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Development and Testing of the Web-Based Learning Self-Efficacy Scale (WBLSES) for Older Adults

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Abstract Web-based health information is particularly important for the increasing number of older adult online users. One strategy to deliver synthesized, evidence-based health information to these individuals is through Web-based learning modules. There is, however, a lack of research in the area of using Web-based learning for older adults. To assess the effects of Web-based health learning modules, older adults' ability to use the modules must be assessed. This article described the development and testing of the psychometric properties of the Web-Based Learning Self-Efficacy Scale (WBLSES). Initially, the eight-item WBLSES was developed based on an in-depth review of the literature, prior findings, and expert consultation. Preliminary psychometric testing was conducted using a single group descriptive study (N=33) and the WBLSES was then retested among a larger sample of 221 older adults. The findings supported the reliability of the WBLSES as evidenced by appropriate internal constancy and stability, and the validity through hypothesis testing and Rasch analysis. Further studies are needed using other Web learning programs and more diverse samples.

Keywords Health information · Web-based learning · Self-efficacy scale · Older adults

Introduction

There is an increasing number of health Web sites available to the public. Many of these sites are intended to provide health information and empower consumers to make informed health decisions (Gustafson et al. 2002; Madden and Fox 2006; McKay et al. 2001). With the rapidly increasing numbers of older adult online users

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and their interest in health, the Web can serve as an effective medium to provide a large number of older adults with health information and to promote healthy behaviors (Fox 2004; Fox 2006; Nahm et al. 2004). A Pew Internet study in 2004 showed that 22% of Americans age 65 or older (about 8 million) used the Internet, and 66% of them searched online for health information (Fox 2004). The interest in online health information and the number of older adult online users (32% in 2006) continues to increase (Fox 2004; Fox 2006; Madden 2006; Nahm and Resnick 2001; Nahm et al. 2006; Nahm et al. 2007).

Unfortunately, most older adult online users have some difficulty using general online search engines (e.g., Yahoo® or Google) and have concerns about the credibility of the online information (Fox 2004; Mayhorn et al. 2004; Nahm et al. 2004; National Institutes of Health 1998; Stronge et al. 2001). These issues can be overcome in several ways, such as education about the use of effective search engines, improvement of users' health literacy, and better branding of Web sites. A more direct strategy is to offer synthesized, evidence-based health information using Web-based learning modules. Although this type of Web-based learning has already become an important formal education delivery method (e.g., online classes; Picciano 2001; Simonson et al. 2003), it has rarely been used with older adults (Lenhart et al. 2001; Notess and Lorenzen-Huber 2006). Web-based learning can be an effective method for older adult online users. Using this method, they can learn important health topics at their convenience and repeat these modules as needed (Echt 2002; Hendrix 2000). Moreover, the Web modules can be enriched by incorporating various technologies such as video demonstrations, functions to communicate with experts and interactive quizzes (Nahm et al. 2004; Nahm et al. 2006).

Generally, older adults who are unfamiliar with computers and the Web tend to be less confident with regard to their ability to use them. Healthcare professionals who plan to use Web-based learning modules, therefore, must assess the older adults' confidence with regard to using this type of learning method. Prior research findings in behavioral studies demonstrated that one's confidence (or perceived self-efficacy) is an important factor for carrying out a certain behavior or activity (Kukafka et al. 2002; Napolitano et al. 2003; Resnick 1999; Resnick 2002). Self-efficacy, which is a key factor in social cognitive theory, is defined as "beliefs in one's capabilities to organize and execute courses of action" (Bandura 1997). To use Web-based health learning modules, therefore, older adults must believe that they are capable of using the program.

Few researchers investigated the effects of computer self-efficacy on computer use (Compeau and Higgins 1995; Reed et al. 2005). Compeau and Higgins reported that repeated use of the computer increased self-efficacy and lowered computer anxiety in adult individuals (Compeau and Higgins 1995). Other findings showed that computer self-efficacy mediated the relationship between age and computer skills (Reed et al. 2005). Although some Web-based learning has been used with older adults, there has been a lack of research examining self-efficacy for Web-based learning among older adults (Gustafson et al. 1998; Nahm and Resnick 2001; Nahm et al. 2006; SeniorNet 2007). The purposes of this study were to develop the Web-Based Learning Self-Efficacy Scale (WBLSES) for older adults and to pilot-test the psychometric aspects of the scale.

Development of the Web-Based Learning Self-Efficacy Scale (WBLSES) for Older Adults

Prior Studies on Self-Efficacy for Computers or Internet Use

Overview Several computer and Internet self-efficacy scales have been developed (Compeau and Higgins 1995; Ertmer et al. 1994; Torkzadeh et al. 2003; Torkzadeh and Van Dyke 2001). Most of these measures, however, only assessed the individual's confidence to perform specific computer/Internet-related tasks (e.g. how to copy files) rather than his/her confidence to overcome specific challenges in the use of the computer (e.g., when faced with physical challenges such as arthritis). Moreover, many items on those measures were not relevant to the majority of older adult online users because they are overly technical (e.g., encryption or moving blocks of text while word processing; Ertmer et al. 1994; Torkzadeh et al. 2003) and/or include terminology with which many older adults might be unfamiliar, such as "browsing the World Wide Web" (Torkzadeh et al. 2003).

Prior computer self-efficacy measures Torkzadeh and Van Dyke (2001) developed and tested the reliability and validity of a 17-item Internet self-efficacy scale (Torkzadeh and Van Dyke 2001). The scale assessed the individual's perceived ability to use the Internet in both academia and practice and included three factors: surfing/browsing, encryption/decryption, and system manipulation. It was tested employing 277 undergraduate students in the Management Information Systems. The calculated alpha coefficients for three factors ranged from 0.93 to 0.96. The findings showed some evidence for convergent and discriminant validity. Although the authors did not specify the target population, this tool seems to be applicable for younger individuals who have some computer knowledge. For instance, items about the confidence for encryption and decryption functions are not applicable for most older adult online users.

Torkzadeh et al. (2003) developed a 27-item scale to assess self-efficacy for computer use and tested its psychometric aspects using confirmatory factor analysis. This scale included four factors: beginning skills, file and software skills, advanced skills, and mainframe skills. Unfortunately, many of the items were inappropriate for use with older adults (e.g., "writing simple programs for the computer").

The two previously described measures primarily assessed competency of specific skills. Conversely, the Computer Self-Efficacy Measure (CSEM) developed by Compeau and Higgins (1995) assessed the self-efficacy of the individual for using a software program against the potential challenges of using the program. The initial measure was developed based on literature reviews and revised after the three surveys conducted by the researchers. The final CSEM was a 10-item measure with a 10-point Likert scale ("1" being "not at all confident"; "10" being "totally confident"). There was support for the reliability and discriminant validity of the CSEM based on testing with 100 adult professionals who subscribed to a Canadian business periodical (most subscribers were in managerial positions in various industries, including manufacturing, finance, and government; Compeau and Higgins 1995). While this measure was more applicable to many adult online users, it still does not specifically address the issues relevant to older adults.

Web-Based Learning Self-Efficacy Scale (WBLSES) for Older Adults

To fill the gap in older adult-focused self-efficacy measures related to Internet- and computer-based programs, the initial 12-item Web-Based Learning Self-Efficacy Scale (WBLSES; Table 1, Initial WBLSES) was developed. The items were identified by combining the work of others and our own experience in helping older adults with computer use (Compeau and Higgins 1995; Ertmer et al. 1994; Nahm and Resnick 2001; Nahm et al. 2006; Nahm et al. 2004; Nahm et al. 2003; Nahm et al. 2006; Torkzadeh et al. 2003; Torkzadeh and Van Dyke 2001). Specifically, the following challenges to Web-based online learning among older adults were identified and incorporated into the measure: (1) instruction method for using the program (items 1–5); (2) availability of assistance (item 6); (3) amount of time available to complete the program (items 7, 8); (4) encouragement (item 9); (5) physical conditions (items 10, 11); and (6) navigation method (item 12).

Prior findings indicated the types of instruction methods (e.g., face-to-face vs a printed copy) were one of the most influential factors for older adults in making a decision to learn computer technologies (Nahm and Resnick 2001; Nahm et al. 2006; Nahm et al. 2004; Nahm et al. 2006; Resnick et al. 2003). Some physical conditions, such as arthritis of the hands or impaired visual acuity, were reported to

Table 1 Web-based learning self-efficacy scale (WBLSES)

	Initial WBLSES	Revised WBLSES
1	… if I had someone sitting at the computer with me to help me know what to do	… if I had someone sitting at the computer with me to help me know what to do
2	… if no one is available in person, but *I had written instructions to follow*	… if no one is available in person, but *I had written instructions to follow*
3	… if no one is available to help me in person and there are no written instructions, *but I could choose a help button to show me how to proceed with the program*	… if no one is available to help me in person and there are no written instructions, *but I could choose a help button to show me how to proceed with the program*
4[a]	… if I had watched someone one time go through the program before trying it myself	
5[a]	… if someone else helped me get started	
6	… if there is no one available via phone when I got stuck *while using the program*	… if there is no one available via phone when I got stuck *while using the program*
7	… if I had a specific time limit to complete the learning modules	… if I had a specific time limit to complete the learning modules
8[a]	… if I could not practice the program multiple times	
9	… if there is no close family or friend who encourages me to learn this program	… if there is no close family or friend who encourages me to learn this program
10	… if my arthritis bothers me using the keyboard	… if my arthritis bothers me using the keyboard
11	… if my vision bothers me looking at the screen	… if my vision bothers me looking at the screen
12[a]	… if I could easily go back and start again when I make mistakes	

The following questions ask you to rate how confident you are with using this type of a program to learn new information. Rate your confidence in response to each of these statements by putting a "√" mark for Number *1* for "*No Confidence*" to Number *10* for "*A Lot of Confidence*."

[a] Items deleted in the revision

be major barriers to computer use among older adults. Findings from our research and empirical teaching experience, however, revealed that older adults who encountered such challenges could establish techniques to overcome them when they were motivated to use the computer and/or the Internet. It is therefore critical to optimize older adults' motivation to engage them in computer/Internet use and help them have the confidence and skills to overcome those challenges.

The initial face validity of the measure was assessed employing a nurse researcher with experience in the development of self-efficacy based measures for changing behavior in older adults and two older adult online users. The three items noted to be repetitive were removed. One item about the navigation method ("… if I could easily go back and start again when I make mistakes") was also removed as it was mainly focused on the "user friendliness" of the program. The final revised scale included the remaining eight items (Table 1, Revised WBLSES).

Administration and Scoring

The WBLSES uses a 10-point Likert scale ("1" being "not at all confident"; "10" being "totally confident"; Bandura 2005; Compeau and Higgins 1995). Consistent with other self-efficacy scales (Bandura 2005; Compeau and Higgins 1995; Resnick 1999), the scoring method for the WBLSES is the summation of all scores of each item.

Testing of the WBLSES for Older Adults

The initial psychometric aspects of the final 8-item WBLSES was tested in a pilot study (N=33). The measure was then further tested using a larger sample (N=225).

Pilot Testing

Design/Setting/Sample The WBLSES was pilot-tested using a single group descriptive study with two data collection points (2 weeks apart). Upon approval from the Institutional Review Board at the University of Maryland, Baltimore, 33 participants were recruited from a continuing care retirement community (CCRC) through flyers placed on bulletin boards in the computer lab, health clinic, and mailroom. Older adults were eligible to participate if they were (1) residents in the selected CCRC; (2) age 62 years or older (age criteria for the CCRC); (3) cognitively intact [Folstein Mini-Mental Status Examination (MMSE) test score of at least 27]; (4) able to use the Web on their own or willing to review the Web learning module with help from the research nurse (both online users and non-online users were recruited to assess construct validity using the contrasted-group approach); (5) able to read and speak English; and (6) able to read text on the computer screen.

The majority of the participants were Caucasian (n=32, 97.0%) and female (n=30, 90.9%), with a mean age of 83.2±6.0 years (range, 69.0–92.0). Nineteen participants (57.5%) were online users. All online users and more than half of the nonusers (n=9, 64.3%) completed a college or graduate degree. There was a significant difference in mean age between online users and non-online users, 80.9 and 86.1 years (t=2.7, p=0.01), respectively. The average years of Web use for online users was 6.0±6.2 years (range, 0.2–24.0). Overall average MMSE was 29.8, and there was no difference between the user (29.9) and nonuser (29.7) group.

Material Many older adult online users are unfamiliar with structured Web-based learning. To pilot-test the reliability and validity of the WBLSES the authors developed a prototype fall prevention Web learning module for older adults using the FrontPage program. The prototype module was approximately 5 to 10 min in length and included instructional content, glossaries (hyperlinked with the content), and interactive self-assessment quizzes.

Reliability and validity testing The internal consistency of the WBLSES was assessed by calculating Cronbach'salpha coefficients. An alpha of 0.7 or more was considered to be acceptable (Nunnally and Bernstein 1994). The stability of the measure was tested using the test–retest procedure with a 2-week interval. Correlations between the first test scores and the retest scores were calculated using the using the Pearson's r test.

The construct validity was assessed using the contrasted groups approach (Waltz et al. 2005). It was expected that online users would demonstrate higher self-efficacy on the WBLSES compared to non-online users.

Procedures The prototype fall prevention Web learning module was loaded on a research nurse's laptop, which was equipped with an external regular mouse device. Once the older adult agreed to participate in the study, the first data collection session was set up at the participant's preferred location (e.g., in a private office in the retirement community center or the participant's home). After a short introduction provided by the research nurse, online user participants completed the Web learning module on their own, and non-users read the module while the research nurse navigated the Web pages. After the introduction, the participants completed the WBLSES. At the end of the session, they were provided with the packet that included the same WBLSES, instructions to complete the questionnaire in 2 weeks, contact information, and a self-addressed return envelope.

Results Thirty three participants completed the baseline survey, and 30 of them completed the second survey. Three individuals could not complete the second surveys within the timeline due to their travels. Most participants reported that the prototype learning module program was easy to use. Individuals who had prior experience using the Internet were able to complete the program independently. All participants expressed a great deal of interest in reading about online health information.

The findings from this pilot study showed that the WBLSES was internally consistent, as evidenced by the calculated Cronbach's alpha value of 0.98. The WBLSES was also stable over time (r=0.82, p<0.01). Some evidence of the construct validity of the WBLSES was indicated by the findings from the contrasted groups approach. The online users reported significantly higher self-efficacy for Web-based learning (mean, 8.7 out of 10) than non-users (mean, 5.8; p<0.001).

Further Testing of the WBLSES

Design/Setting/Sample The reliability and validity of the WBLSES was also tested with a larger sample of older adults who participated in an online study that examined the effects of a social cognitive theory (SCT)-based hip fracture prevention Web site (Nahm et al. 2007; Nahm et al. 2006).This study used a two-group comparison design with repeated measures (baseline, at the end of the second week, and 3-month follow-up). Participants were randomly assigned into two different hip fracture Web intervention groups (SCT-based Web site vs conventional site). Both interventions used Web-based learning modules. Each group used the intervention for 2 weeks. Self-efficacy for Web-based learning was examined at the end-of-treatment (EOT) and at a 3-month follow-up.

Participants were recruited from two online Web sites, as well as through one newspaper. Individuals were eligible to participate if they: (1) were age 55 years or older; (2) had access to the Internet/e-mail; (3) were able to use the Internet/e-mail independently; (4) resided in a community setting in the USA; and (5) were able to read and write English. A total of 225 older adults completed the 2-week online program and the end-of-treatment survey. The majority of the participants (n=176, 78.2%) were female, Caucasian (n=205, 91.1%) with the mean age of 69.1±7.6 (range, 55–92). Most participants had some college or higher education (n=197, 87.5%) with average years of Web experience of 10.3±5.2 years.

Reliability and validity of the WBLSES For reliability testing, internal consistency with an alpha coefficient of 0.7 or greater was considered appropriate. Additionally, using Rasch analysis, person separation reliability was calculated as this was indicative of how well the items of the instrument separate or spread out the subjects in the sample (Bond and Fox 2001; Smith and Smith 2004). This value is analogous to the KR-20 or Cronbach's alpha.

The construct validity of the WBSLES was examined based on the hypothesis testing approach and Rasch Analysis (Bezruczko 2005; Smith and Smith 2004; Waugh and Chapman 2005). It was hypothesized that users with higher perceived computer knowledge would demonstrate higher scores on the WBLSES. Using Rasch analysis the 8-item WBLSES was conceptualized to be unidimensional, and item mapping was considered to describe the rank ordering of items from least to most difficult. In the Rasch measurement model two values are used throughout the analysis to determine the fit of the items to the model: logit measures and fit statistics. Logits, or log-odd units, convert ordinal raw scores into linear interval measures. The logit is the natural logarithm of the odds of a person being successful at a specific task or an item being successfully carried out. The logit measures indicate whether one item is more difficult than another to agree with or endorse than another.

The analysis was conducted using the Winsteps statistical program (Linacre 2007). The item responses were categorized as low self-efficacy (scores 1 to 4), medium self-efficacy (scores 5 to 7) and high self-efficacy (scores 8 to 10). To establish the fit of each of the items the INFIT and OUTFIT statistics, which are reported as mean square (MnSq) fit statistics, were examined. The mean square fit statistic value is the ratio of observed variance (variance attributable to the data) to expected variance (variance estimated by the Rasch measurement model).

The INFIT and OUTFIT MnSq statistics are considered acceptable if they are within the range of 0.6 to 1.4 (Smith and Smith 2004). Ideally, the ratio will be 1.0, so that observed variance equals the expected variance. For example, when the MnSq fit statistics value is 1.7, there is 70% more variation in the observed data than the Rasch model predicted. When the fit statistic value is less than 1.0, there is less variation in the observed data than the Rasch model predicted. An INFIT and OUTFIT value of less than 0.6 indicates that the item does not provide additional information beyond the rest of the items on the scale. An INFIT and OUTFIT value of greater than 1.4 indicates that the item: (1) does not define the same construct as the rest of the items in the instrument; (2) is poorly constructed or misunderstood; or (3) is ambiguously defined (Bezruczko 2005). OUTFIT statistics are unweighted and affected by unexpected responses far from the item or person (e.g., a person of low ability unexpectedly getting a correct score on a difficult item). INFIT statistics are weighted, and are affected by unexpected responses close to the person or item (e.g., a person of low capacity unexpectedly getting an easy item incorrect).

Results The findings showed high internal consistency based on a calculated Cronbach's alpha coefficient of 0.9. Rasch model testing showed a person separation index of 1.29 and a reliability score of 0.88.

The construct validity of the WBLSES was supported by significant positive correlation between the perceived computer knowledge and the scores on the WBLSES (r=0.24, p<0.01). INFIT and OUTFIT statistics of Rasch model testing also provided some additional support for the construct validity of the WBLSES (Table 2), as the fit statistics ranged from 0.6 to 1.4, demonstrating a good fit of the items to the model.

In addition, findings from the Rasch item mapping analysis showed the order of item difficulty level conforms with our prior findings (Jones and Bayen 1998; Nahm and Resnick 2001). For instance, the finding indicated that having step-by-step written instructions (item 2) was an easiest way for a participant to use a Web-based learning module. The next easiest items were having someone sitting at the computer with you (item 1) and having a help button to use (item 3). The two most difficult

Table 2 Rasch model testing: INFIT and OUTFIT statistics (Acceptable range from 0.6 to 1.4)

	Revised WBLSES	INFIT	OUTFIT
1	… if I had someone sitting at the computer with me to help me know what to do	1.07	1.12
2	… if no one is available in person, but *I had written instructions to follow*	0.81	0.56
3	… if no one is available to help me in person and there are no written instructions, *but I could choose a help button to show me how to proceed with the program*	0.84	0.75
4	… if there is no one available via phone when I got stuck *while using the program*	1.09	1.08
5	… if I had a specific time limit to complete the learning modules	1.08	1.22
6	… if there is no close family or friend who encourages me to learn this program	0.89	0.71
7	… if my arthritis bothers me using the keyboard	1.10	1.00
8	… if my vision bothers me looking at the screen	1.13	1.16

items were those that focused on physical problems: when the individual had arthritis (item 7) or visual problems (item 8). Category structure of the WBLSES showed an appropriate stepping between the three categories developed (low, medium and high self-efficacy).

Discussions

Findings from the two studies provided some support for the reliability and validity of the WBLSES using both the traditional measurement theory and Rasch model testing. In particular, the participants groups used in both studies represent different levels of computer knowledge and skills (i.e., non-users and online users with various levels of knowledge and experience), which increases the generalizability of the measure.

Overall, participants showed high self-efficacy for the Web-based learning, evidenced by average item scores of 7.8±2.9 (range, 1–10) for the pilot study and 8.5±1.8 for the further testing. Several factors (e.g., usability of the program), however, may influence the individual's confidence level for using Web-based learning. These factors must be considered in interpreting the scores of the WBLSES.

The mapping of the items provided some information regarding situations where older adults feel more or less confident related to Web-based learning. Prior qualitative findings(Nahm and Blum 2006; Nahm et al. 2004; Nahm and Resnick 2001) support the results noted in item mapping. For instance, older adults feel much more comfortable in using computers and/or Web programs when they have step-by-step instructions and have someone sitting next to him/her to help them. In addition, physical problems (e.g., arthritis or visual problems) are known to influence participant's use of the computer and/or Web in general.

Among online users, the relationship between computer knowledge and confidence in using Web-based learning was significant; however, the correlation was low (r=0.24, p<0.01). This suggests that although computer knowledge is associated with the individual's ability to use Web-based learning programs (i.e., experienced computer users are likely to have less difficulty), it may not guarantee the individual can learn health information from Web-based learning programs.

The samples used in both studies were highly educated with some college or higher education levels (93.2%, n=31; 87.5%, n=205), which is similar to general older adult online users (Fox 2004; Nahm et al. 2003). The high education level may have influenced the participants' self-efficacy for using Web-based learning modules. In order to further generalize the findings, the scale must be tested using older adult online users with diverse socioeconomic characteristics and lower education levels.

Conclusion

Considering the fast growing number of older adult online users and their interest in health information, Web-based learning has the potential to be an effective method for their health education. While the number of older adult online users is growing, there continues to be a large percentage of older individuals who are unfamiliar with Web-based interactive learning. To benefit a greater number of older adults from available online health learning, more effort need to be made to increase older adults' confidence for using such programs.

The WBLSES, which is a short questionnaire designed to assess older adults' confidence for using Web-based learning modules can be helpful to identify those individuals who lack computer confidence. With some additional support (e.g., instruction sessions, demonstration) these individuals may be able to benefit from various Web-based health programs.

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