Research Article

Bridging the Digital Divide for Older Adults via Intergenerational Mentor-Up

Research on Social Work Practice
2019, Vol. 29(7) 786-795

DOI: 10.1177/1049731518810798
journals.sagepub.com/home/rsw
SAGE

Othelia Eun-Kyoung Lee[1] and Do-Hong Kim[2]

Abstract

Objectives: The effectiveness of Intergenerational Mentor-Up (IMU), an innovative intervention that engages college students in tutoring older adults, was examined with regard to eHealthy literacy and social isolation. **Method:** A total of 55 older adults (mean age = 73.82) participated in the six-session IMU tutorials. In this mixed methods study, quantitative and qualitative data were collected in a parallel fashion. Participants were interviewed after participating in the IMU. **Results:** Older adults presented significant improvement between pre- and postsurveys in various outcomes such as eHealth literacy, technophobia, self-efficacy, and interest in technology. Intergenerational interaction brought about by IMU helped to decrease social isolation among older adults. Qualitative data revealed that individualized training, modifications, adaptations, and intergenerational interactions can decrease their anxiety and boost their confidence. **Discussion:** Study findings enable the identification of the training needs to help close the digital divide and allow these older adults to reap the benefits of technology use.

Keywords

intergenerational learning, health information technology, social isolation, eHealth literacy

Over the past two decades, Internet technology has increased access to health-related information and facilitated communication and social connections that transcend geographic distance at relatively low cost. Indeed, Internet becomes a prerequisite for meaningful participation in the society in which one can gain access to health care, education, employment, and entertainment (Pew Research Center, 2014). In this sense, digital inclusion refers to activities necessary to ensure that all individuals and communities, including the most disadvantaged, have access to and use of information and communication technology (National Digital Inclusion Alliance, 2016).

Older adults are the most frequent and heaviest users of health services in the United States. Yet, research has identified a digital divide in older adults' use of health information technology (HIT), referring to management across computerized systems and exchange of health information between consumers and providers (Czaja et al., 2013; Jensen, King, Davis, & Guntzviller, 2010). A variety of physical, mental, emotional, and social barriers affect an older adult's ability to effectively use today's information technology. Previous studies have found that older adults who did not use the Internet or e-mail tended to be among the oldest groups of individuals, of racial/ethnic minority status, and had less education, worse physical and functional health, fewer social and financial resources, and greater perceived social isolation (Ilyas, 2012; Mitzner et al., 2010; Wagner, Hassanein, & Head, 2010).

Other studies also report that the most powerful predictors of not using information technology among older adults are cognitive decline associated with the aging process and technophobia or anxiety about computer use and lack of computer efficacy (Werner, Carlson, Jordan-Marsh, & Clark, 2011). Additional challenges include functional impairments such as arthritis and joint pain that interfere with typing, visual deficits, and ergonomic barriers (e.g., need for adaptive devices); a need for simpler instructions; and the amount of time needed to learn about computers (Choi & DiNitto, 2013b). Recently, the costs of Internet access, mistrust of Internet systems, and privacy-related concerns have become the leading barriers to technology use among older adults (McCausland & Falk, 2012).

eHealth literacy, a set of skills required to effectively seek, find, understand, and appraise information technology for health and apply the knowledge gained to addressing or solving a health problem, comprises basic literacy in health, science, media, and computer (Norman & Skinner, 2006). Research has shown that eHealth literacy is lower among older adults, those with lower socioeconomic status, and those with less computer

[1] School of Social Work, University of North Carolina at Charlotte, Charlotte, NC, USA
[2] Department of Advanced Studies and Innovation, College of Education, Augusta University, Augusta, GA, USA

Corresponding Author:
Othelia Eun-Kyoung Lee, School of Social Work, University of North Carolina at Charlotte, CHHS Building 9201, University City Blvd., Charlotte, NC 28223, USA.
Email: othelia.lee@uncc.edu

experience (Choi & DiNitto, 2013b). Higher eHealth literacy is associated with more positive outcomes from Internet searches in three domains: cognitive (e.g., health knowledge/information gathering), instrumental (e.g., self-management of health needs and health behaviors), and interpersonal (e.g., communication with doctors; Czaja et al., 2013; Neter & Brainin, 2012).

Digital literacy is a constellation of life skills that are necessary for full participation in our media-saturated, information-rich society (National Digital Inclusion Alliance, 2016). Absence of basic digital literacy skills will prevent people from sharing information, creating content, and communicating with families and friends. Due to low level of digital literacy, many older individuals may be unable or uninformed about how to operate their technology, avoiding its use altogether. As the Internet is increasingly used for information dissemination, nonusers find themselves at an increasing disadvantage.

Older adults with a larger social network (e.g., children, friends) are more likely to receive encouragement to learn to use the Internet as well as emotional and instrumental assistance from their social network connections (Choi & DiNitto, 2013a). Participation in activities with family, friends, and other network members is also likely to increase the need for and perceived usefulness of Internet connectivity as a means to maintain communication. One exploratory study found that the most frequent pathways to computer/Internet use were having observed and talked with children and grandchildren about their use and having informal help from family and friends on how to use a computer/Internet (Russell, Campbell, & Hughes, 2008).

Therefore, training programs for older adults could be implemented to help elders learn how to use technology to engage in meaningful activities. Such educational approach will better prepare them to apply their learning to new technologies and to troubleshooting problems with existing technologies so that they would be better prepared to help themselves if the need arose. Research also implies that the anxiety and lack of confidence elders feel toward technology use can be influenced. To illustrate, Chu, Huber, Mastel-Smith, and Cesario (2009) found that experience with computers/Internet reduced anxiety and increased self-confidence and positive attitudes about computers/Internet use in older adults regardless of income or educational level. Werner, Carlson, Jordan-Marsh, and Clark (2011) found that older adults with a proactive approach to the challenges of learning to use technology were more likely to use a computer.

Intergenerational Mentor-Up (IMU)

The IMU was an innovative intervention, offering educational opportunities for college students to interact with older adults in the classroom, research interviews at senior centers, and intergenerational exchanges via youth-led tutorials on using HIT and social networking services (Lee & Kim, 2017). Each learning activity was designed to create an active learning environment focused on producing intergenerational relationships that can help older adults to perceive the benefits and efficacy of the Internet.

The IMU was developed based on a review of the literature on information technology among older adults mentioned above as well as the notion that older adults who positively perceive the Internet's usefulness, ease of use, and efficacy are more likely to become Internet users. Likewise, the IMU was developed adhering to the adult-learning principle that learners operate on a need-to-know basis (Knowles, 1990). Taking a more learner-centered approach may facilitate behavior change to comprehend and adapt to new technology.

Research Aims

First, we examined IMU senior mentees' Internet use patterns, eHealth literacy, and attitudes toward computers/Internet. Second, we examined IMU senior mentees' feelings of social isolation. Specifically, this study addresses the following research questions: (a) Is there evidence that IMU senior mentees demonstrate greater eHealth literacy, proactive attitude toward using HIT, and reduced technophobia? and (b) Is there evidence that IMU senior mentees experience a decrease in feelings of social isolation?

Method

Participants

This study was conducted in a public university in a Southeastern city in the United States drawn from a list of 50 cities evaluated in terms of social mobility or the ability of a person to move up the economic ladder (Chetty, Hendren, Kline, & Saez, 2014). Of the 50 cities, the city ranked at the bottom, representing extremely low social mobility, was chosen as the study site.

Older IMU senior mentees were recruited in two senior centers and two senior housing facilities in low-income areas between 2015 and 2016. A total of eight IMU classes were offered (four at senior centers and four in housing facilities). Each class consisted of six to eight IMU senior mentees. All research participants were cognitively intact English speakers, as identified by the service providers and score 8 on the Short Portable Mental Status Questionnaire (Pfeiffer, 1975). This research proposal was approved by the institutional review board for Research with Human Subjects at the research team's university.

Procedures

The six-session IMU program was designed to contain guided learning opportunities to promote intergenerational exchanges between youths and older adults. Our preliminary findings indicate that one of the most difficult challenges that older adults face is a lack of accessibility to the skills needed to use information technology and the consequent social isolation (Lee & Kim, 2017).

In this study, a total of 276 mentoring hours were provided in kind by 78 undergraduate students (on average 3.5 hr per student) as part of their course assignment in Human Behaviors and Social Environment course. For the purpose of this particular research, the author produced a brief video tutorial about how to work with older adults via Canvas, the online course management system (Lee & Kim, 2017). This tutorial introduced tips about cultural sensitivity to communicate with older people and effective methods for tutoring older adults. Youth mentors were instructed to review this video prior to their visit to senior centers. These mentors help older adults overcome potential technology communication barriers, while refining their interpersonal skills and receiving community service learning credits in return. They played an active role in providing technology lessons for older adults about using the Internet and social media (e.g., Facebook, Twitter, Pintrest), being randomly paired with 55 seniors for one-on-one technology tutorials.

In each class, youth mentors and senior mentees sat around long tables or in a big circle during the initial part of class before breaking into smaller groups to work on individualized tasks. Seniors were asked to state their learning goals for the sessions. To illustrate, a 68-year-old woman said, "I was really computer illiterate with capital letters, and I need to learn about e-mailing and looking things up online for means of information." A 93-year-old woman noted, "I was hoping to learn how to maneuver and operate this challenge [Kindle], which I thought was a fantastic challenge."

The subsequent discussion centered on what the older adults wanted to learn about technology, the types of devices that they had, and the ways in which they currently use technology. Because there were many different levels of knowledge within the room, each youth was paired with a senior mentee to help them with their particular issues. At the senior center, each student/senior pair found a place to work in the computer room and library. In the residential facilities, some pairs worked in the senior's apartment/unit.

Measurements

Multiple methods were used to document key variables associated with the implementation of IMU and to examine its relation to older adults' use of and attitude toward technology and social isolation. Semistructured, face-to-face interviews with 55 older adults were administered by five research assistants prior to and after participating in the IMU. Each interview lasted about 30 min. The interview questionnaire included Internet use patterns, eHealth literacy, attitude toward computer/Internet, technophobia, social isolation, and life stressors.

eHealth literacy. The 8-item eHealth Literacy Scale (eHEALS) was used to measure senior mentees' combined knowledge, comfort, and perceived skills at finding, evaluating, and applying electronic health information to health problems (Norman & Skinner, 2006). The items included knowing what information is available, where/how to find it, how to use the Internet to answer health-related questions, and the use of information to make health-related decisions. The final eHEALS score is the average of all 8 items, with higher scores' suggesting higher eHealth literacy. In the present study, the internal consistency reliability coefficient for the 8-item eHEALS for current Internet users was Cronbach's $\alpha = .97$.

In addition, two eHEALS supplemental items were used to measure perceived usefulness of the Internet in helping the older adults to make health decisions and the perceived importance of being able to access health resources on the Internet. All items were scored on a 5-point Likert-type scale, with higher scores indicating higher levels of perception.

Attitudes toward computers/Internet. Attitudes were measured with the 5-item Computer Efficacy subscale and the 5-item Computer Interest subscale of the Attitudes Toward Computers Questionnaire, with each item scored on a 5-point Likert-type scale (Bear, Richards, & Lancaster, 1995). Examples of efficacy items are as follows: "I know that if I worked hard to learn about computers/Internet, I could do well" and "Given a little time or training, I know I could learn to use a computer/Internet." Examples of interest items are as follows: "Learning about computers/Internet is a worthwhile and necessary subject" and "Reading or hearing about computers/Internet would be boring."

For both the Efficacy and Interest subscales, the final score is the average of all 5 items, and higher scores suggest higher computer/Internet efficacy or interest. In the present study, the original term *computer* was changed to *computer/Internet* in each item (Attitudes Toward Computer/Internet Questionnaire) to emphasize the Internet. The internal consistency reliability coefficients for the Efficacy and Interest subscales in this sample were Cronbach's $\alpha = .98$ and .91, respectively.

Willingness to use online health information was measured with 1 item, "If someone can teach me how to use the Internet to look for health information, I am willing to try," and scored on a 5-point Likert-type scale. Higher scores suggest greater willingness.

Technophobia about the computer use was assessed in terms of anxiety and confidence. Appropriate items for older adults were selected (e.g., learning computer terminology, taking a class) from the computer Anxiety Scale (Marcoulides, 1989). The scale is a 5-point, Likert-type instrument measuring computer anxiety with responses ranging from *strongly agree* to *strongly disagree*. The internal consistency reliability coefficient for current sample was Cronbach's $\alpha = .89$.

The Confidence subscale was adapted from Computer Attitude Scale (Gressard & Loyd, 1986). This 5-point Likert-type scale was a measure of perceptions by students of their confidence in different situations related to computers (e.g., "I am sure that I could learn a computer language," "I am no good with computers"). α coefficient reliabilities for Confidence subscale were .71.

Social isolation. To evaluate whether the IMU program results in a decrease in feelings of social isolation and an increase in

social connection among senior mentees, a perceived social isolation measure, developed by Cornwell and Waite (2009), was used with a scale that combined 9 items that assess loneliness and perceived (lack of) social support. The 3-item Loneliness Scale included the following questions: "How often do you feel that you lack companionship?" "How often do you feel left out?" and "How often do you feel isolated from others?"

Regarding 6-item perceived lack of social support from one's family, respondents were asked, "How often can you open up to members of your family if you need to talk about your worries?" and "How often can you rely on them for help if you have a problem?" The same two questions were asked about the respondent's friends and spouse or current partner. Higher scores indicate greater perceived isolation. This 9-item scale has acceptable internal consistency ($\alpha = .70$) and moderate to strong item-test correlations in this sample.

Life stressors were measured using the checklist (adopted from the current serious problems list used in the Health and Retirement Study; https://ssl.isr.umich.edu/hrs/): (1) not having enough money to live on, (2) loneliness or not having enough friends, (3) having to depend too much on other people for daily living due to health problems and disability, (4) having too many problems or conflicts in the family, and (5) having to take care of a sick spouse or other relative.

In this mixed methods study, qualitative data were collected and analyzed. When completing the IMU, interviews were conducted with senior mentees about their experiences. First, participants were asked to describe Internet/computer activities that they have learned. Second, they were asked to explain how they use these activities in their lives. Third, they were encouraged to provide any suggestion to improve the IMU program. Each interview was audiotaped with permission and later transcribed. In addition, the researchers recorded field notes on their observations of the mentorship processes.

Data Analysis

Both quantitative and qualitative data were collected to examine IMU senior mentees' eHealth literacy, attitudes toward computers/Internet, technophobia, and social isolation. Descriptive statistics (frequencies, proportion distributions, mean, and standard deviation [*SD*]) were used to summarize the data. Paired *t* tests were conducted to compare pre- and postsurvey results. For statistically significant results, Cohen's *d* effect size for paired samples was calculated (Lakens, 2013).

Content analysis was conducted to determine meaningful phenomena in regard to older adults' learning processes and IMU experiences. To analyze this qualitative data, the authors used open coding derived from the grounded theory approach to examine learning processes (Glaser & Strauss, 1967). While reading (and rereading) the text line by line, categories were generated through an inductive process to capture experiences from the individual's point of view. Further coding and analysis on qualitative data were conducted using NVivo Version 10 for Windows. Possible researcher biases were rigorously evaluated, using ongoing peer debriefing and intercoder reliability checks.

Table 1. Demographic Characteristics of Intergenerational Mentor-Up Senior Mentees.

Characteristics	*n*	%	*M*	*SD*
Age			73.82	12.30
Gender				
Female	35	63.6		
Male	20	36.4		
Race/ethnicity				
Non-Hispanic Black	31	56.4		
Non-Hispanic White	21	38.2		
Other	3	5.5		
Education				
Less than high school	5	9.1		
Completed some high school	7	12.7		
High school graduate	9	16.4		
Some college	16	29.1		
College graduate and above	18	32.7		
Marital status				
Married	4	7.3		
Widowed	25	45.5		
Divorced/separated	18	32.7		
Never married	8	14.5		
Family size	53		0.32	0.75
Years of living alone	52		11.39	14.65
Working (yes)	13	23.6		
Number of health conditions	54		2.65	1.65
Life stress	55		0.60	0.93

Results

Table 1 presented demographic profiles of IMU senior mentees. Of 59 people aged 65 and older initially recruited, 55 (93.2%) completed the six-session IMU classes. Of 55 participants, 63.6% were female and 36.4% were male. In addition, 56.4% were non-Hispanic Black and 38.2% were non-Hispanic White. Only 7.3% were currently married, 45.5% were widowed, and 32.7% were divorced/separated. The average family size was .32 ($SD = 0.75$). The majority lived alone for a mean of 11.39 years. They had a mean of 2.65 chronic illnesses ($SD = 1.65$). Judging from the number of life stressors, the IMU participants reported low level of stress.

Internet Use Patterns and Activities

Table 2 shows senior mentees' Internet use patterns prior to participating in the IMU. Close to three quarters of the senior mentees reported that they were currently using the Internet (72.7%) and had an e-mail address (70.9%). Fewer than 10% of the senior mentees had never used the Internet, and 16.4% had used it rarely. Among the respondents, just over half (54.5%) used the Internet daily, 18.2% used it every few days, and the rest used it less often than weekly.

Among IMU senior mentees, 61.8% reported that they had a relatively easy time with finding the information that they were

Table 2. Health Information Technology Use Among Intergenerational Mentor-Up Senior Mentees.

Technology Use	*n*	%
Internet		
Never used	5	9.1
Previous user	9	16.4
Current user	40	72.7
No answer	1	1.8
Have e-mail address	39	70.9
Use frequency		
Once a day	30	54.5
Every few days/once a week	10	18.2
Few times/once a month	3	5.5
No answer	12	21.8
Accessibility		
Always easy	15	27.3
Somewhat easy	19	34.5
Not so easy	7	12.7
Difficult	4	7.3
Very difficult	6	10.9
No answer	4	7.3
Challenges		
Pain in the limbs	7	12.7
Unsteady hands	5	9.1
Concentration	6	10.9
Difficulty sitting	13	23.6
Tired eyes	14	25.5

looking for on the Internet, suggesting that they felt confident about their search skills. Many reported discomfort, however, in using the computer/Internet due to physical, functional, and vision-related limitations. The problems that senior mentees reported included tired eyes (25.5%), difficulty sitting (23.6%), difficulty with pain in a limb (12.7%), concentration (10.9%), and unsteady hands (9.1%).

Many senior mentees needed help to learn the basic functionality of different icons and apps on a phone or tablet. Although the majority (70.9%) had an e-mail account, many had a difficult time with retrieving their password. Youth mentors provided practical tips to set up passwords that senior mentees could remember, to clean up their inboxes, to delete messages, and to organize messages in folders. Some youth–senior pairs also discussed the pros and cons of setting up a Gmail account versus keeping the Internet provider's e-mail account. For example, a 79-year-old woman acknowledged, "I've learned I need a lot of practice with e-mail. It's like piano, you have to practice."

After breaking up into pairs, both seniors and youths initially appeared to be nervous due to unfamiliarity with communicating with someone from a different generation. Following this initial period of anxiety, much warmth was demonstrated and expressed by seniors and youths alike, and all senior mentees seemed to be enjoying themselves and sharing laughter. An 82-year-old woman talked about "a long gap" in her technology use due to her illness, stating, "and you've helped me get back to it." A 78-year-old woman remarked, "When it comes to computers and smartphones, those are two of the things we use quite frequently, but we do not know to use them properly, and I think it's been an exciting [class] here."

Seniors also described IMU as a positive and sometimes unique experience for a number of reasons. First, many IMU senior mentees appreciated the patience and expertise that the youth mentors brought. A 75-year-old woman stated, "My son gave me this phone but he does not necessarily have the time and patience to teach me." Second, IMU promoted self-directed learning, as described by a 70-year-old woman who was a former teacher and had taken several computer classes elsewhere:

> This class was unique in a sense that it allowed the seniors to learn whatever they needed to know. So, if we needed to know how to operate any technical device we have at home, we could bring it here. So, I ended up bring my iPhone, external hard drive, and Jawbone . . . . That's what made it so worthwhile coming. Then, when I was home, I started thinking about, "I'm coming today. What else can I ask [a name of youth mentor] to teach me?" And then you guys give me ideas, wonderful ideas. So what can I tell you? I just love this class.

As shown in Table 3, several major themes emerged in the qualitative data analyses regarding IMU activities. Sending and receiving e-mail was the most popular Internet activity (69.1%), followed by research on nonhealth- and health-related information (60%), engaging in online shopping/banking (47.3%), and participating in social media (34.5%).

At the end of each session, everyone came together, so that the seniors could share their accomplishments with the entire group. Many senior mentees reported spending time on reviewing previous lessons. A 78-year-old woman who would like to become "more technologically savvy" acknowledged, "I've been struggling through all of this to try to learn this technology, and I've learned that I have to learn slowly."

This debriefing time was also used to address some common concerns. Many IMU senior mentees were curious about the different usages of social media (e.g., following celebrities, keeping up with family/friends, keeping electronic journals, and sharing interests with friends). Based on the discussion, the research team created a "dos and don'ts about social media" handout and distributed it to IMU mentees.

Outcome Evaluation of IMU

eHealth literacy. As shown in Table 4, at pretest, eHEALS scores suggest that self-rated eHealth literacy, on average, was at a neutral (i.e., "undecided") level, and the IMU senior mentees, on average, showed significant improvement at posttest ($t = -5.89$, $p < .001$, $d = -0.79$). Senior mentees' views about the Internet's usefulness in helping them to make decisions about their health were significantly changed from pre- to posttest ($t = -4.6$, $p < .001$, $d = -0.62$), as was their opinion about the importance of being able to access health resources on the Internet ($t = -4.35$, $p < .001$, $d = -0.59$). At pretest, IMU senior mentees expressed a lower level of willingness to use

Table 3. Types of Internet Use and Intergenerational Mentor-Up (IMU) Activities.

Types of Device	IMU Activities
Computer ($n = 42$, 76.4%)	E-mail
	Participate in social media
	Download Windows 10
	Use assistive technology: large fonts
	Organize Dropbox
	Learn Word, set printers
	Burn music CDs
Phone ($n = 26$, 47.3%)	Learn the functions of various icons
	Send texts, attach photo to text message
	Use camera to take a picture and selfies, share pictures through text
	Check voicemail, add contacts, and delete missed calls
	Set group messages and differentiate group versus individual messages
	Download apps to be used, delete icons or apps that will not be used
	Use assistive technology: large font, magnifier, flashlight, and speech to text
	Set various alums and reminders (e.g., doctor's appointments, church events)
	Add tasks and dates onto cell phone
	Change lock screen time-out to unlimited unlock screen
Tablet ($n = 15$, 27.3%)	Keep pictures on an iPad
	Operate and navigate through Kindle
	Download *New York Times* (*NY Times*) app on Kindle
	Keep artwork on iPad
	Navigate photo album
Send/receive mails ($n = 38$, 69.1%)	Set e-mail account
	Stop junk mail, clean up inbox
	Organize messages in folders
Research health and other information ($n = 33$, 60%)	Research health information: set medical ID, electronic medical record, navigate WebMD, and Healthgrades
	Research employment: search job information for seniors
	Join a dating site
	Explore genealogy and organize family trees
	Find weather
	Find recipes
	Travel information (e.g., flight, train reservation)
	Find directions; set up geo tag
	Navigate Google Maps and Google Earth
Buy products/online banking ($n = 26$, 47.3%)	Shop
	Pay bills: PayPal
Participate in social media ($n = 19$, 34.5%)	Open account: Facebook, Twitter, Tumbler, Pinterest, and Google Hangout
	Invite family members and befriend
	Set privacy status and time line in Facebook
	Set anonymous Facebook account
	Upload picture, change profile photo
	Tweet and retweet
	Communicate with family members and friends via FaceTime or Skype
Watch video ($n = 17$, 30.9%)	Watch music videos
Read papers ($n = 16$, 29.1%)	Download Amazon, *NY Times* apps
Play games ($n = 13$, 23.6%)	Use Lumacity

online health information (if someone taught them how to use the computer/Internet). By posttest, their levels of willingness ($t = -7.99$, $p < .001$, $d = -1.08$) significantly increased.

Attitudes. As noted, attitudes toward computers/Internet were measured with the efficacy and interest subscales. IMU senior mentees showed significant improvement in their self-efficacy ($t = -8.36$, $p < .001$, $d = -1.13$) and interest ($t = -9.24$, $p < .001$, $d = -1.25$) in using computers/Internet at posttest.

Technophobia. Following the IMU training, senior mentees also felt confident about their skills in utilizing computers/Internet ($t = -3.69$, $p < .001$, $d = -0.50$). As a consequence, their anxiety toward technology decreased ($t = 2.65$, $p < .01$, $d = 0.36$).

Social isolation. As noted, social isolation measures consisted of the components of loneliness and perceived (lack of) social support. Feelings of loneliness significantly decreased following the completion of the IMU program ($t = 7.53$, $p < .001$, $d = 1.45$). Perceived lack of social support also decreased, but the change was not significant. Overall, the sum of social isolation decreased by participating in the IMU program ($t = 3.84$, $p < .001$, $d = 0.74$).

Qualitative Evaluation

As shown in Table 3, 46 individual codes were generated for various types of Internet use and IMU activities. These activities were categorized into 10 family codes, and their frequencies were reported in Table 3. Based on each activity, researchers coded perceived benefit as to how participants use each activity in their daily lives. Benefits perceived by IMU senior mentees were emerged into four major themes: communication tools, independent living, leisure activities, and intergenerational learning. Intercoder reliability check for the coding (i.e., 55 pages and 60 codes) with two raters yielded a weighted κ of .86. Each theme is discussed below.

Communication tools. The most common learning activities centered on communication, including sending texts, sharing photos, and posting on social media.

Table 4. Comparison of Pre- and Postsurvey.

	Pretest		Posttest				
Item	*M*	*SD*	*M*	*SD*	*t*(54)	*p*	Effect Size, *d*
eHealth literacy (8 items)	2.78	1.62	3.83	0.86	−5.89	<.001	−0.79
Usefulness of Internet	2.98	1.87	4.05	1.15	−4.60	<.001	−0.62
Importance of Internet	3.29	1.88	4.35	0.87	−4.35	<.001	−0.59
Willingness to learn	1.84	2.30	4.40	0.66	−7.99	<.001	−1.08
Attitude							
Self-efficacy (5 items)	1.71	2.07	4.21	0.65	−8.36	<.001	−1.13
Interest (5 items)	1.63	1.99	4.16	0.62	−9.24	<.001	−1.25
Technophobia							
Confidence (10 items)	2.05	0.78	2.40	0.75	−3.69	<.001	−0.50
Anxiety (4 items)	2.16	0.87	1.78	0.69	2.65	<.011	0.36
Loneliness (3 items)	6.52	1.31	4.26	0.98	7.53	<.001	1.45
Lack of social support (6 items)	13.52	3.14	12.78	1.78	1.29	.210	0.25
Sum of social isolation (9 items)	20.04	4.05	17.04	2.46	3.84	.001	0.74

A 75-year-old man who received an iPad as a birthday gift said:

> I'm anxious to get started and find some contact. Outside contact means a lot when you're in one of these buildings. I think I know a little bit of what I'm doing now. Before, I didn't know what I was doing.

When a 66-year-old woman opened her Facebook account, she was pleasantly surprised to see family members in her contact list. For an "introverted" woman who stated, "I am really not one of those people who love being out there online," a student mentor taught her to set up an anonymous social media account. As she was relocating to a new city, this became a very useful tool for her to reach out.

Following their IMU lessons, many of the older adults reported accomplishments, including sending a "first" text to a daughter and sharing photos with a grandchild via Facebook. After a 67-year-old woman posted on her Facebook, and her grandson called her up astonished, stating, "Grandma, you are really learning!" In the final session, she also reported that she was able to exchange Easter greetings with this grandson via Facebook.

A 76-year-old woman who had a doctorate in English literature was struggling to retain her verbal skills after a recent stroke. She wanted to respond to an op-ed in the local paper. A student mentor assisted her to electronically submit her reply, which made her "very happy."

Independent living. The second common area for which older adults requested help concerned activities that enhanced their independence in daily activities These activities included setting various alarms with different tones for reminders (e.g., doctor's appointment, church events), tasks, and dates onto a smartphone calendar as well as searching for employment opportunities.

Although the IMU senior mentees were not afraid of or unwilling to use technology and were able to acquire the necessary skills, many reported usability problems (e.g., difficulty with reading small fonts, difficulty of navigation) and associated frustration with the computer system due, in part, to the cognitive, perceptual, and motor skill demands that they required. Youth mentors were helpful in pointing out options for assistive technology, such as magnifiers, flashlight, and speech-to-text software as well as enlarging fonts.

Some older adults learned how to set up medical ID information and to search for health information by navigating sites. A 68-year-old woman stated:

> I also learned how to operate my Jawbone that I had for about 3 months and never used it. Now, I can monitor my sleep, my exercise, my steps, and also my food intake; so, that kind of keeps me sort of healthy. See, even if you're a senior, you have to work on your weight too.

Another 66-year-old woman learned how to set up an Uber account and used this driving service. This became a very significant event in her life, as she regained her independence without having to ask her daughter to give her a ride.

Some IMU senior mentees were interested in online shopping and learned how to look at product reviews, comparison shop, and order online. Items purchased by three IMU mentees during the study period included a guitar, phone chargers, and books. Two IMU mentees also explored Groupon and PayPal.

Major concern raised by senior mentees was identity theft and strategies to protect oneself from financial exploitation. A 66-year-old woman stated, "We are targeted as senior citizens. The predators are after us. So we need to know how to protect ourselves more. And this training helped me to do that. I feel much more secure."

Leisure activities. Youth mentors also helped a few of the older adults to explore online dating sites. Other popular activities were to search recipes and to get directions, the weather, and travel information. One IMU mentee made a flight reservation.

IMU senior mentees, due to low levels of literacy, may not see the need for much of what is currently available online. Youth mentors were instrumental in showing uncharted territories of what the Internet has to offer. For example, two mentees were fascinated with Google Earth. A 69-year-old woman talked about seeing her old house in Google Earth and taking a "trip down the memory lane." Later she learned to explore exotic travel destination in her bucket list and excitedly stated, "It takes me directly to Rome or to the Sistine Chapel!"

Two senior mentees also explored an online memory game. Other IMU mentee explored family ancestry and genealogy. A 68-year-old woman who identified herself as a "family historian" learned how to save hundreds of photos in an external hard drive and organize them in Dropbox.

A 77-year-old man learned how to download music and organize his selections. He burned a CD with the Beatles songs and presented it to his youth mentor. The youth mentors also taught the senior mentees how to synchronize music to be listened to at different locations, such as at home and in the car.

Intergenerational learning. Both the senior mentees and students expressed that mutual learning was occurring in terms of technology skills, life experiences, and shared interests. The words used to describe this intergenerational experience included "awesome," "happy," "inspiring," and "a real joy."

Almost all IMU senior mentees felt that working with their youth mentors made them "feel young." A 68-year-old man thought that the best part of the class was "having younger people actually explain and show us different things about technology." A 68-year-old woman claimed, "Learning is lifelong, and I just believe in learning and meeting new people-never think as an elder that we cannot learn from the young people."

An 82-year-old woman echoed:

> I am being connected to the computer generation, and it means the world to me because everybody else is in the computer generation, and I think it's a godsend that the students are teaching us. . . . . I would pay anything to continue with the skills I've learned so far.

A 78-year-old woman was appreciative to have mentors who were "full of information, not condescending," commenting, "I always came away thinking our world is going to be better because these guys are in it." A 77-year-old man felt "better informed," stating, "[students] are to be commended for their knowledge."

A 72-year-old woman shared:

> You get kind of feeling defeated when you're older, and you don't communicate very much. You feel kind of lonely and [are] not wanting to push yourself. But [this was] a very inspiring experience! You just enrich our lives so much. We are not the lost generation. We are the generation that is still learning.

Likewise, a 93-year-old woman was grateful for the opportunity to be "infused with [the student mentors'] enthusiasm and your knowledge," stating, "It's so uplifting . . . [The mentors] have brought a light into my life . . . [and] renewed my faith in humankind!"

As the IMU program was winding down, several senior mentees asked whether they could have more technology classes. One expressed concern that, after this technology class finishes, she'll be "left half-hanging" with what she knows. Almost all senior mentees asked for "more classes like this." A 78-year-old woman said, "We cannot maintain what we learned from week to week, so we are hoping that [you] plan an extended class so that we can continue what we've learned and be able to use it in our everyday living."

At the last session, an IMU certificate of accomplishment was given to each mentee who completed the full 6-hr sessions. The senior center and housing facilities offered ice cream and cake to celebrate. The commencement ceremony was conducted in a large dining room during lunch hour. Senior graduates of the technology class walked across the front of the dining room, to audience applause, as they received their certificate.

Discussion

Older adults are increasingly interested in using technology as a part of their everyday lives but are more challenged in purchasing, utilizing, and troubleshooting new devices (Czaja et al., 2013). Previous studies about Internet technology use among older adults employed cross-sectional research designs, concerning accessibility barriers (Ilyas, 2012), technophobic attitudes (Chu, Huber, Mastel-Smith, & Cesario, 2009), and digital divide among socioeconomically disadvantaged groups (Choi & DiNitto, 2013b). Research also suggested that major factors that can reduce digital divide among older adults were innovative interventions to enhance eHealth literacy (Jensen et al., 2010; Neter & Brainin, 2012) and social connectedness (McCausland & Falk, 2012; Russell et al., 2008).

The IMU program was implemented to help older adults to learn how to use technology to engage in meaningful activities. It was hypothesized that intergenerational interactions can decrease their technophobia and social isolation and boost their confidence and eHealth literacy when working with this technology. Whereas a majority of IMU mentees initially reported using Internet, the vast majority of them were unaware of features that actually could be useful. The IMU program was instrumental in bringing these gaps by providing tailored training and mentoring for older adults with low level of digital literacy as shown in the qualitative data analyses.

In this study, the majority of the senior IMU participants enjoyed having the opportunity for intergenerational interaction with youth mentors. Study findings presented significant improvement between pre- and postsurveys in various outcomes, including eHealth literacy, technophobia, self-efficacy, interest, self-confidence, and social isolation, demonstrated medium to large effect sizes. Qualitative findings also revealed that vast majority of IMU participants involved in

range of Internet-related activities and found them to be beneficial to adapt in their daily lives.

Feedback from older adults and staff at senior centers was overwhelmingly positive, and the older adults expressed gratitude for what they were able to learn about technology. The only criticism concerned the tutorials was: there was a request to offer more and longer sessions. A previous study showed that as a result of IMU, students improved their knowledge of and attitudes toward working with older people (Lee & Kim, 2017). In sum, the IMU program produced synergistic effects by improving older adults' utilization of HIT and strengthening the knowledge base and cultural competence of college students.

This study is limited in generalizability due to the small sample size, convenience sampling, and potential social desirability bias. Another major limitation of this study is the absence of a clear assessment of what the older adults learned or whether this intervention increased use of computers and the Internet over time. Therefore, more longitudinal research is needed to include follow-up with IMU senior mentees about their detailed Internet use patterns.

The findings of this study provide a preliminary base of knowledge about HIT needs and viable community-based training program among older adults, using a single-group pre- and posttest design. To further evaluate the efficiency and effectiveness of the IMU program, with a focus on fostering social connections between college students and older adults, a future study should incorporate comparison group. Allowing more appropriate comparisons regarding the effects of this training program, the outcomes of IMU senior mentees should be compared with the two control groups: those who completed Internet tasks on their own or who simply socialized with young adults.

Older adults who have health problems and feel socially isolated are especially likely to benefit from the use of Internet technology because it allows them to carry out an increasingly diverse array of tasks, especially when they lack family and friends or health and service providers who can assist with these tasks. Internet technology and free online resources may likewise promote older adults' physical and mental health and reduce their social isolation and dependence on informal and formal support systems. Given vulnerable low-income older adults' substantial physical and mental health needs, examining their ability to search for high-quality health information and making informed decisions about applying the information to improve their quality of life may be particularly useful.

HIT can provide a diverse array of online resources for older adults to manage their health problems and maintain social connections. The study findings implied that it was not too late for older adults to learn new technology. Digital divide and inequalities in the use of HIT could be due to a lack of accessibility to the skills needed to use technology. Therefore, further innovative programs and services like IMU are needed to help older adults to become more involved in technology to maximize utilization of HIT.

Senior centers, public libraries, and other community-based settings can provide opportunities for older adults to gain low-cost access to computers and the Internet. Social work practitioners who are concerned about independence and social integration should consider providing the older adults with appropriate training and the opportunity to use the Internet. Intergenerational services should be extended to homebound seniors who are at great risk for social isolation by providing them with transportation services to senior centers. Research on HIT and ways of teaching technological skills that support aging should be at the forefront of community-based interventions. More translational research should be implemented to help older adults to effectively use technologies that support health, independence, safety, and social engagement.

Acknowledgments

The authors are grateful to the seniors who participated in this study and the staff members who helped us recruit the study participants. We would also like to express our thanks to research assistants Emma Sheedy, Susanna Pantas, Erica Alford, Aayla Alexander, and Morgan Miller.

Declaration of Conflicting Interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The authors declared the following potential conflicts of interest with respect to the research, authorship, and/or publication of this article: This study is funded by Chancellor's Diversity Challenge Fund and the Scholarship in Teaching and Learning grant at University of North Carolina at Charlotte.

References

Bear, G. G., Richards, H. C., & Lancaster, P. (1995). Attitudes toward computers: Validation of a computer attitudes scale. *Journal of Educational Computing Research*, *3*, 207–218. doi:10.2190/1DYT-1JEJ-T8J5-1YC7

Chetty, R., Hendren, N., Kline, P., & Saez, E. (2014). What is the land of opportunity: The geography of intergenerational mobility in the United States. *Quarterly Journal of Economics*, *129*, 1553–1623.

Choi, N., & DiNitto, D. (2013a). Internet use among older adults: Association with health needs, psychological capital, and social capital. *Journal of Medical Internet Research*, *15*, e97. doi:10.2196/jmir.2333

Choi, N., & DiNitto, D. (2013b). The digital divide among low-income homebound older adults: Internet use patterns, eHealth literacy, and attitudes toward computer/Internet use. *Journal of Medical Internet Research*, *15*, e93. doi:10.2196/jmir.2645

Chu, A., Huber, J., Mastel-Smith, B., & Cesario, S. (2009). Partnering with seniors for better health: Computer use and Internet health information retrieval among older adults in a low socioeconomic community. *Journal of the Medical Library Association*, *97*, 11–19. doi:10.3163/1536-5050.97.1.003

Cornwell, E. Y., & Waite, L. J. (2009). Measuring social isolation among older adults using multiple indicators from the NSHAP study. *The Journals of Gerontology Series B: Psychological*

Sciences and Social Sciences, *64B*, i38–i46. doi:10.1093/geronb/gbp037

Czaja, S. J., Sharit, J., Lee, C. C., Nair, S. N., Hernández, M. A., Arana, N., & Fu, S. H. (2013). Factors influencing use of an e-health website in a community sample of older adults. *Journal of American Medical Information Association*, *20*, 277–284. doi:10.1136/amiajnl-2012-000876

Glaser, B., & Strauss, A. (1967). *The discovery of grounded theory*. Hawthorne, NY: Aldine.

Gressard, C. P., & Loyd, B. H. (1986). Validation studies of a new computer attitude scale. *Association Education Data System Journal*, *18*, 295–301.

Ilyas, M. (2012). A study of web accessibility barriers for older adults, and heuristics evaluation of email websites based on web accessibility heuristics for older adults by AARP. *Journal of Emerging Trends in Computing and Information Sciences*, *3*, 806–813.

Jensen, J. D., King, A. J., Davis, L. A., & Guntzviller, L. M. (2010). Utilization of Internet technology by low-income adults: The role of health literacy, health numeracy, and computer assistance. *Journal of Aging and Health*, *22*, 804–826. doi:10.1177/0898264310366161

Knowles, M. S. (1990). *The adult learner: A neglected species*. Houston, TX: Gulf.

Lakens, D. (2013). Calculating and reporting effect sizes to facilitate cumulative science: A practical primer for t-tests and ANOVAs. *Frontiers in Psychology*, *4*, 863. doi:10.3389/fpsyg.2013.00863

Lee, O. E., & Kim, D. (2017). Intergenerational forum to enhance students' engagement and learning outcomes: A community-based participatory research study. *Journal of Intergenerational Relationships*, *15*, 241–257. doi:10.1080/15350770.2017.1330043

Marcoulides, G. A. (1989). Measuring computer anxiety: The computer anxiety scale. *Educational and Psychological Measurement*, *49*, 733–739.

McCausland, L., & Falk, N. (2012). From dinner table to digital tablet: Technology's potential for reducing loneliness in older adults. *Journal of Psychosocial Nursing & Mental Health Services*, *50*, 22–26. doi:10.3928/02793695-20120410-01

Mitzner, T. L., Boron, J. B., Fausset, C. B., Adams, A. E., Charness, N., Czaja, S. J., . . . Sharit, , J. (2010). Older adults talk technology: Technology usage and attitudes. *Computers in Human Behaviors*, *26*, 1710–1721. doi:10.1016/j.chb.2010.06.020

National Digital Inclusion Alliance. (2016). NDIA definitions. Retrieved December 16, 2017, from http://www.digitalinclusionalliance.org/definitions

Neter, E., & Brainin, E. (2012). eHealth literacy: Extending the digital divide to the realm of health information. *Journal Medical Internet Research*, *14*, e19. doi:10.2196/jmir.1619

Norman, C. D., & Skinner, H. A. (2006). eHEALS: The eHealth literacy scale. *Journal of Medical Internet Research*, *8*, e27. doi:10.2196/jmir.8.4.e27

Pew Research Center. (2014). Older adults and technology use. Retrieved from http://www.pewinternet.org/2014/04/03/older-adults-and-technology-use/

Pfeiffer, E. (1975). A short portable mental status questionnaire for the assessment of organic brain deficit in elderly patients. *Journal of the American Geriatrics Society*, *23*, 433–441.

Russell, C., Campbell, A., & Hughes, I. (2008). Ageing, social capital and the Internet: Findings from an exploratory study of Australian "silver surfers." *Australian Journal of Ageing*, *27*, 78–82. doi:10.1111/j.1741-6612.2008.00284.x

Wagner, N., Hassanein, K., & Head, M. (2010). Computer use by older adults: A multi-disciplinary review. *Computers in Human Behavior*, *26*, 870–882. doi:10.1016/j.chb.2010.03.029

Werner, J. M., Carlson, M., Jordan-Marsh, M., & Clark, F. (2011). Predictors of computer use in community-dwelling, ethnically diverse older adults. *Human Factors*, *53*, 431–447. doi:10.1177/0018720811420840