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Factors affecting the information quality of personal web portfolios

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Factors Affecting the Information Quality of Personal Web Portfolios

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Personal Web portfolios have become a popular information source and an effective method for individuals to present themselves to others in cyberspace. Thus, the quality of personal Web portfolios is critical and affects the perception that others have of the individuals. But how do we measure quality of personal Web portfolios? What are the important factors affecting quality of personal Web portfolios? This study presents the development of an instrument measuring factors affecting information quality of personal Web portfolios. The proposed instrument, based on the Information Quality framework, was refined and validated to assess its construct validity, convergent validity, and discriminant validity. The proposed instrument can be used to guide those who want to design their personal Web portfolios and also to help those who need to evaluate the quality of personal Web portfolios.

Introduction

A personal portfolio is a collection of work designed for a specific objective; that is, to provide a record of a person's accomplishments. It can be viewed as a direct indicator of learning and experience, and can tell the story of the personal self and achievement or growth. Artists, architects, and others have long used personal portfolios to show their visual work, musicians use them to demonstrate their musical talents, and scores of other professionals use them to tell their creative stories (Ittelson, 2001).

Personal portfolios allow individuals to present more detailed personal information in comparison to a traditional résumé (Bayless, Flatley, & Quible, 2000; Lancaster, 1999). Thus, an area where personal portfolios have been extensively used is education. For many years, students have built their personal portfolios to collect the work that they have selected to show growth and changes over time (Barrett, 2001). Additionally, students' personal portfolios provide for collaborative reflection, including ways for students to reflect about their thinking processes, approaches to problem solving and decision making, and understanding of subjects and skills (Paulson, Paulson, & Meyer, 1991).

Using personal portfolios to showcase and assess learning is not a new idea; personal portfolios have been used in education for decades. What is new, however, is the notion that personal portfolios can be developed by Web technology and shared with much larger audiences via the Web. The development process of personal Web portfolios encourages students not only to become more actively involved in planning to achieve their educational goals but also to learn and practice their information technology skills. Nowadays, students' work is mostly in electronic form or is in an electronic file even if it is printed. Students are more and more able to collect, store, manipulate, and share information digitally.

Many academic programs require that students publish their personal Web portfolios before graduating (Young, 2002). The portfolio program information published by the American Association for Higher Education includes more than 40 institutions currently using personal Web portfolios in their various academic programs ("Portfolio Programs," 2006). Additionally, collaborative efforts to develop software for personal Web portfolios have increased rapidly (Treuer & Jenson, 2003); for example, the Electronic Portfolio Consortium ("eport Resources," 2006). Furthermore, there have been several initiatives to provide personal Web portfolios to broader users. Several Web service providers encourage customers to develop and post their personal Web portfolios on the Web servers ("Epsilen," 2006; Similarly, in March 2005, the Learning Innovations FORUM d'Innovations d'Apprentissage (LIfIA), a leading Canadian e-learning organization, launched an initiative to provide personal Web portfolios to all its members and set its mission to promote portfolios for every Canadian citizen by 2010 ("Major Milestone," 2006).

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The use of personal Web portfolios is growing dramatically. It has been suggested that for educators to make personal Web portfolios useful to each learner, a common set of standards for personal Web portfolio design would be necessary (Treuer & Jenson, 2003); however, designing personal Web portfolios is a poorly understood art. Previous works in personal portfolio design and evaluation provide some heuristics or checklists with little or unknown theoretical bases. Thus, the objective of this study is to develop an instrument with a clear theoretical basis for assessing information quality of personal Web portfolios.

The rest of the article is organized as follows: The next section describes the definition and the current status of personal Web portfolios. The third section explicates the Information Quality framework (Huang, Lee, & Wang, 1999; Wang & Strong, 1996) that is used as the theoretical foundation for evaluating effective personal Web portfolios. The article then presents the proposed framework, the research methodology, and the posttest study. Finally, the article discusses the implications of this research for practitioners and researchers as well as the limitations of this study.

Personal Web Portfolios

There is a concern regarding the means in which to store and manage information and materials included in personal portfolios (Lankes, 1995). Often these personal portfolios had been bulky and taken up a lot of space; some work samples have been of various sizes and often too large to be kept in a folder or binder (Abrenica, 2004). Thus, a likely solution to this problem is the creation and storage of personal portfolios using information technology, especially via the Web.

Information technology in general and Web technology specifically can facilitate the capture, storage, display, retrieval, and deletion of all information included in any personal portfolios. In this study, *personal Web portfolio* is defined as a selective and purposeful collection of a person's work made available on the web to represent his or her efforts, progress, and achievements. Similar to traditional portfolios, personal Web portfolios can be used for personal visioning and philosophies, for taking inventory of personal/ career assets, for personal/career goal settings, for career planning, for employment applications, for self-assessment, and for defining capacities and responsibilities.

Personal Web portfolios have become a hot topic in standards-based performance assessment (Wilkerson & Lang, 2003). Education institutions are encouraging or even requiring students to create their own personal Web portfolios as a repository for anything that demonstrates their accomplishments and activities (Young, 2002). Nevertheless, there are a host of questions about personal portfolios—especially in their latest Web format—and few answers to be gleaned from empirical research (Carney, 2004). Zeichner and Wray (2001) also expressed concern that despite the popularity of personal portfolios, there have been very few systematic studies on personal portfolios. Only a few studies have suggested design guidelines for personal portfolios, and most of these had been conceptual or anecdotal rather than research based (Carney, 2004).

Kimeldorf (1997) posited that the personal portfolio should list one's different experiences by groups of skills, instead of in a chronological stair-step fashion. Nathan (1998) suggested that personal Web portfolios should demonstrate personality that reflects a personal vision. Kilbane and Milman (2003) recommended that instead of including more artifacts for the sake of "coverage," personal portfolios should include fewer documents for the purpose of "uncovering" the best, most illustrative work.

A portfolio checklist for the Bachelor of Arts degree in Sociology/Anthropology at the University of Minnesota-Duluth was summarized by Treuer and Jenson (2003). This checklist suggested that portfolios should include contact information (e.g., e-mail address, telephone number), academic record (e.g., college and major, degree audit), education documentation (e.g., research papers), academic honors, career documentation (e.g., résumé, internship), computer skills, and professional memberships.

Similarly, the Kalamazoo College Portfolio Framework ("Portfolio Framework," 2006) suggested that students' personal Web portfolios should demonstrate five dimensions: Lifelong Learning (e.g., study in major, course projects), Intercultural Understanding (e.g., study abroad, language and culture courses), Social Responsibility (e.g., service projects, volunteer work), Career Readiness (e.g., employment, internships), Leadership (e.g., leader programs, management positions), and the four skills (a) Written Expression (e.g., writing seminars, publications), (b) Oral Expression (e.g., presentations, representatives), (c) Quantitative Reasoning (e.g., mathematics/statistics courses), and (d) Information/Computer Literacy (e.g., computer science courses, computer projects).

Personal Web portfolios should have a simple user interface, and any audience should be able to access and view them without specific sets of directions or lessons. Montgomery and Wiley (2004) noted that photos and video clips should be included only if they add interest and complement the purpose of the portfolio because they tend to have deeper meaning to the person who has a vested interest in them and little meaning for an outsider. Similarly, animations included in personal Web portfolios might be too distracting (Parker, 1998). Finally, Benson and Barnett (2005) posited that each artifact included in a personal portfolio should be accompanied by student commentaries that explain the original assignment and discuss the student's work process, the student's assessment of the quality of the work, and what the work demonstrates about the student's learning and progress at that point.

Despite many design guidelines recommended for personal Web portfolios, there currently exists no universally accepted rubric for evaluating personal Web portfolios, and the issue of review and evaluation criteria exists in every classroom and educational setting (Ittelson, 2001). Since personal Web portfolios have been used as a source to provide information about individuals, they should have a quality measure to assess how well they fulfill the information requirements of the users or audiences who visit them. Thus,

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the main objective of this study is to develop an instrument for assessing the information quality of personal Web portfolios as a source providing information about individuals.

Literature Review and Research Framework

Researchers have conducted several studies on how to evaluate the quality of Web design. When evaluating the information quality of Web sites for Internet commerce, one may look at both information content and information presentation and delivery (Kim, Kishore, & Sanders, 2005; Katerattanakul & Siau, 2003). In a study of online travel agents, results suggested that information quality of Web sites included relevance, timeliness, reliability, scope, and perceived usefulness (McKinney, Yoon, & Zahedi, 2002).

Yang, Cai, Zhou, and Zhou (2005) suggested that quality of Web portal was determined by information quality (i.e., usefulness of content and adequacy of information) and system quality (i.e., usability, accessibility, privacy/security, and interaction). Similarly, based on the Information Systems Success Model, information quality was proposed to capture the Internet commerce content and include completeness, ease of understanding, personalization, relevance, and security (DeLone & McLean, 2003). In a study to examine quality of airline Web sites based on the WebQual model, three factors were determined: information quality (i.e., accuracy, timeliness, and reliability), interaction quality, and design quality (Shchiglik & Barnes, 2004). Finally, it was suggested that (a) factors determining Web site quality may have different quality designations in different domains or types of Web sites and that (b) each domain may require unique and domain-specific factors (Zhang & von Dran, 2002).

Results from these previous studies showed that information quality is a main factor determining quality of virtually every Web site; however, the underlying items determining a Web site's information quality have not been consistently identified by those previous studies. This might be due to the fact that factors determining Web site quality may vary across different domains (Zhang & von Dran, 2002) or that those previous studies adopted broader theoretical foundations (e.g., Information Systems Success Model, WebQual) rather than specifically focusing on information quality.

Similarly, we argue that information quality is the most important factor determining quality of personal Web portfolios because personal portfolios allow individuals to present more detailed personal information (Bayless et al., 2000; Lancaster, 1999). Additionally, in this study, we adopt the Information Quality framework (Huang et al., 1999; Wang & Strong, 1996) as our theoretical foundation to identify items determining information quality of personal Web portfolios.

To measure and improve the quality of an information system and the information it provides, it is necessary to understand what the information means to consumers or which qualities consumers want the information to have (Wang & Strong, 1996; Southard & Siau, 2004). Because of this, from the information consumers' perspective, the Information Quality framework (Huang et al., 1999; Wang & Strong, 1996), conceptualizing the underlying aspects of information quality that are important to consumers, was developed through a series of studies (Strong, Lee, & Wang, 1997a, 1997b; Wand & Wang, 1996; Wang & Strong, 1996).

The Information Quality framework has been applied to different objectives in several previous studies. In a study of a global manufacturing company, Lee, Pipino, Strong, and Wand (2004) applied this framework with a management theory about quality improvement to develop an iterative information quality improvement process. Similarly, Pipino, Lee, and Wang (2002) used the Information Quality framework to develop a metric for assessing information quality in a study of the consumer goods and manufacturing companies.

In the Web context, information-seeking or content gratifications are the motivations that cause users to attend to specific commercial messages and sales offered at a single, specific Web site (Armstrong, 1999; King, 1998). Thus, the Information Quality framework was applied to develop a conceptual framework of effective Web site design for business-to-consumer Internet commerce (Katerattanakul, 2002; Katerattanakul & Siau, 2001). Additionally, the Information Quality framework was employed to identify 29 Web design practices supporting customer information search in using the Web for retail Internet commerce (Lee, Katerattanakul, & Hong, 2005). The Information Quality framework consists of four major information quality categories:

- Intrinsic Information Quality
- Contextual Information Quality
- Representational Information Quality
- Accessibility Information Quality

Intrinsic Information Quality

Intrinsic information quality denotes that information has quality in its own right, and the main dimension of intrinsic information quality is the accuracy of information (Huang et al., 1999; Wang & Strong, 1996). Rieh and Belkin (1998) found that accuracy of the information in a Web document is one criteria users employ when making judgments of Web information quality. For Internet commerce, reliable information of products/services was found to be a major antecedent for customer satisfaction (Ho & Wu, 1999; Kim, 1999). Furthermore, Javenpaa and Peterson (1997) found that customers were frustrated by numerous broken or inactive hyperlinks and that customers also criticized the hyperlinks for being misleading, making them expect one thing but providing another. Lynch and Horton (1999) also posited that when we see a hyperlink on a Web page, we have few cues to where we will be led. Similarly, users complained that hyperlinks that do not work are one of the major problems in using the Web (Swenson, Constantinides, & Gurak, 2002).

For a personal Web portfolio, determining the accuracy and reliability of its information content is somewhat impractical. That is, by reviewing only the content on a personal Web portfolio, readers cannot assess whether the

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information is accurate or reliable; however, by browsing a personal Web portfolio, readers can assess the accuracy of a portfolio's information presentation and delivery.

Thus, we propose to assess the accuracy of personal Web portfolios via two constructs: (a) accuracy of presentation and (b) accuracy of delivery. The accuracy of presentation is concerned with any typographical errors (i.e., number of grammatical and spelling errors). The accuracy of delivery is concerned with the justification of various navigational tools (i.e., relevancy of wordings or images used for hyperlinks in relation to their destination Web pages, amount of broken hyperlinks).

Contextual Information Quality

Contextual information quality highlights the requirement that information quality must be considered within the context of the task at hand. That is, the information must be relevant and complete (Huang et al., 1999; Wang & Strong, 1996). In retail Internet commerce, Ho and Wu (1999) found that the variety of products/services and complete detailed product/service information significantly impacted customer satisfaction. Similarly, relevant information and its complete coverage were necessary factors for Web user satisfaction with the site design (Zhang & von Dran, 2000). Additionally, content customization (e.g., adjusting site content to match customer's interests), complete product information (e.g., variety, availability, product price, product picture, product comparison), and useful information (e.g., contact information, frequently asked questions) were significant factors in supporting customer information search in retail Internet commerce (Lee et al., 2005).

Personal Web portfolios provide visitors with a glimpse at the work and personal life of the individuals and a communication channel between these visitors and the individuals. Therefore, we propose that the contextual information quality of personal Web portfolios should be measured by whether the Web portfolios provide sufficient personal details and contact information.

Representational Information Quality

Representational information quality emphasizes that information needs to be presented in a way that is interpretable, easy to understand, concise, and consistent (Huang et al., 1999). Hong and Moriai (1997) suggested that the designs and layout of visual elements (i.e., paragraphs, images, backgrounds, colors, texts, fonts, headings), the consistent presentation, and the concise information provided are the main areas that directly contribute to the comprehension of the Web site and the understandability of its content. Users judge the information quality of a Web site by the format and presentation of its content (Rieh & Belkin, 1998). Additionally, credibility of a Web site was found to be based on the overall visual design of the site, and a nonconfusing and easy-to-understand presentation was a significant Web design practice supporting consumer information search in Internet commerce (Lee et al., 2005).

Thus, we define the representational information quality of personal Web portfolios as consisting of impressions from visual settings, a combination or layout of visual settings on Web pages, consistent appearance and page layout, page length, and uses of multimedia to increase vividness (i.e., sound and animation).

Accessibility Information Quality

Web sites need to provide enough navigation mechanisms so that visitors can reach their desired information faster and easier (Lynch & Horton, 1999). Zhang and von Dran (2000) found that effective navigation aids and clear directions for navigating the site are necessary factors for user satisfaction with Web site design. Similarly, Lee et al. (2005) found that "hyperlink efficiency" (e.g., obtaining desired information in the fewest steps) and "navigation tools" (e.g., site map, search engine, indicator of Web page location) are important design practices for supporting customer information search in retail Internet commerce.

Thus, we propose that the accessibility information quality of personal Web portfolios should be assessed by whether sufficient navigational tools are provided so that portfolio visitors will be able to quickly and easily find their desired materials included in the portfolio.

The four categories of information quality and the original research framework used to measure the information quality of personal Web portfolios are summarized in Table 1.

Research Methodology and Results

Pilot Study

In the pilot study, a preliminary questionnaire was developed. The questions were designed based on the proposed

TABLE 1. Four categories of information quality and original research framework.

Intrinsic information quality	Errors in the content Accurate, workable, and relevant hyperlinks
Contextual information quality	Provision of author's information
Representational information quality	Organization, visual settings, typographical features, and consistency Vividness and attractiveness Clarity of the content
Accessibility information quality	Navigational tools provided

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information quality measures. In other words, the 41 design concepts asked in the questionnaire were classified into four groups based on the four categories of information quality in the original framework. The importance of each concept was rated on a scale of 0 (*not important at all*) to 6 (*extremely important*). A pretest of the questionnaire was administered to 6 doctoral students who had extensive experience in developing and evaluating Web sites. Based on their feedback, some corrections in the wording were made.

The preliminary questionnaire was then distributed to 64 participants who had experience in developing and evaluating personal Web portfolios as part of their academic assignments. Descriptive statistics of responses from these participants showed that most of the concepts in the preliminary questionnaire were considered to be important design concepts for personal Web portfolios. Almost all of the concepts (39 of 41) had at least 1 participant answering that it was extremely important. Moreover, the results of the exploratory factor analysis (EFA) conducted in this pilot study were, to a certain extent, consistent with the original framework. For contextual information quality, eight concepts (of nine) loaded onto the same factor. Similarly, for accessibility information quality, seven concepts (of eight) loaded onto the same factor. However, results from the EFA provided some evidence that representational and intrinsic information quality should be merged.

Main Study

Modified framework and questionnaire. We reevaluated the concepts that had mean scores lower than the midpoint of the scale (i.e., 3) and that did not load onto any information quality category or onto their target categories. Some concepts were dropped from the questionnaire, and others were reassigned to another information quality category. The concepts which questioned similar design criteria were combined and reworded.

Generally, primary adjustments involved the representational and the intrinsic information quality categories. These adjustments resulted in a new framework for effective personal Web portfolios with only three information quality categories—contextual, accessibility, and presentation quality—as shown in Table 2.

A new questionnaire, consisting of 20 concepts, was developed based on the modified framework. Each question in this new questionnaire rates the importance of a concept on a scale of 0 (*Not Important At All*) to 6 (*Extremely Important*). At the beginning of this new questionnaire, there were instructions on how to answer the questionnaire, and a scenario was provided that asked the participants to act as if they were designing their personal Web portfolios to provide their personal information. The new questionnaire was pretested, and some minor changes in the wording were made.

Participants. The main study included 307 participants from five information systems classes at two universities. All participants had experience in developing and evaluating personal Web portfolios as part of their academic assignments. Responses from the participants in each class were randomly divided into half, and each half was combined across the five classes. This procedure resulted in the first dataset, the "testing group" with 153 cases, and the second dataset, the "holdout group" with 154 cases.

Instrument refinement. The instrument refinement process includes the first analysis and the second analysis (see Figure 1). This process was carried out based on data from the testing group, which consisted of 153 cases.

First analysis: Purify the measures.

- Descriptive Statistics Analysis: The instrument refinement process began with a descriptive statistics analysis to examine (a) normality of the score distribution for each concept and (b) how important the participants rated each concept (see Appendix A). As none of the concepts has the absolute values of its skewness and kurtosis higher than 2.0 and 7.0, respectively, the score distribution of each concept is not significantly different from normal (Curran, West, & Finch, 1996). Under the condition of univariate-normality, researchers have held that factor models may be developed appropriately with ordinal measures (Boomsma, 1987); thus, a factor analysis could be conducted.

Regarding the importance of each concept, none of the concepts has mean scores lower than 3 (i.e., the midpoint of the scale); thus, none of the concepts was perceived by the participants to be in the not-so-important range.

- Coefficient Alpha: Coefficient alphas for the presentation quality [P], the contextual quality [I], and the accessibility quality [N] are 0.86, 0.89, and 0.85, respectively (see Appendix A).

TABLE 2. Modified framework.

Presentation information quality [P]	Use and organization of visual settings and typographical features Consistent presentation Attractiveness Accuracy and correctness of content	8 concepts
Contextual information quality [I]	Provision of author's information	6 concepts
Accessibility information quality [N]	Navigational efficiency Workable and relevant hyperlinks	6 concepts

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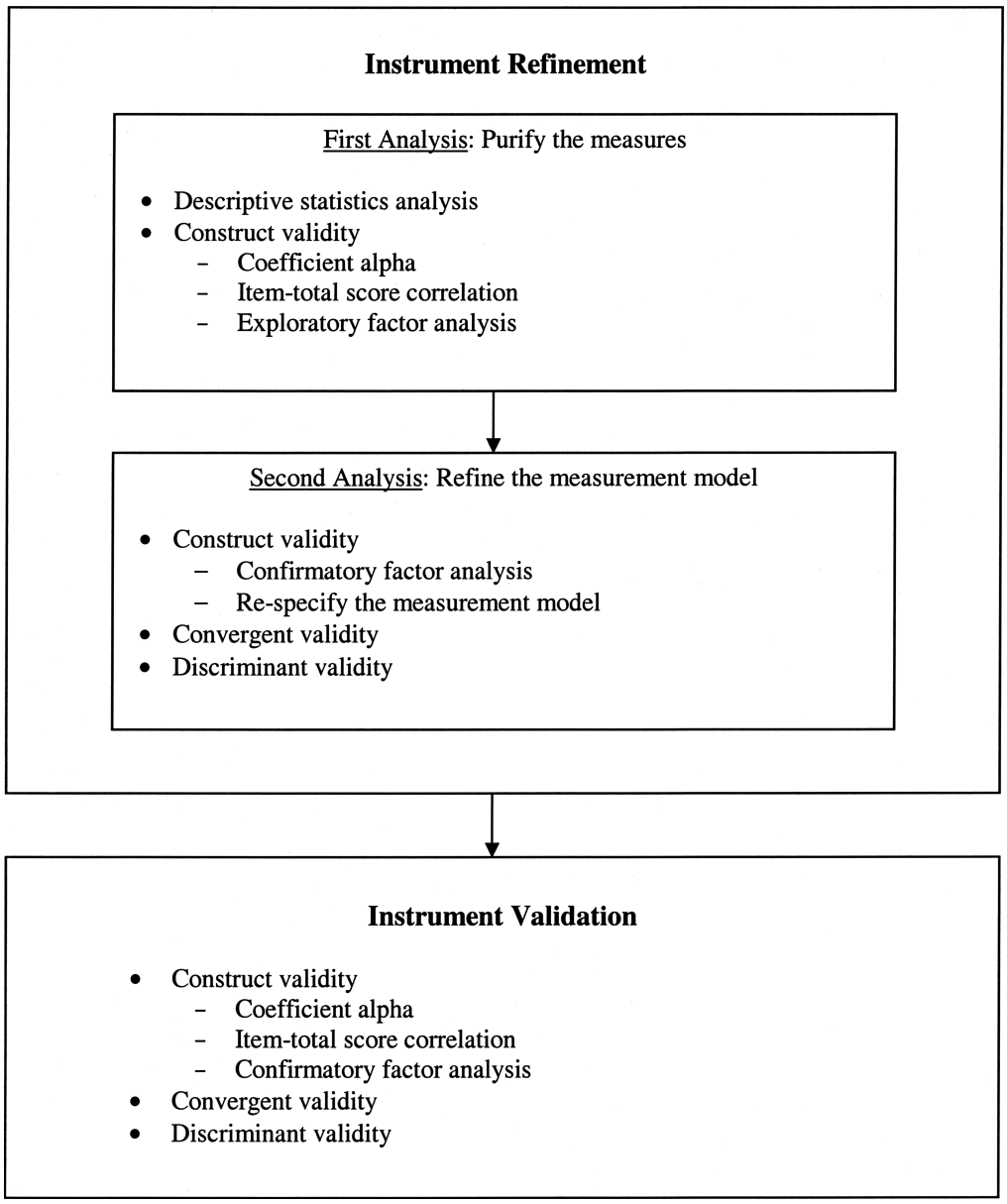

FIG. 1. Data analysis: Instrument refinement and instrument validation.

Thus, coefficient alphas of each quality category pass the 0.80 rule of thumb used as a gauge for reliable measures (Nunnally, 1978); however, results also show possible higher coefficient alphas for the presentation quality and the accessibility quality if Concept P7 (When the site was last updated) and Concept N2 (External hyperlinks) were excluded from the framework.

- Item–Total Score Correlation: The item–total score correlation approach assumes that the total score is valid; thus, the extent to which the item correlates with the total score is an indication of construct validity.

Item–total score correlation results (see Appendix A) are consistent with the results from coefficient alphas. That is, Concepts P7 and N2 show low item–total score correlations (0.375 and 0.397, respectively). Although Doll and Torkzadeh (1988) noted that there is no accepted standard for the cutoff value in this item–total score correlation approach, the item–total score correlations of all other concepts are between 0.469 and 0.779, respectively. This range is comparable to the ranges used in other studies that developed the instruments for measuring some Information Systems constructs (Doll & Torkzadeh, 1988; Ives, Olson, & Baroudi, 1983).

Although providing the date when the personal Web portfolio was last updated (Concept P7) presents the currency of the personal Web portfolio, this provision may not strongly contribute to the portfolio's presentation quality because (a) when compared to the content of business Web sites (e.g., product price, availability), information provided in personal Web portfolios is less time sensitive; and (b) much of the information provided in personal Web portfolios is usually time related (e.g., graduation year with institution and

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degree, creative work with its production date). Similarly, the external hyperlinks included in personal Web portfolios (Concept N2) do not contribute to the Web portfolio's accessibility quality since these links are external and instead could lead to visitors leaving the Web portfolio. Thus, both Concepts P7 and N2 were removed from further analyses.

EFA: EFA was conducted on the remaining 18 concepts of the three quality categories by using the Principal Component method with Varimax rotation and specifying a three-factor solution. Results of EFA (see Appendix B) are consistent with the three hypothesized quality categories. All 18 concepts except Concept P5 (Free of typographical errors) load onto their corresponding quality categories with high factor loadings (range = 0.549–0.839). The total variance explained by the three successive factors is 65.14%. Additionally, coefficient alphas for all three factors are higher than 0.80.

Concept P5 loads onto the contextual quality category instead of the presentation quality category (i.e., the target category). This concept was designed to measure how important it is for personal Web portfolios to be free of grammatical, spelling, and other typographical errors. The high factor loading of Concept P5 onto the contextual quality category implies that if the information provided in the personal Web portfolio contains some errors, the information may not be useful and the personal Web portfolio may not serve its purposes (e.g., as a communication channel, as a tool to create an impression). For example, if the contact information contains some errors, those visitors who use this information may not be able to reach the portfolio's owner. Additionally, typographical errors found in any personal Web portfolio could lead its visitors to have negative perceptions about the portfolio's owner (e.g., being a careless person). This negative perception was found in a previous study showing that a résumé's characteristics provide cues (e.g., neatness, organization, clarity) that may translate into dispositional attributions about the job applicant (Thoms, McMasters, Roberts, & Dombkowski, 1999). Thus, we argue that it is justifiable to rehypothesize Concept P5 (Free of typographical errors) from the presentation quality category to the contextual quality category.

Second analysis: Refine the measurement model.

- Confirmatory Factor Analysis (CFA): The results of the first analysis, with 18 concepts and three latent constructs for the three quality categories, provide a structure for the original CFA model (see Appendix B). This original CFA model was tested to assess how well the model would fit the observed data by analyzing the covariance matrix of all 18 concepts. In this model fit test, the maximum-likelihood estimation method was selected since the fit indices obtained from this method perform much better (as they are less likely to be influenced by various sources of irrelevant effects and less likely to depart from their true-population values) in comparison to those indices obtained from the generalized least squares or the asymptotic distribution-free estimators (Hu & Bentler, 1998). With the maximum-likelihood method, Hu and Bentler (1998) recommended a two-index presentation strategy for researchers. This would include definitely using a standardized root-mean-square residual (SRMR) and supplementing this with one of the following indices: comparative fit index (CFI) or root-mean-square error of approximation (RMSEA). Kline (1998) also suggested using a Pearson χ^2 statistic as one of the fit indices and reducing the sensitivity of χ^2 statistic to the sample size by dividing the χ^2 statistic by its degrees of freedom (i.e., χ^2/df). In addition to fit indices, the significance and magnitude of each loading, proportion of the explained variances (R2), and modification indices were examined.

Results of standardized loadings, t values, and explained variances (R^2) for each concept are reported in Appendix C. Every standardized loading is high (range = 0.53–0.90). The t values of all loadings are higher than 2.00; thus, all loadings are significant at $p = .05$. All explained variances are in the moderate-to-high range (range = 0.40–0.81), except for Concept I2 (only 0.28); however, one fit index for this original CFA model (i.e., RMSEA = 0.093, see Appendix D) does not suggest that this original model provides a very strong fit to the observed covariances. Thus, modification indices were carefully examined to identify potential model fit improvement.

Modification indices reported from the model fit test suggest strong error covariances among three concepts: I2 (Author's pictures), I4 (Author's personality), and I5 (Author's goals in life). To some extent, these three concepts involve the personality of the portfolio's owner. Personality represents those characteristics of a person that account for consistent patterns of feeling, thinking, and behaving (Pervin & John, 1996). As pictures provide an example of the characteristics and behaviors of a person, pictures also could be used to present one's personality. Similarly, hobbies, preferences, and so on provide information about one's characteristics and activities, and thus also could present one's personality. Finally, theorists undoubtedly agree that goals in life and anticipations about the future can influence and have effects on what one thinks about as well as one's behavior and personality (Pervin & John, 1996).

Another strong error covariance suggested by modification indices is between Concept N1 (Hyperlinks within the site) and Concept N6 (Consistently provide hyperlinks). Both concepts involve the internal hyperlinks provided in personal Web portfolios. That is, Concept N1 focuses on the provision of internal hyperlinks to the portfolio's homepage and other main pages while Concept N6 emphasizes that these internal hyperlinks must be consistently provided on every Web page throughout the Web portfolio. These two concepts measure a similar design practice.

Accordingly, two modifications were made to the original CFA model. A new concept—"Personality information" (I245)—of the contextual quality category was created from the average scores among I2, I4, and I5. Similarly, another new concept—"Provision of internal hyperlinks" (N16)—of the accessibility quality category was also created from the

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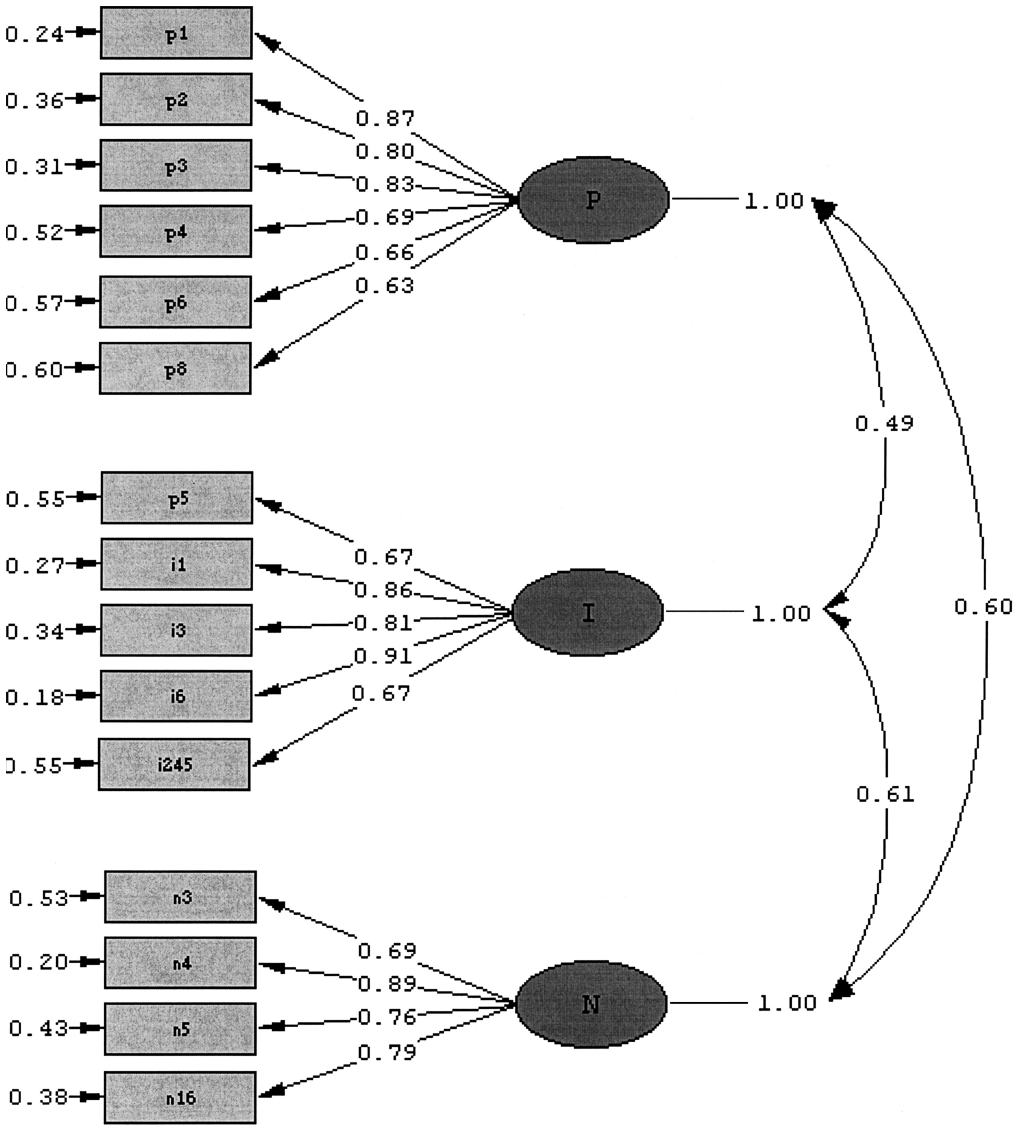

FIG. 2. Confirmatory Factor Analysis (Modified Model).

average score between N1 and N6. These modifications resulted in a modified CFA model as in Figure 2. This modified model was reevaluated to assess how well it would fit the observed data. Results of standardized loadings, *t* values, and explained variances (R^2) for each concept are reported in Appendix E. Every standardized loading is high (range = 0.63–0.91) and is significant at $p = .05$. All explained variances are within the moderate-to-high range (range = 0.40–0.82). Fit statistics (see Appendix D) show that the modified model provides a good fit (SRMR = 0.067, CFI = 0.95, RMSEA = 0.067, χ^2/df ratio = 1.78).

- Convergent and discriminant validity: If the concepts that are meant to measure the same underlying quality category have relatively high loadings in that quality category and are at least moderately correlated with each other, they have achieved convergent validity (Kline, 1998). In the modified CFA model, the minimum standardized loading is 0.63 (from P to P8; see Figure 2), and the minimum correlation among the concepts measuring the same quality category is 0.4. Thus, all concepts measuring the same quality category achieve convergent validity.

  Discriminant validity was assessed via testing for the significant difference in χ^2 scores of the unconstrained model and the constrained model (The constrained model was accomplished by setting the correlation between two quality categories to 1.0.) Results of the χ^2 difference tests for all three pairs of quality categories (P vs. I, P vs. N, and I vs. N) are significant at $p = .01$; thus, correlations between each pair of the three quality categories are significantly less than 1.0, and the three quality categories are indeed distinct. These results provide strong evidence for discriminant validity.

Instrument validation. As outcomes of the instrument refinement produced satisfactory results, the measures would

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be ready for some additional testing for which a new sample of data should be collected (Churchill, 1979). Thus, the instrument validation was conducted by using data from 154 respondents in the "holdout group."

In this instrument validation, results of construct validity show that the coefficient alphas for all three quality categories are between 0.80 and 0.88 and pass the 0.8 rule of thumb (Nunnally, 1978). Similarly, all item–total score correlations are between 0.432 and 0.776; this range is comparable to those ranges used in other Information Science instrument-development studies (Doll & Torkzadeh, 1988; Ives et al., 1983).

Moreover, CFA results for the instrument validation (see Appendix E) indicate that all standardized loadings are high (range = 0.49–0.82) and significant at $p = .05$. All explained variances (R^2) are in the moderate-to-high level (range = 0.42–0.68), except those for P5 and N5 (0.24 and 0.26, respectively). Fit indices (see Appendix D) show that although the results do not suggest an equally good fit of the model as those results of the instrument refinement, these results provide a fair fit (SRMR = 0.086, CFI = 0.91, RMSEA = 0.082, χ^2/df ratio = 2.15). In summary, results of coefficient alphas, item–total score correlation, and CFA provide the evidence of construct validity.

In this instrument validation, convergent validity was assessed by examining the standardized loadings of and the correlations among all concepts of the same hypothesized quality category (Kline, 1998). The minimum standardized loading is 0.49 (from I to P5, see Appendix E), and the minimum correlation among the concepts measuring the same quality category is 0.36. Thus, all concepts measuring the same quality category achieve convergent validity. Finally, χ^2 difference tests show significant results for all three pairwise comparisons and provide the evidence for discriminant validity.

Posttest Study

In the posttest study, the instrument (see Appendix F) developed from the aforementioned instrument refinement and validation was used to assess the quality of two personal Web portfolios. Each of the 15 items in the instrument was framed using a 7-point Likert scale, anchored at 6 (*Strongly agree*), 3 (*Neither agree nor disagree*), and 0 (*Strongly disagree*).

Selected personal Web portfolios. Two personal Web portfolios were selected to represent two different groups of personal Web portfolios developed by the designers who have different backgrounds and experiences. The first personal Web portfolio was designed and developed by an individual who has had limited experience in Web design and is perceived as an amateur Web designer. This first designer is pursuing a career in Elementary Education and has obtained her knowledge and experience in Web development from an educational technology course that she had taken. On the other hand, the second personal Web portfolio was designed and developed by an individual who is pursuing a career in Information Technology. The second designer has extensive knowledge in business and Web programming, and had successfully developed many business Web applications; thus, this second designer is perceived as a professional Web designer.

Independent raters and their responses. The independent raters assessing the two selected personal Web portfolios were recruited from the undergraduate students in an information technology introductory class. To encourage the raters to participate in this posttest study, extra credit was granted to each rater. The raters were trained to ensure that they would correctly enter their responses into the instrument. Then, the raters were instructed to visit and evaluate the two selected personal Web portfolios and to return their reports within 2 weeks. To complete the task, each rater would return the instrument with his or her responses and a two-page summary on what the rater had seen and read in the two personal Web portfolios. This summary helped to ensure that the raters had spent sufficient time in visiting and evaluating each selected personal Web portfolio.

After 2 weeks, we received the complete reports (i.e., the instrument with rater's responses and the two-page summary) from 28 raters. Upon reviewing the complete reports, two judges mutually agreed that each rater had spent sufficient time when visiting each personal Web portfolio and that the responses from all 28 raters were valid for further analysis.

Posttest analysis. To assess the "aggregate" consistency of the responses from all raters, we followed an approach suggested by Rosenthal and Rosnow (1991). This approach applies the *Spearman-Brown formula* to derive the *aggregate reliability* or the *effective reliability* (i.e., the composite reliability of all raters). Results in Table 3 report the effective reliability and the *mean reliability* (i.e., average of the pairwise correlations of all raters). For both the amateur and the professional personal Web portfolios, the aggregate consistencies of the responses from all raters (i.e., the effective reliabilities) are higher than 0.80. These results suggest that the instrument developed in this study is valid for assessing the quality of personal Web portfolios.

Additionally, the mean comparison by the paired sample *t* test conducted in this posttest study provided some interesting results. The *t*-test results showed some significant differences in personal Web portfolio designs between the amateur and the professional designers (see Appendix F). That is, in her personal Web portfolio, the amateur designer used more attractive and eye-catching images and other visual settings.

TABLE 3. Posttest study results: Effective reliability and mean reliability.

	Effective reliability	Mean reliability
Amateur personal Web portfolio	0.84	0.17
Professional personal Web portfolio	0.95	0.43

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The amateur designer explicitly focused more on her personality and career goals. On the other hand, the professional designer emphasized consistent visual settings, résumé, and contact information. In addition, the professional designer's personal Web portfolio was free of grammatical errors.

Discussion and Conclusion

This study developed and validated the framework and the instrument for measuring information quality of personal Web portfolios based on the Information Quality framework; however, rather than having four quality categories as in the original Information Quality framework, the items measuring information quality of personal Web portfolios were reclassified into only three quality categories: presentation quality, contextual quality, and accessibility quality.

Presentation quality focuses on the visual settings and typographical features that are not confusing and contains a well-organized layout, with appealing graphics and photos, and the overall attractiveness of Web pages in personal Web portfolios. Presentation quality also emphasizes the site's design consistency (i.e., using similar visual settings on every Web page). Personal Web portfolios also should avoid excessive lengthiness and/or should minimize the amount of scrolling their readers need to do on each Web page in the portfolio.

Contextual quality suggests that personal Web portfolios should be free of any typographical errors and should include a résumé and the career goals of the portfolio's owner. In addition, personal Web portfolios should include information about the personality of its owner. Personal information such as interests, hobbies, and objectives and goals in life as well as pictures of the portfolio's owner could aid in representing his or her personality. The portfolios also should provide contact information (e.g., mailing address, e-mail address) so that visitors are able to easily reach the portfolio's owner.

Finally, accessibility quality is concerned with the navigational tools provided in personal Web portfolios. Hyperlinks that lead to various sections within the portfolio should be consistently provided on every Web page in the Web portfolio. Moreover, internal hyperlinks should be designed in such a way that they allow visitors to obtain the desired information in the least number of possible steps (i.e., minimizing the number of hyperlinks required to reach the desired information within the Web portfolio). All hyperlinks included in the Web portfolio have to function properly and lead to the expected destinations. Hyperlink descriptions should not mislead visitors; that is, wording, icons, or images used to describe the hyperlinks should be relevant to the expected destinations.

Results of this study assure the validity of the developed instrument. Coefficient alphas, item–total score correlations, and EFA provide evidence for construct validity. CFA results suggest a fair-to-good fit of the tested models and provide evidence for construct validity and convergent validity. Similarly, the significant differences in χ^2 scores provide evidence for discriminant validity. Furthermore, results of the posttest study show high consistency of the responses from all raters using the developed instrument to assess the information quality of personal Web portfolios.

For practical implications, the three quality categories that emerged and their design concepts can be used as key criteria for those who would like to design their own personal Web portfolios and for those who want to evaluate the information quality of personal Web portfolios.

The results of this study suggest that if a personal Web portfolio contains any typographical errors, it is not useful and may not serve its purpose. This finding shows a strong relationship between accuracy of presentation and relevancy and completeness of information provided in a personal Web portfolio (Concept P5: Free of typographical errors, was loaded onto the contextual quality category). Similarly, accuracy of delivery (i.e., accurate, workable, and relevant hyperlinks) defined in this study also has a strong relationship with accessibility quality.

These findings are somewhat different from the original Information Quality framework that defines accuracy as a separate information quality category. These findings also invalidate our hypothesis to apply the accuracy category from the original Information Quality framework to the information presentation and delivery concept. Thus, further investigation of these differences would provide a better understanding of the applicability of the Information Quality framework on measuring Web design quality, and specifically on how to measure the accuracy of personal Web portfolios.

Additionally, another research implication is the need for testing the proposed framework by replicating this study. Although college students often utilize personal Web portfolios to present themselves, a replication of this study could use different types of participants. In particular, potential readers or users of personal Web portfolios could be a likely place to start (e.g., human resource staff of companies that actively recruit online).

The posttest study result also suggests another interesting area for future research: the impact of other factors (e.g., amateur vs. professional, gender, educational background, expected career path) on personal Web portfolio design. This would help us to better understand how individuals design and use their personal Web portfolios.

Note that different personal Web portfolios may be designed and developed for different purposes and that different portfolios may need to contain different types of contents; however, items in the instrument developed in this study do not focus on any specific type of content included in personal Web portfolios. This can be considered a limitation. Additionally, this study focuses only on the information quality of personal Web portfolios and does not cover system quality (e.g., response time, interaction, security), found as another important design quality for Internet commerce Web sites.

Although the criteria derived in this study may not be complete, this is the first study to provide a list of criteria derived from a clear theoretical basis for evaluating personal Web portfolios. Thus, this study's results can serve as a starting

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point for future studies to identify other criteria that are important for evaluating personal Web portfolios.

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Appendix A

Data in the "testing group," descriptive statistics, coefficient alphas (α), and item–total score correlations (r).

Concept	Cases	*M*	*SD*	Skewness	Kurtosis	α	*r*
[P1] Nonconfusing visual settings	153	4.93	1.04	−0.784	0.060		0.729
[P2] Length of Web page	153	4.44	1.19	−0.530	−0.300		0.665
[P3] Well-organized layout	153	5.02	0.97	−0.951	0.798		0.715
[P4] Eye-catching graphics	153	4.64	1.15	−0.820	0.688	0.86	0.678
[P5] Free of typographical errors	153	5.39	1.08	−1.851	3.193		0.469
[P6] Attractiveness of Web page	153	4.53	1.07	−0.296	−0.374		0.633
[P7] When the site was last updated	153	3.91	1.36	−0.372	−0.354		0.375
[P8] Use similar visual settings	153	4.51	1.19	−0.598	0.027		0.680
[I1] Author's career goals	153	4.50	1.66	−1.110	0.572		0.736
[I2] Author's pictures	153	3.32	1.78	−0.366	−0.787		0.578
[I3] Contact information	153	5.14	1.36	−1.887	3.333	0.89	0.694
[I4] Author's personality	153	3.76	1.50	−0.614	0.012		0.726
[I5] Author's goal in life	153	3.29	1.71	−0.353	−0.606		0.722
[I6] Author's résumé	153	4.80	1.66	−1.540	1.605		0.779
[N1] Hyperlinks within the site	153	4.61	1.19	−0.572	0.107		0.716
[N2] External hyperlinks	153	3.61	1.38	−0.412	0.070		0.397
[N3] Minimizing hyperlinks clicked	153	4.31	1.31	−0.559	−0.311	0.85	0.643
[N4] Relevant hyperlink description	153	4.56	1.25	−0.686	0.314		0.743
[N5] Broken hyperlink	153	5.07	1.22	−1.310	1.536		0.652
[N6] Consistently provide hyperlinks	153	4.56	1.23	−0.720	0.232		0.721

Appendix B

Instrument refinement: First analysis, Exploratory Factor Analysis results—Factor loadings and coefficient alphas (α).

Factor	Factor loading	Concept
Presentation Quality [P]	0.839	[P1] Nonconfusing visual settings
$\alpha = 0.88$	0.823	[P2] Length of Web page
	0.788	[P3] Well-organized layout
	0.748	[P4] Eye-catching graphics
	0.617	[P6] Attractiveness of Web page
	0.660	[P8] Use similar visual settings
Contextual Quality [I]	0.549	[P5] Free of typographical errors
$\alpha = 0.89$	0.750	[I1] Author's career goals
	0.706	[I2] Author's pictures
	0.719	[I3] Contact information
	0.799	[I4] Author's personality
	0.788	[I5] Author's goal in life
	0.798	[I6] Author's résumé
Accessibility Quality [N]	0.758	[N1] Hyperlinks within the site
$\alpha = 0.88$	0.730	[N3] Minimizing hyperlinks clicked
	0.771	[N4] Relevant hyperlink description
	0.692	[N5] Broken hyperlink
	0.836	[N6] Consistently provide hyperlinks

**Total Variance Extracted = 65.14%.

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Appendix C

Instrument refinement: Second analysis, Confirmatory Factor Analysis results (original model)—standardized loadings, *t* values, and explained variances (R^2).

Factor	Concept	Standardized loading	*t*	R^2
Presentation Quality [P]	[P1] Nonconfusing visual settings	0.87	13.22	0.76
	[P2] Length of Web page	0.80	11.49	0.64
	[P3] Well-organized layout	0.83	12.20	0.69
	[P4] Eye-catching graphics	0.69	9.39	0.48
	[P6] Attractiveness of Web page	0.66	8.77	0.43
	[P8] Use similar visual settings	0.63	8.35	0.40
Contextual Quality [I]	[P5] Free of typographical errors	0.66	8.85	0.43
	[I1] Author's career goals	0.85	12.73	0.72
	[I2] Author's pictures	0.53	6.77	0.28
	[I3] Contact information	0.80	11.65	0.64
	[I4] Author's personality	0.68	9.30	0.47
	[I5] Author's goal in life	0.70	9.61	0.49
	[I6] Author's résumé	0.90	14.06	0.81
Accessibility Quality [N]	[N1] Hyperlinks within the site	0.73	10.16	0.54
	[N3] Minimizing hyperlinks clicked	0.68	9.18	0.46
	[N4] Relevant hyperlink description	0.88	13.20	0.77
	[N5] Broken hyperlink	0.76	10.58	0.57
	[N6] Consistently provide hyperlinks	0.78	10.98	0.60

Appendix D

Fit Index Statistics, Standardized Root Mean Square Residual (SRMR), Comparative Fit Index (CFI), Root Mean Square Error of Approximation (RMSEA), and Ratio of chi-square (χ^2) and its degrees of freedom (*df*).

	Desired value	Instrument refinement: Second analysis Original CFA model	Instrument refinement: Second analysis Modified CFA model	Instrument validation
SRMR	≤ 0.08	0.076	0.067	0.086
CFI	≥ 0.90	0.89	0.95	0.91
RMSEA	≤ 0.06	0.093	0.067	0.082
χ^2 (*df*)	na	305.53 (132)	154.96 (87)	186.75 (87)
χ^2/df	≤ 3.00	2.31	1.78	2.15

Appendix E

Instrument refinement: Second analysis (Modified Model), and instrument validation Confirmatory Factor Analysis Results—standardized loadings, *t* values, and explained variance (R^2).

		Instrument refinement: Second analysis Modified CFA Model			Instrument validation		
Factor	Concept	Loading	*t*	R^2	Loading	*t*	R^2
Presentation Quality (P)	[P1]	0.87	13.23	0.76	0.82	12.07	0.68
	[P2]	0.80	11.50	0.64	0.74	10.36	0.55
	[P3]	0.83	12.18	0.69	0.80	11.55	0.64
	[P4]	0.69	9.38	0.48	0.70	9.61	0.49
	[P6]	0.66	8.77	0.43	0.72	9.95	0.52
	[P8]	0.63	8.36	0.40	0.69	9.34	0.47
Contextual Quality (I)	[P5]	0.67	9.06	0.45	0.49	6.04	0.24
	[I1]	0.86	12.86	0.73	0.82	11.75	0.67
	[I3]	0.81	11.91	0.66	0.73	10.04	0.54
	[I6]	0.91	14.16	0.82	0.80	11.40	0.65
	[I245]	0.67	9.11	0.45	0.76	10.56	0.58
Accessibility Quality (N)	[N3]	0.69	9.24	0.47	0.65	8.35	0.42
	[N4]	0.89	13.49	0.80	0.79	10.82	0.62
	[N5]	0.76	10.55	0.57	0.51	6.33	0.26
	[N16]	0.79	11.18	0.62	0.74	10.04	0.55

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Appendix F

Posttest study: Mean comparison by paired samples *t* test.

	Amateur personal Web site		Professional personal Web site			
	M	*SD*	*M*	*SD*	*t**	*p* (two-tailed)
Visual settings (e.g., heading, background, color, font, icon) on the Web pages in this Web portfolio do not look confusing	5.04	1.00	5.29	0.71	−1.23	0.23
Every web page in this Web portfolio is of reasonable length.	4.61	1.07	4.71	0.98	−0.46	0.65
Layout of the Web pages (i.e., arrangement of photos, paragraphs of text, sections, etc.) in this Web portfolio is well organized.	4.43	1.10	4.89	1.13	−1.47	0.15
Images, graphics, and photos in this Web portfolio are eye catching.	4.89	1.17	3.12	1.52	5.53	<0.01
This Web portfolio uses attractive background, icon, font, heading, etc.	4.89	1.23	3.18	1.36	4.92	<0.01
This Web portfolio consistently uses the same heading, background, color, font, etc., on every Web page throughout the site.	2.79	1.79	5.46	0.74	−6.78	<0.01
This Web portfolio is free of grammatical, spelling, and typographical errors.	4.21	1.91	5.46	0.79	−3.77	<0.01
Career goals of the site's author are presented in this Web portfolio.	5.14	1.30	4.36	1.39	2.53	0.02
Information about how to contact the portfolio owner is provided in this Web portfolio.	5.11	1.45	5.96	0.19	−3.11	<0.01
The portfolio owner includes his or her résumé in this Web portfolio.	4.46	1.73	5.96	0.19	−4.53	<0.01
From this Web portfolio, you learn some personality of the portfolio owner.	5.25	0.70	3.75	1.27	5.12	<0.01
In this Web portfolio, the number of hyperlinks you need to click to get specific information is minimum.	4.61	0.96	4.57	1.29	0.15	0.88
In this Web portfolio, wording, image, or icon used as a hyperlink is relevant to the Web page that the hyperlink leads to.	4.46	1.53	4.93	1.15	−1.12	0.27
This Web portfolio does not contain any broken hyperlink (i.e., hyperlink that does not work).	4.21	1.89	4.00	2.14	0.40	0.69
On every Web page in this Web portfolio, there are hyperlinks to the homepage and to other major pages in the Web portfolio.	4.54	1.79	5.04	1.45	−1.71	0.10

*$df = 27$.

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