they live. They have instant access to unlimited Web sites. Yet, for many older adults, theirs is a culture of social isolation because—among other reasons—they do not have computers skills or the ability to access the Internet (Fioto, 2002; White et al., 1999; Wright, 2000).

Social isolation may well occur as we grow older. Loss of a spouse, retirement from work, or moving to a retirement home, are common events for older adults. They may strain the emotional resources of the individuals and restrict the expression of their potential. The opposite of social isolation is connection which can be achieved by the introduction and use of computer technology. Older adults can move from a culture of social isolation to a culture of communication.

Technology

Many older adults are not of the computer generation. If they are without computer skills, they typically begin with a basic computer course. Basic courses often teach word processing, accessing the Internet, and sending/receiving e-mail. The content they are taught needs to be age-appropriate for their learning level. The older adult’s learning level needs to be a priority.

Learning, according to Harlow and Cummings (2003), has three levels: a) survival learning for just getting by; b) adjustment learning, which is forced learning and not owned; and c) discovery learning, or intrinsic learning, which is owned. During survival level learning, whether old or not, learners experience learning tasks as being beyond their grasp. Some things make sense; others do not. But as

a whole, the process seems alien to the learners. The overall process does not seem to click. At this level, doubts occur and learners need support and aid. Direct instruction and practice, along with emotional support, are instructional ways of helping learners advance beyond the survival level.

With developing confidence and certain skills, learners enter the adjustment level. Here, the person is directed by outside instructions and tutors, but does not rely on their own sense of mastery and control. They do not yet own the learning process. There are things to be done, areas to be learned, but the authority for experimental and further learning is not the learners. The learners are preoccupied with the “right way” of proceeding, and take their cues from outside authorities.

Discovery learning occurs when skill development and comfort with new learning results in a sense of mastery. The computer and its possibilities are experienced as a part of personhood. It is at the discovery level that learners begin to own the learning process. The computer becomes a way to solve problems and experiment. This third level, discovery learning that is owned, is typically observed among adult learners.

It is important for older adult learners and their computer teachers to be aware of the learners’ learning levels. The nature of learning approaches and the methods of overcoming barriers will be different, depending on the level of comfort among older learners and their ownership of their learning. As older learners experience needs and interests that learning will satisfy, they become motivated to learn. Typically, their orientation to learning is life-centered, and experience is the richest source for adult learning. There is a “deep need to be self-directed, and individual differences among people increase with age” (Beisgen & Kraitchman, 2003, p. 72). In an effort to meet the need to remain in touch with family or to control their own finances, older learners may want to learn about technology and how to use e-mail and the Internet. Such skills can give them the ability to e-mail grandchildren or check investments online.

Sometimes called the Digital Divide, there is a socioeconomic and demographic division between those who use computers and those who don’t (Morrell, Mayhorn, & Bennett, 2002). While America today is technology driven, the elderly are underrepresented: 8% of seniors aged 65 and older have Internet access, compared to 40% of the under-65 population. Many older adult learners want to learn technology skills, and do not want to be excluded from computer training (Beisgen & Kraitchman, 2003).

CREATE NEW COMBINATIONS OF IDEAS

Older adults using computers to receive, express, and create thought and information are in a realm that may remove them from the tedium of the everyday. Popular areas of study for researchers include psychosocial aspects and quality of life for older adult Internet users. White et al. (1999) studied older adults in a retirement community ($n = 15$) and noted a decrease in loneliness of participants due to the learning and use of computer skills. A study by Wright (2000) focused on older adults ($n = 136$) in a computer-mediated environment. Frequent Internet users had greater satisfaction with Internet providers of social support than less-frequent Internet users. The study showed that the more involvement older adults have with the online community, the lower their life stress. Knowing how to use a computer and the Internet makes a difference.

A DEMONSTRATION WITH THE HOMEBOUND

Nahm and Resnick (2001), in a qualitative study of five elderly homebound individuals, each suffering from a debilitating condition, saw the computer as a medium that moved each from survival to discovery. They described the process of instructing the five learners in the use and possibilities of the computer. Several themes emerged from the Nahm & Resnick study (2001). Participants noted the importance of having supportive mentors and considered this essential to their learning processes. By continuing to practice and taking time to learn, difficulties were overcome.

The difference technology made in the lives of the participants was highly significant. Participants noted that they were bored and isolated prior to learning to use e-mail and the Internet. After learning to use e-mail, their lives became more interesting, they communicated more with others, and they felt less isolated. A new perspective on life was voiced by participants who created schema for computer skills. With new combinations of ideas for communicating via computers, e-mail, and the Internet, participants described how their lives had changed. Some examples, in the words of the participants, were:

Before [she started to use the Internet and e-mail], I did laundry (laugh), I did... It was nothing, because I couldn't go out a lot.

It enables me to have a whole new world out there that I didn't know existed. I do enjoy it immensely.

It gives you something to look forward to.

I've got a grandson in Kentucky, I write to him. I've got a daughter . . . and another granddaughter in Pennsylvania, and of course I like to send e-mails to them for practice [laugh] (2003, p. 261).

RESOLVING A CRISIS

Learning computer skills has been shown to have a positive impact on the life problem-solving of older adults, along with giving them increased control over life options. For example, The Pew Internet and American Life Project (2003) detailed the experiences of a woman caring for her ill husband at home. She used the Internet to research his medications and health concerns. She was a new user of the Internet, but forged ahead with learning how to use it. Her husband was in a special bed with a high rise alternating air pressure mattress.

Two days before Christmas, a power surge blew out the motor for the mattress. The mattress was needed not only for preventing skin breakdown, but also for the husband's breathing. The wife called the agency that set-up the bed, but they no longer dealt with the bed manufacturer because Medicare/Medicaid no longer paid for the beds. The agency had her contact the bed manufacturer, but they could not supply a back-up motor. Repair by a local repairman would take at least a couple of weeks.

The wife went online to e-Bay and found a used motor on auction; the price was reasonable so she had it shipped overnight. The wife said, "Saved the holiday, saved hubby from potential problems and we have a back up (motor) in the house should we ever have another problem" (Pew Internet & American Life Project, 2003). She saved her husband from serious respiratory problems by using the Internet. Uses like this give new meaning to accessing the Internet, a meaning that goes far beyond e-mail to grandkids and travel information to Tahiti. Older adults can use computer skills, not only to create new ideas, but also to create new ways to cope with life.

TEST NEW IDEAS

Before developing a curriculum for teaching computer skills to older adults, the teacher needs to understand the unique anxiety that is part of the learning process for this population. Computer anxiety, by definition, usually appears when one is thinking about using

computer technology or the consequences of its use. Namlu (2003) listed typical computer anxiety behaviors as a) avoidance of computers and the place where they are located, b) excessive caution when learning computer skills, and/or c) negative remarks about computers. For older adults, computer anxiety commonly occurs in the form of fearing they will break the computer, or they are too old to learn, or fearing that if they strike the wrong key the computer will explode (Dyck & Smither, 1994; Laguna & Babcock, 1997; Lansdale, 2002). Strong motivation can mediate individual anxieties; i.e., wanting to learn how to use a computer so one can e-mail grandchildren or play computer card games.

Deciding what to teach needs particular attention when the learners are older adults who want to use computers. Maddux, Johnson, and Willis (1997) describe two types of educational computing applications. Type I applications stimulate relatively passive involvement on the part of the user. The learning process, for example, may involve pressing the space bar, typing YES, or answering questions by rote memory. Type I applications require that the user conform to a very limited repertoire of acceptable responses predetermined by developers of the software. Tutorials and drill and practice software are typical examples. Type I applications make it easier, quicker, more efficient, or more convenient to teach the same things in the same ways as has always been done.

Type II applications, by contrast, require active user intellectual involvement, place control of what happens on the screen in the hands of the user, and have as their goal the achievement of relatively creative tasks (Maddux, et. al., 1997). These applications include word processing, spreadsheet and database management, simulations, problem-solving, and telecommunications, i.e., e-mails or using the Internet. As was mentioned earlier, discovery learning involves ways to solve problems and experiment. Type II computer applications offer many opportunities for discovery learning. To accommodate older adults, particularly their beginning efforts at computer use, teachers need to select applications that are achievable.

For older adult learners, drill and practice may be appropriate as a teaching method. Step-by-step directions with many pictures or screen captures will also help, allowing the learner to know exactly what they are supposed to be seeing on their computer screen. The basic skill of moving the mouse—while foreign to an older adult new to computers—can be taught if described in a familiar context. For example, Weiss-Morris teaches older adults to “iron the shirt” (2002, p. 98), a familiar movement to the generation that regularly ironed clothes. Older learners will need to test the new computer skills

and ideas they have been taught, and decide which ones they want to keep in their repertoire.

FIND FAULTS

Dorothy Rowe (1995) has said, “Suffering is the attempt to make reality repeatable” (p. 357). Problem solving for older adults involves being realistic about what conditions must be dealt with whether health difficulties, social isolation, or cognitive changes. Prior to beginning a computer class for older learners, teachers need to identify the problems that are unique to this age group. Problems with seating, lighting, and/or operating the computers need to be addressed so faults can be found and resolved. Hardware accommodations might include using monitor screens with low glare or making a roller-ball mouse available for those with crippling arthritis in their hands.

Older learners typically have problems with some aspects of software in common use, i.e., drop down menus or scrolling text (National Institute on Aging and National Library of Medicine, 2002). A few niche software companies have begun to address the faults of existing software. Where larger computer companies have been unable to serve older adults with the current crop of computers and software, niche businesses have stepped in to make computers easier to use. Sageport (<http://www.sageport.com>) sells Sagevision, an Internet appliance designed to connect seniors to the Internet at a cost of \$399.00. Another company, It’s Never 2 Late (<http://www.insnever2late.com/>), sells computers with adaptive keyboards and magnified screens (Leavengood, 2001). Visual impairments need not limit Internet use by older adults.

RELATE NEW IDEAS TO REAL WORLD

Many older adults are motivated to learn computer skills. They want to be modern, and they don’t want to be left behind (Beisgen & Kraitchman, 2003; Lansdale, 2002). For older learners to learn well, they need to see a connection between the computer skills and their everyday life. For example, to learn e-mail, they need to have a desire to communicate or to feel connected to the outside world.

The more they can relate their computer skills to the real world, the more motivated they become. Their motivation may be to stay independent for as long as possible. Others find that communicating via computer decreases loneliness. One participant from a study by

Nahm and Resnick (2001) noted, “We check on each other. Sometimes I don’t see CM, but then on the Internet she’ll have something on there; she was making sure everything’s OK” (p. 261). Many are amazed at their increased ability to seek information online, find it, and share it with others. As one happy older adult commented, “Now I send e-mails, several letters a day, and I learned how to go on to the Internet to find out interesting things, news, inspirational things. I send them with my e-mail” (Nahm & Resnick, 2001, p. 259).

DETERMINE TYPE OF EDUCATION

How do older adults best learn to use computers? In most ways older adults learn much as a learner of any age would. Yet presentations to older adults need to be tailored to their preferences. A study by Austin-Wells, Zimmerman, and McDougall (2003) found that older adults prefer PowerPoint presentations over use of a flip chart or overheads. Involving older adults in the process of need assessment, planning, and implementing educational programs is key. Mehrotra (2003) recommends giving older adults opportunities to share experiences, engage in reflection, and be active in decision-making.

Older adults may have debilitations and physical limitations they did not possess in their early lives. They may well need special attention and accommodations as they undertake learning to use a computer. Beisgen and Kraitchman (2003) provide the following suggestions for encouraging the process of learning with the older adult learner.

1. Provide personal attention.
2. Help learners relate new knowledge to past experiences.
3. Speed works against older learners, so fast-paced drills may not be successful.
4. Provide opportunity to succeed at something in every class.
5. Provide small amounts of information at a time; summarize frequently to increase retention and recall.
6. Use practice, repetition to enhance learning.
7. Use positive reinforcement to enhance learning (2003, pp. 81–83).

It should be emphasized that encouragement and motivation should be offered throughout the learning process, not just in the beginning stages. Tomporowski (2003), in his study of older adult

learners, has pointed out that despite some sensory and short-term memory loss, the elderly learner with the benefit of directed practice can learn and retain new skills as effectively as younger learners. He notes that older learners tend to learn new material more slowly than their younger counterparts. While the shape of the learning curve will differ from the younger learner, the older learner, with encouragement and greater opportunity for practice, will gain facility in acquiring new skills. The computer offers the advantage of self-paced practice and the eventual increase in processing speed.

What older adults learn about computer skills is equally important as how they learn. Older adults who are beginners and have no previous computer experience might benefit from tutorials with step-by-step directions. If older adults have had years of experience with computers prior to retirement, more challenging content would be appropriate curriculum.

We view the computer as a direct medium of experiencing the older adult learner's intelligence. The realization of potential will be enhanced or reduced by our conception of intelligence. Intelligence is often conceived of as academically oriented, much like a traditional I.Q. test or S.A.T. score. Gardner (1999, 2004) has been helpful in going beyond psychometric measures and viewing intelligence in broad and diverse ways. Gardner defines intelligence as "biopsychological potential to process specific forms of information in a certain way" (2004, p. 29). From his studies of the forms that individuals bring to different types of problems, Gardner identifies eight different intelligences: verbal, logical-mathematical, spatial, musical, bodily-kinesthetic, naturalistic, interpersonal, and intrapersonal/or inward reflective. Intelligence is then not a single faculty, but rather is multiple in its development and experience. Intelligence is best seen as:

not things to be seen or counted. Instead they are potentials—presumably neural ones—that will or will not be activated, depending upon the values of a particular culture, the opportunities available to that culture, and the personal decisions made by individuals (Gardner, 1999, p. 34).

Purdie and Boulton-Lewis (2003) point out that the loss view of aging predominates in the literature on gerontology. The loss view begins with the idea of deficit; and this takes away the possibilities and opportunities that are available to the elderly. What are the true barriers to learning experienced by older adult learners?

BARRIERS TO LEARNING

Ford (as cited in Emmons, 1999) lists four factors that are essential for adaptive problem solving:

1. **Motivation as goal directed.**
2. **Skills necessary to produce the desired goal.**
3. **Biological architecture and function.**
4. **A supportive environment.**

Each factor can be related to overcoming cognitive and physical barriers to learning when bringing computer technology to older adult learners.

Motivation

When problems arise in an older adult's life, the use of the Web can be probed as a way of resolving difficulties. For instance, e-mail can be used as a way of continual connection to grandchildren or government agencies serving Medicare recipients. One older adult commented, "Lots of people like me go to libraries to read but they are dependent on help from other people. I want to learn a few little basic skills, so I can find out things on the computer myself" (Purdie & Boulton-Lewis, 2003, p. 138).

Skills

Direct instruction that attends to the cognitive needs of individual older adult learners will help introduce sequential skills that enable them to explore and use the computer. It is no accident that card games like Solitaire are found on computers. Computer teachers who work with older adults value the practice students receive when playing card games, and see it as a vital exercise in learning to "click and drag," an important skill needed for navigating an operating system as well as the Internet. Skills are often the result of perseverance, a common characteristic of many older adults.

Biological Architecture

Accommodations can be made that acknowledge sensory or physical limitations due to increasing age. The following prevalent age-related changes warrant consideration.

Vision

Physical changes occur with age that degrade vision, the first beginning between the 35th and 45th years. The second change is in the mid-50s when circulation of blood to the cells of the retina begins to decrease. As a result, the retinal cells degenerate and perform less effectively (Tomprowski, 2003). These changes may result in cataracts and macular degeneration. Cataracts cloud the lens of the eye and reduce the sharpness of images, resulting in blurred vision and increased susceptibility to glare. Macular degeneration involves degeneration of receptor cells in the macular section of the retina (the center of the back of the eye), where the center of the field of vision occurs and fine details are perceived. In both cases, reading becomes difficult (Kausler & Kausler, 2001).

Available accommodations for visually impaired older adults now include glare-protective screens; large monitors with increased font size; fewer screen icons for less confusion; select colors for more contrast between background and fonts; and adhesive-backed keycap labels to provide large, bold letters on the keyboard. Microsoft Office provides Magnifier to enlarge screen images as an option on its Accessibility menu.

IBM supports the older adult market through its research efforts. Software with specific accommodations for older adults has been developed by IBM, and is currently being evaluated by members of SeniorNet (SeniorNet, 2004). Prototype designs have been developed to provide software for blind users, and teaching strategies exist to teach them how to navigate and research the Web (Morley et al., 1999; Lin, 2003).

Hearing

Sounds from the immediate environment provide a filter to help determine what is right and what is wrong in the world surrounding older adults. While efficient use of a computer depends mainly on visual skill, hearing is important too because there are sounds or cues emitted from computers that can be confusing or misinterpreted by older adults.

It is a fact that older adults are the largest population affected by hearing loss: one in three over age 60 has hearing loss, and that percentage increases to 50% in those over age 85 (New York-Presbyterian Hospital, 2003). Decline in hearing occurs gradually, with those who were constantly exposed to loud sounds evidencing the greatest hearing loss. The loss is due to degenerative changes of hair cells in the cochlea of the ear, which are most noticeable beginning in the seventh decade of life. This contributes to loss of sensitivity to high-frequency sounds.

As a result, older adults become less able to extract information from the environment.

Some of the loss of physiological function can be compensated for by other components of the information-processing system (Tomprowski, 2003). Accommodations that aid the hearing-impaired older adult are available. Speech systems can provide hardware and software that allow computers to capture and analyze speech. These voice input and output packages improve communication skills. Visual indicators can show when sound is being generated and software flags can signal the user that sound is occurring (Cohen & Falls, 1997; Gunderson, 1997). Recent versions of Microsoft Office have a helpful option available via the Accessibility drop-down menu: Narrator gives voice to any words appearing on the screen.

Motor Skills

Vulnerable to arthritis and loss of mobility as age progresses, older adults can be challenged by the dragging and clicking required to operate a computer mouse. Hardware accommodations now provide a large, simple keyboard requiring a lighter touch, a rollerball instead of a mouse, and alternate input devices (Morris, 2004; Tomprowski, 2003).

One participant in an Internet-use project described the frustration commonly experienced by older adults with arthritic hands: “I couldn’t click, click. . . So I had trouble. . . I couldn’t get that second click right because my hands were too shaky. . . M showed me this new mouse with a ball in the middle. . . he ordered one for me. . . you you have to put your mind to it. . . work with it. . . well, I said to myself I never give up on anything I want to do so I am going to have to learn this” (Nahm & Resnick, 2001, pp. 260–261). Hardware accommodations can support successful learning.

Supportive Environment

The myth that older adults cannot learn as well as younger learners is unfounded (Chen & Sun, 2003; Freudenthal, 2001; Kelley, Morrell, Park, & Mayhorn, 1999; Kubeck, Miller-Albrecht, & Murphy, 1999; Mead, Sit, Rogers, Jamieson, & Rousseau, 2000; Nicoll, 2003). However, their learning process is slower due to age (Tomprowski, 2003). Difficulties encountered are likely due to age-related cognitive changes, e.g., slowing of processing speed, decline in working memory and spatial ability, and decrease in sustained and divided attention (Echt, Morrell, & Park, 1998; Lin, 2003; White et al., 1999). For example, one frail grandmother reached for a cooking pan then frowned as

she wiped her hands on her apron. When asked what was wrong, she replied, "I think I downloaded the wrong recipe" (Holt, p. 159, 2002).

Older adults will take more time to learn computer programs and make more errors. Yet, they can be quite successful when given accommodations for their pace and problem-solving needs (Clark, 2002; Ellis & Allaire, 1999; Nahm & Resnick, 2001; White et al., 1999). Challenges for older adults learning to use computer technology are easily remedied by individualized instruction. Small, self-paced classes with one-on-one assistance when problems occur also help (Weiss-Morris, 2002; White et al., 1999).

Communities are responding to the need for training and Internet access with successful programs in the homes and senior residences of frail older adults. Such people are homebound with arthritis, cardiovascular disease, or diabetes, and use wheelchairs or walkers (Clark, 2002; Ellis & Allaire, 1999; Nahm & Resnick, 2001; White et al., 1999; Wright, 2000). Senior Cyber Net (SCN) helps homebound older adults learn to use the Internet and e-mail. Participants in the program range from 50 to 85 years old, and typically have medical histories of stroke, functional impairment of the hands due to arthritis, difficulty ambulating due to arthritic knees, or are hard of hearing. They rarely leave their homes and, when they do, they need assistance. The SCN program has opened new worlds for them. With few social contacts in their homes, learning to use the Internet can help older adults feel less isolated.

There needs to be an availability of helping individuals who aid older adult learners as they proceed through exploration of the computer and its possibilities. As Beisgen and Kraitchman suggest, there needs to be a "high degree of interaction among . . . learners and teacher" (2003, p. 80). They also suggest gearing the amount of time devoted to instruction to the individual's energy level (Beisgen & Kratchmann, 2003).

While the thrust of the model we are using is on encouragement and connection of old learning to new, there are physical barriers to learning with some of the older adult population that must be considered. As age progresses, certain conditions ensue. Tomporowski (2003) points out that "tissues stiffen, ligaments tighten, blood flow and the supply of oxygen to the brain decrease. As the capacities of individual systems decline, a general physiological imbalance gradually emerges" (p. 251). Sensory systems also decline. For example, 13 million people in the United States are estimated to have age-related macular degeneration (AMD), and 1.2 million are visually impaired as a result of the disease (Houde and Huff, 2003). The loss of vision brings with it such "psychological reactions as depression,

low morale, hopelessness, and poor self-esteem” (Ryan, Anas, Beamer, & Bajorek, 2003, p. 39). The teacher working with older adult learners may well have to develop and use accommodations to overcome physical barriers.

Purdie and Boulton-Lewis (2003) did a two-phase study on barriers to learning as perceived by older adults. In the first phase, they interviewed 17 older adults, ages 70 to 82. Physical barriers were noted; for example, reduced mobility, degenerating sight and hearing, and illness. Cognitive barriers were also described. These included not being able to hold so many things in mind, such as how to start the computer, and needing to be taught in language that they understood. One participant commented,

Absorption of information is a problem because a lot of people lose their concentration. They sort of drop out of circulation. If you are not communicating or keeping up with current affairs, I think you lose your power of concentration (p. 137).

Attitudes were also acknowledged as barriers. Some participants thought learning was not necessary at their age, while others wanted to learn yet were quite challenged by it. An older participant said,

The younger children, the mouse movements are second nature to them. I have to stop and think about what I am doing and if I do the wrong thing, I panic. I don't know how I am going to repair the damage that I may have done (p. 137).

A quite positive attitude was reflected by one of the participants who recognized that learning was still possible.

Whatever in life, I welcome a challenge and that is my attitude, but bearing in mind that I am an extremely disabled veteran. I've got my limitations. But I'm not going to lie down and bloody die. Get that! 79 and not out! (p. 138).

In a second phase of the study, 160 older adults completed a survey based on interview responses from the first phase (Purdie and Boulton-Lewis, 2003). In general, participants were confident they would successfully address their needs related to health, safety, and

transportation, but not those associated with technology. Creating the proper environment for older adults to learn technology requires, at the very least, concern for their age-related physical challenges and thoughtful planning.

TEACH AND LEARN

Jones and Bayen (1998) suggest ways to accommodate older adult learners. Toolbars can include large buttons to reduce difficulty finding and identifying images. Extra-large monitors can be used, e.g., 17 or 21-inch. Larger size and sans-serif style fonts can make reading easier. Color can be adjusted to increase the contrast between text and background. Glare can be reduced by using screen magnifiers, dimming lights, and closing shades. Screen magnifiers will also enlarge icons (Editors of FC&A, 2002). Large print keyboards make finding keys easier, and keyboard labels that fit over keys make each letter bigger and easier to read. A partial list of other useful approaches from Weiss-Morris (2002) is shown in Table 1.

Most computers produced since 2000 have tools for special needs. Mouse properties, for example, can be fine tuned (Editors of FC&A, 2002). By clicking on the Start button, pointing to the Settings option, and clicking on Control Panel option, a window opens containing a mouse icon. By double-clicking on the icon, the Mouse Properties dialogue box opens and allows, for example, changing the mouse from right-handed to left-handed. Also in this dialogue box is a speed adjustment for the mouse. This is a sliding bar that can be used to slow down the clicking speed and make the computer accept slower clicks. The Mouse Properties dialogue box can also be used to put a tail on the pointer that makes it easier to follow as it moves across the screen. It is also possible to slow down the speed of the pointer's movement. Drawing parallels with concepts familiar to older adults is another way to facilitate learning. For example, word processing is like your secretary, spreadsheets are like your bookkeeper, and the Internet is like a system of roads connecting one computer with another (Editors of FC&A, 2002).

With thoughtful instructional design, teachers can respond to older adults' cognitive challenges, slower processing, and sensory deficits. A commonly recommended method for evaluation of instructional designs for older adults is focus groups (Editors of FC&A, 2002). Focus groups give older adults a chance to experiment with what is planned. They can give feedback to teachers on what will work well and what needs improvement. When working with older adults, go to the source.

Table 1. Helpful ways to teach older adults computer skills

Challenge for older adults	Recommended approach for teacher
Afraid they might harm the computer, or it might harm them	Give lots of reassuring praise, and use fun activities like card games; make eye contact and circulate among students; show concern, empathy
Eliminating frustration	Give frequent breaks, or tell students to take breaks whenever they need them
Making mistakes	Correct the mistake by saying something like, "It just might work a little better if we do it like this. . ."
Some feel better in the morning and others feel better in the afternoon	Offer flexible hours for classes
Difficult concepts for students to grasp	Relate concepts to familiar physical objects; for example, disk storage is like an old fashioned file cabinet or like the records stored in a juke box
Getting lost/missing a portion of a class	Build in extra reviews
Difficulty learning terms	Use simple language; for example, rather than an e-mail address, call it SMTP address (Send Mail To People)
Difficulty relating to software	If teaching MS Word, have students make a list of favorite singers, e.g., Frank Sinatra, Tony Bennett
Difficulty learning to use the Internet	Have students look up a favorite topic, e.g., gardening, health, or investments
Difficulty with demonstrations	Mix up demos with practices, break topics down into small pieces

Computer anxiety	Ask students about their backgrounds, and try to relate the information taught to their past experiences
Tests	Make tests easy enough for students to feel successful
Vision problems, bifocals, progressive lens	Move monitor to a suitable distance from student, or seat vision-impaired students at front of classroom
Difficulty reading class manual when it is laid open on top of their desks	Provide easel-style copy holders to hold manuals and ease constant refocusing between manual and monitor
Difficulty grasping mouse due to arthritic, gnarled hands	Have trackball mouse available for students with hand disabilities, or give two pencils and have them use the eraser ends to strike keys on keyboard
Difficulty using mouse	Rotate mouse 60 degrees counterclockwise and use/rest thumb on left mouse button; slow down clicking speed (<i>Keyboard</i>) settings [MS Windows] <i>Control Panel</i> ; teach use of familiar motion, e.g., “iron the shirt”
Difficulty hearing	Seat students on end of row where teacher will walk by and can be heard more easily
Needing to shut down computer instead of just turning it off	Draw parallel with record player that needs to be shut off when done playing records
For students from “paper generation,” confusion with fields or files	Draw parallel with lines on a tax form (fields), or index cards in a box or cards in a Rolodex file (files)

ENLARGE SENSE OF SELF

It is Dewey's view that personhood grows through the problems and goals an individual confronts. In using their intelligence to seek greater connection to the outside community, and in perhaps creating a new community of possibilities and options, personhood grows. As Rogers notes, existence is "a process of potentialities being born, rather than being or becoming some fixed goal" (1961, p. 172).

For older adults, a feeling of community may result from learning to do e-mail or using chat rooms on the Internet (Nahm & Resnick, 2001). The value of having access to a network of supportive relationships through on-line interaction cannot be overestimated. Lower perceived life stress has been correlated with involvement in an on-line community (Wright, 2000). The benefit is obvious: Social isolation is decreased and the individual sense of well-being is increased. There is also decreasing alterations in emotional and physical health (Fioto, 2002).

For older adults, loneliness is often brought on by the absence of a needed relationship (or group of relationships) and lack of meaningful contact with others (Beisgen & Kraitchman, 2003). A program called LinkingAges (Lansdale, 2002) addressed loneliness along with helplessness, boredom, and cognitive decline. The program cultivated community and promoted interdependence between older adults and their families, friends, and health-care providers. It did this by teaching them to use e-mail and the Internet in small-group, hands-on, peer-facilitated, user-friendly settings. Everett Rogers called this diffusion of innovations or adopting new ideas and concepts based on social networks (1995).

LinkingAges was based on four metaphors familiar to older adults:

1. **Driving—an antidote to helplessness:** after giving up the car keys, they learn to cruise the information superhighway.
2. **Building bridges—an antidote to boredom:** closes gaps between older adults and technology by learning to send e-mails and then experience the anticipation of hearing from family and friends
3. **Meetings at the well—**participants gather around an Internet access station and learn collectively to send/receive e-mails and surf the Internet.
4. **Back to school night—**formal learning sessions for the purpose of cognitive stimulation, focused on skills to work with devices and, in turn, explore new horizons (p. 136).

There is no substitute for hands-on learning to master one's use of computers. Bandura developed the concept of self-efficacy that suggests the most important beliefs to people are their ability to control their own motivations, their own behavior, and environmental demands (1998). Self-efficacy is developed through mastery, modeling, social persuasion, and physiological adaptation. Despite apprehension as a significant barrier to learning computer skills, self-efficacy can drive learning for older adults from one domain (physical limitations) to another (adaptation). As one nursing-home resident commented, "I have found that as I develop confidence with using the computer, I am starting to take more responsibility for changing my colostomy bag" (Lansdale, 2002, p. 138). For older adults, enlarging the sense of self by learning computer skills can only promote communication, improve cognition, and boost confidence.

MEET THE CHALLENGE: INITIATE COGNITIVE LEARNING

As a result of cognitive slowing, the older adult learner has limited processing resources, and failure to inhibit task-irrelevant information. Cognitive aging results in age-related changes in cognitive abilities. Yet, allowing sufficient time for older adults to process events and information can yield success. When, for example, they are given opportunity to complete hands-on activities at their own pace, environmental support facilitates encoding or retrieval of information (Jones & Bayen, 1998).

Research has shown that older adults have age-related deficits in working memory. Yet, for example, medical information can be understood by them when it is clearly structured and organized, or when working-memory demands are reduced (Morrell, Park, & Poon, 1989). The ability to comprehend text is also important to cognitive learning by older adults. Text comprehension is relevant to computer skills in two ways: a) one must be able to comprehend the tutorials for the hardware and software, and b) one must also be able to understand information presented on the monitor screen. Despite age-related problems with perceptual speed or the speed at which mental operations are performed (Holt & Morrell, 2002), the text comprehension challenge can also be overcome—if the designers of electronic materials for older adults include accommodations. They need Back and Forward buttons, or buttons that say "Click here to begin." With accommodations, older adults can meet the challenge of learning computer skills, and initiate access to a world just waiting to connect with them.

Improvement in cognitive ability is a natural outcome of learning computer skills later in life. Armed with newfound ways to reach-out to the world and to others, older adults experience a new perspective and a new motivation to start each day. As one woman commented after learning computer skills at age 86, "I think I am addicted to my computer: I checked my e-mail this morning before I even put my teeth in" (M. Edelman, personal communication, March 19, 2001).

CONCLUSION

This article has detailed a model that considers significant factors in teaching technology to older adult learners. The model is to be considered as a dynamic process with all of the factors continually interacting. The ideal outcome is a comfortable process for older adults learning computer skills: at their pace, in their time, to their satisfaction.

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