New Review of Academic Librarianship

ISSN: (Print) (Online) Journal homepage: https://www.tandfonline.com/loi/racl20

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To cite this article: Hamid Keshavarz & Yaghoub Norouzi (2022) Measuring a Model on Credibility Evaluation of Scientific Websites: Exploring Relationships and Priorities, New Review of Academic Librarianship, 28:3, 321-345, DOI: 10.1080/13614533.2021.1925713

To link to this article: https://doi.org/10.1080/13614533.2021.1925713

NEW REVIEW OF ACADEMIC LIBRARIANSHIP
2022, VOL. 28, NO. 3, 321–345
https://doi.org/10.1080/13614533.2021.1925713

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Measuring a Model on Credibility Evaluation of Scientific Websites: Exploring Relationships and Priorities

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ABSTRACT

Owing to the extreme importance of evaluating the credibility of existing scientific websites, the present study sets out to measure a proposed model concerning the views and preferences of university students in Iran, when evaluating information. Data were collected by administrating a highly validated questionnaire among 487 students in ten top universities in Iran. Structural Equating Modelling using software SmartPLS was conducted to analyse the data collected. To evaluate the measurement and structural models, a set of criteria including Cronbach's alpha, factor loadings, convergent and divergent validities, R^2, Q^2, redundancy, and GoF were considered to measure the power and validity of the model. Considering the path coefficients and the t-statistic for the dimensions and their components, path analysis showed that the t-statistic is greater than 2.57 indicating that all of the constructs contributed to the credibility of information on scientific websites at 99% confidence level. Coefficients of correlation concerning the overall information credibility were found to be 0.728 for trustworthiness and 0.718 for expertise. Expertise with a path coefficient of 0.968 and trustworthiness with 0.948 were the first and second priorities for the main variable. Moreover, ethics with a path coefficient of 0.787 and objectivity with 0.464 were the first and last priorities for trustworthiness respectively while accuracy with 0.874 and professional information with 0.674 were the first and last priorities for the dimension expertise respectively. The model could be used to evaluate the credibility of scientific websites' information, which also provides a potential set for further research.

KEYWORDS

Credibility evaluation; model assessment; online information behaviour; students; website information

Introduction

The fast-growing and changing nature of the web environment in respect of the amount and variety of digital information resources available has made

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This article has been corrected with minor changes. These changes do not impact the academic content of the article.

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evaluating the quality of information a crucial task. Acquiring relevant information is a difficult and challenging process, and identifying its distinct features by users is an issue of great significance in this environment (Chu et al., 2018; Shen et al., 2019). This is particularly true at a time when new forms of electronic sources that are not necessarily reliable are being posted to the web and consequently are being used recklessly by users (Sbaffi & Rowley, 2017). Furthermore, the fact that web searching is among the most popular activities in all Internet-based applications, and the study of this also receives a high profile, means that research in this area is of extreme importance (Lovett, Gordon, Patton, & Chen, 2019).

Evaluating the quality of information on websites is considered through a set of criteria such as reliability, authority, and credibility (Lucassen, Muilwijk, Noordzij, & Schraagen, 2013). Information credibility is one of the most important criteria for evaluating websites in that, the more attention given to this element the higher the probability of retrieving quality information. However, the lack of content quality management and editing procedures within websites has resulted in a serious difficulty for identifying appropriate information for most users who are not specialised in various areas of the subject (Flanagin & Metzger, 2001).

Consequently, the web is not only considered a great source of information, but also a questionable source of information (see for example Metzger, 2007; Robins & Holmes, 2008). Based on Metcalfe's Law (1995), the value of a given network would be increased if more people use it. In the case of the web, its value lies in the ways it can open up our questions but there is a choice crisis" (Lankes, 2008) when users are confronted with the wide range of information resources available.

The individuals or organisations that we can trust in the digital environments and how we judge the quality of information are the major challenges (Flanagin & Metzger, 2001, 2011, 2013). Considering the role and effect of the quality and credibility of information available on the web, with regard to the levels of trust, decision making and activity of users, means that it is necessary to carry out research to assess the process of the evaluation processes. Research findings indicate the widespread use of and trust in website information in recent years through a new generation of websites and social networks with more freedom to create content, has added to the complexity of the issue (Jacobs, Amuta, & Jeon, 2017).

As future researchers and experts, students in various disciplines can influence the production and usage of science (Chu et al., 2018) and their approach to web resources can also affect the direction of the research policy-makers and community to the credibility of information resources especially in some areas like health (Jacobs et al., 2017; Jung, Walsh-Childers, & Kim, 2016) and social media (Han, Nakawatase, & Oyama, 2014; Zha,

Yang, Yan, Liu, & Huang, 2018). Moreover, some related research is highly needed in terms of optimising information search and retrieval procedures to enable new insights for experts of web design areas (Wierzbicki, 2018). The findings of such research could also influence user training and education in search and evaluation techniques. Managers and decision-makers can also benefit from the results of such research because they will provide solutions based on the benefits, disadvantages, risks, and outcomes of websites usage (Flanagin & Metzger, 2011, 2013).

In previous studies, little attention has been paid to identifying and prioritising the dimensions or components of the credibility of information available on scientific websites such as online professional sites, academic websites and scientific databases, journals, articles, weblogs and portals (Metzger, Flanagin, & Zwarun, 2003). Overall, it is still not clear what dimensions or components are used for the concept of the information credibility on scientific websites and also what set of criteria are considered among users and researchers. The current nationwide survey of Iranian university students, was conducted with the aim of exploring a conceptual model for credibility evaluation of scientific website information by students as a major group of users.

The present study was conducted to provide researchers and students with an awareness of the importance of evaluating scientific website information by measuring a proposed model. Moreover, the study extended to investigate the views and preferences of students regarding the model's constructs. In other words, the research sought to determine whether the designed conceptual model could well represent the main research variable. The other goal of the study was to identify the relationships and priorities that existed among the key components of the model as mentioned by the participant students.

Literature review

Challenges of measuring credibility

Different methods have been implemented to study credibility, especially its dimension identification and scale development. Factor model studies of credibility revealed a multitude of dimensions in source credibility, among which some related to both dimensions of credibility including expertise (competence, expertness, knowledgeability, or qualification) and trustworthiness (intention, character, or personal integrity) as highlighted first by Hovland and his colleagues (Hovland, Janis, & Kelley, 1953; Hovland & Weiss, 1951). In addition, the frequently used dimensions related to the characteristics of presentation style or the appearance of the source (dynamism, attractiveness, attraction, role model dimension, presentation) were also highlighted (Wierzbicki, 2018).

However, there are some drawbacks to the studies conducted in the area of measuring information credibility. The first is related to the procedure of item generation. In fact, the problem concerns a missing theory of credibility when considering the existing extant literature (Metzger et al., 2003). On the other hand, the respondents may associate the credibility of a source with the source's presentation style when characterising different sources of credibility (Aladhadh, Zhang, & Sanderson, 2019). Factor models often produce artificial and unstable factors since the researchers might determine the possible factors through selecting the items and even influencing the outcome of the factor loadings in their choice of the number of similar items (Sbaffi & Rowley, 2017).

The use of the same items for different dimensions leads to the assumption that the factors are not always independent. Therefore, factor analysis procedures are inappropriate by assuming orthogonal factors. Regarding factor interpretation, different expressions are used by researchers to describe the dimensions with loadings on identical items such as character and trustworthiness (Zhang & Yuan, 2020). These methodological problems take the responsibility of inconsistent results of factor model studies in addition to different aspects of the context in which the research is conducted.

Some scholars emphasised that the credibility of a media message may be influenced by non-source factors such as the medium or channel of delivery and even the structure of the messages themselves (e.g., Metzger & Flanagin, 2013), leading to calls for separating the concept at three different aspects including source, medium, and message based on the influential work of the psychologist Carl Hovland, who introduced the distinction between source, message, and media credibility. Accordingly, communication scholarship conceptualises credibility in three primary ways related to the source, recipient, and interaction models (Metzger & Flanagin, 2015). The assessment of credibility in the online environment is often much more complex than in previous media contexts due to 'the multiplicity of sources embedded in the numerous layers of online dissemination of content' (Sundar, 2008).

Credibility evaluation of websites

Exploring the credibility of websites has been a research area in many related disciplines such as computer science, communications, psychology, sociology, media, and information science. One of the difficulties of research in this field is a wide variety of research and approaches that will lead to a variety of methodologies (Shen et al., 2019; Sohn & Choi, 2019). However, what is important is that reviewed research has shown that less research has focussed on the comprehensive investigation and design of a model for website credibility features (Wierzbicki, 2018; Zha et al., 2018).

The studies conducted on website credibility evaluation are different with regard to identifying constructs and research methodologies. Computer scientists consider the concept of credibility as difficult to understand, fuzzy, and uncertain. Although relevance and credibility have been highlighted in research traditions of computer and media sciences respectively, their approaches are not similar even if the main objective of constituting an improved communication is the same (Wierzbicki, 2018). The difference in understanding the two concepts may be related to the origin of early credibility research in media and social science, which aimed to achieve an in-depth understanding of the studied social phenomena or concepts by considering all possible aspects.

On the other hand, informatics requires an operational understanding of the concept of credibility since it is a prerequisite for developing information systems and algorithms, which may be used in practice (Jung et al., 2016). A look at research conducted shows that familiarity with the criteria for evaluating the credibility of website information is imperative so that neglecting them at times can cause harm to the information consumers, especially students. On the other hand, it is apparent in the relevant literature that less research has focussed specifically on the credibility of information, especially in website environments (Lovett et al., 2019). Many studies have taken a quantitative and computational approach and this has been done with a technical and engineering approach. In many studies, one or more websites have been examined based on methodologies such as WebQual and SERVQUAL, all implemented across multiple websites and based on mathematical and software perspectives. Some research has also been carried out with key terms like quality, trust, and reliability that are close to the current research (Dickinger & Stangl, 2013). However, considering the purpose and methodology, they are different from the research in the information credibility area.

Despite conducting some credibility research in the areas of politics, marketing, and rhetoric, little attention has been paid to the credibility of scientific websites as a whole because its scales are usually designed to measure the perceived credibility of either a content or a content provider (Wierzbicki, 2018). Although many researchers have sought to isolate either content or content provider, the literature related to credibility suggests that this can be inappropriate due to their complicated interrelationships. Multiple scales are rarely used repeatedly to measure both content and its source credibility simultaneously.

Website evaluation frameworks

As mentioned by Chiou, Lin, and Perng (2010) and other researchers, the trends in website evaluation normally follow an information systems

approach, a marketing approach, or an integrated approach. Diverse techniques have been applied to address the problem of supporting website information evaluation from a system design approach. For example, Extended Model of Internet Commerce Adoption (eMICA) (Burgess & Cooper, 2000; Lin, Zhou, & Guo, 2009), SITEQUAL (Yoo & Donthu, 2001), E-SEQUAL (Petre, Minocha, & Roberts, 2006), Microsoft Usability Guidelines (MUG), Modified For B2C Firms (Wang & Liu, 2007), WebQual (Loiacono, Watson, & Goodhue, 2007), Culturally-Oriented Website Usability Evaluation (Vidrio-Baron, Luse, & Townsend, 2009), Strategic Framework for Website Evaluation (Chiou et al., 2010), Website Information Content Survey (Hasley &Gregg, 2010), Modified Balanced Scorecard (mBSC) (Stepchenkova, Tang, Jang, Kirilenko, & Morrison, 2010), Hedonic-Utilitarian Dual Mediation Hypothesis (López & Ruiz, 2011), Effectiveness Evaluation Model (Tsai, Chou, & Leu, 2011), Formative Measurement of Website Performance (Dickinger & Stangl, 2013), Quality Evaluation Model (QuEM) (Cebi, 2013), Cube Assessment Framework (Hansen & Bjørn-Andersen, 2013), Web Quality Index (WQI) (Fernández-Cavia, Rovira, Díaz-Luque, & Cavaller, 2014), a Measurement Index Common to Website and Store Images (Bèzes, 2014).

In addition, a large number of questionnaires have been designed specifically to evaluate websites. For example, Website Evaluation Questionnaire (Elling, Lentz, de Jong, & van den Bergh, 2012), System Usability Scale (SUS) (Brooke, 1996), American Customer Satisfaction Index (ACSI) (Anderson & Fornell, 2000), Website Analysis Measurement Inventory (WAMMI), (Kirakowski, Claridge, & Whitehand, 1998), a five-scale questionnaire (Van Schaik & Ling, 2005), and Website User Satisfaction Questionnaire (Muylle, Moenaert, & Despontin, 2004).

These aforementioned tools for evaluating websites have been conducted in different fields for different purposes. For example, the technical aspects of websites are prioritised in the field of computer sciences. The quality of the transmission process from source to the receiver is discussed in the communication studies, while the content and source criteria are considered more in the field of information science. There is no comprehensive study, model or tool with the capability of considering all aspects involved in website information evaluation.

Research questions

The increasing exposure to various issues related to the generation, distribution, and consumption of information available on scientific websites greatly necessitates addressing the factors involved in evaluating the credibility of information in such contexts. There appeared to be a need for

constructing a model or instrument to show which component students could keep in mind when evaluating website information. Therefore, the research was conducted to answer the following questions:

a. *Whether the model represents the main variable in terms of measurement standards?*
b. *What relationships exist among the model's constructs as mentioned by the students?*
c. *What priorities exist among the model's constructs as mentioned by the students?*

Methods

Conceptual model

The conceptual model of research has two main dimensions: trustworthiness with eight components of personal information, objectivity, ethics, updating website, writing style, website appearance, website management and website identity; and expertise with six components of professional information, accuracy, coverage, the currency of resources, usability and interaction. The categorisation of the dimensions and components is mainly based on suggestions made by Freeman and Spyridakis (2004, 2009). For example, accuracy was categorised as expertise, while objectivity was categorised as trustworthiness.

This credibility concept is consistent with a current and highly cited theory originated from the notions of trustworthiness and expertise first conceptualised by Hovland and Weiss (1951). The underlying theoretical structure of this model has also been judged and affirmed recently (Keshavarz, Esmailie Givi, & Norouzi, 2020) as mixed exploratory research. The current research was conducted in a much more extensive context to validate its underlying model, relationships and priorities. In other words, this current research is quantitative and descriptive which has resulted in different and new findings.

Measurement instrument

The questionnaire was derived from the above-mentioned conceptual model and appears to be a common tool used within the existing literature. The questionnaire developed for this study is based on experts' opinions gathered through a Delphi study. This questionnaire has the required reliability confirmed by related experts in communication, media and information sciences and its construct validity of Cronbach's alpha was calculated as 0.962. Concerning the two main dimensions of credibility, trustworthiness was

Table 1. Models and criteria for measuring the model.

Models	Criteria
Measurement model	Reliability
	Validity
	Factor loading
Structural model	t value
	Criterion R^2
	Criterion Q^2
	Criterion Redundancy
Overall model fit	Criterion Goodness of fit (GoF)

defined as the extent to which the websites' authors want to deliver correct information (e.g., intention, ethics, character, or integrity), while expertise seeks to define whether there is such an ability or not (e.g., competence, expertness, knowledgeability, or qualification). The students who particpated, were strongly encouraged to complete the questionnaire inquiring about their perceptions regarding criteria mostly used for evaluating the trustworthiness and expertise of information available on websites. The questionnaire included 80 questions in which there were 40 questions for each dimension.

Participants

To confirm the validity and reliability of the research model, the questionnaire was sent to students from the ten top universities across Iran. These universities were selected based on the rankings put forth by the world's most reputable rankings and the reports delivered in the past five years. The subject areas of these universities are diverse in that they cover all academic disciplines and represent the views of students from a diverse range of disciplines. A stratified random method was used for the sampling method. Thus, out of 111,193 students in these ten universities, 487 were selected as the statistical population with 0.05 sampling error. According to Central Limit Theorem, since the sample size is more than 30 and for each item more than 5 persons responded, the distribution of the statistical population is normal and parametric statistics can be used.

Data analysis

The method used in this study for data analysis is the variance-based method and one of its analysis methods is known as Partial Least Squares (PLS) first introduced by Wold (1966) by the use of software SmartPLS. This modelling approach 'makes minimal demands about measurement scales, sample size, and the distribution of residuals' (Fornell & Bookstein, 1982, p. 449) and 'avoids many of the restrictive assumptions underlying maximum likelihood techniques' (p. 440). As shown in Table 1, the PLS

method covers three parts for evaluating measurement, structural and overall models:

Findings

Demographics

The students who participated in the study, were enrolled in the ten top universities of Iran including Amirkabir University of Technology (n = 44), Sharif University of Technology (n = 38), Iran University of Science & Technology (n = 42), Tarbiat Modares University (n = 30), University of Tehran (n = 115), Tehran University of Medical Sciences (n = 46), Shahid Beheshti University of Medical Sciences (n = 48), Ferdowsi University of Mashhad (42), Shiraz University (40) and Isfahan University of Technology (42). A set of 210 females and 277 males contributed to completing the questionnaires indicating that males were the majority of the sample. Further, from the sample size, 47% studied in general universities (n = 227), 34% in technology universities (n = 166) and 19% in medical universities (n = 94).

Measurement model

Reliability

In the first stage of the data analysis, Confirmatory Factor Analysis showed that index q4 related to objectivity variable, q20, q21 related to website appearance variable, q31 related to website management, q40 related to website identity, q46, q47, q56, q57, q58 related to accuracy variable and q72 associated with the usability variable had a factor loading less than 0.4. Due to the low values, the mentioned indexes were removed and the modified model was launched as illustrated below.

Validity

Cronbach's alpha method was used to determine the reliability of the questionnaire in this initial stage (Table 2). This method is used to calculate the internal consistency of the measurement instrument and tests whether it measures respected items. The acceptable Cronbach's alpha for practical purposes is at least 0.7.

Discriminant validity was also considered in the sense that each marker only measures its construct and composition in a way that all constructs are well discriminated against. Considering the extracted mean-variance index, all the studied structures had AVE values higher than 0.5. Composite Reliability (CR) and Cronbach's alpha values were higher than 0.7 indicating the required reliability of the measurement instrument.

Table 2. Reliability indicators.

Components	AVE	CR	Cronbach's Alpha
Ethics	0.532	0.849	0.776
Professional information	0.599	0.881	0.830
Personal information	0.626	0.831	0.713
Trustworthiness	0.554	0.928	0.920
Credibility (overall)	0.542	0.964	0.962
Objectivity	0.542	0.779	0.785
Expertise	0.530	0.946	0.941
Currency	0.545	0.782	0.781
Accuracy	0.518	0.985	0.864
Updating website	0.573	0.800	0.724
Writing style	0.669	0.889	0.833
Website appearance	0.527	0.870	0.819
Usability	0.517	0.863	0.810
Interaction	0.506	0.877	0.836
Website management	0.546	0.827	0.723
Website identity	0.500	0.870	0.826
Coverage	0.523	0.845	0.770

Factor loadings

Factor loadings were used to analyse the structure of the questionnaire and to identify the constituent factors of each construct. The results of the factor loadings of the research variables are summarised in Figure 1. All values of factor loadings were greater than 0.5 and the calculated values of 't' for each factor loading of each marker with its hidden variable or construct were above 1.96 (significance level less than 0.05). Therefore, it is possible to show the consistency of the questionnaire items for measuring the concepts at this valid value. In fact, the above results show that what the researcher intended to measure by the questionnaire items can be accomplished by this tool. Subsequently, the relationships between constructs or hidden variables can be supported.

The results of the factor analysis presented in Table 3 show that all indexes related to the main dimension trustworthiness have acceptable 't' values (greater than 1.96) and factor loadings (greater than 0.5) and are suitable indexes for credibility.

Moreover, the results of factor analysis presented in Table 4 show that all indexes related to dimension expertise have acceptable 't' values (greater than 1.96) and factor loadings (greater than 0.5) and are suitable indexes for expertise.

Structural model

R^2

The criterion R Square or R^2 is used for examining structural model fit in research. R^2 coefficients are related to endogenous latent (dependent) variables of the model. R^2 is a criterion indicating the influence of one

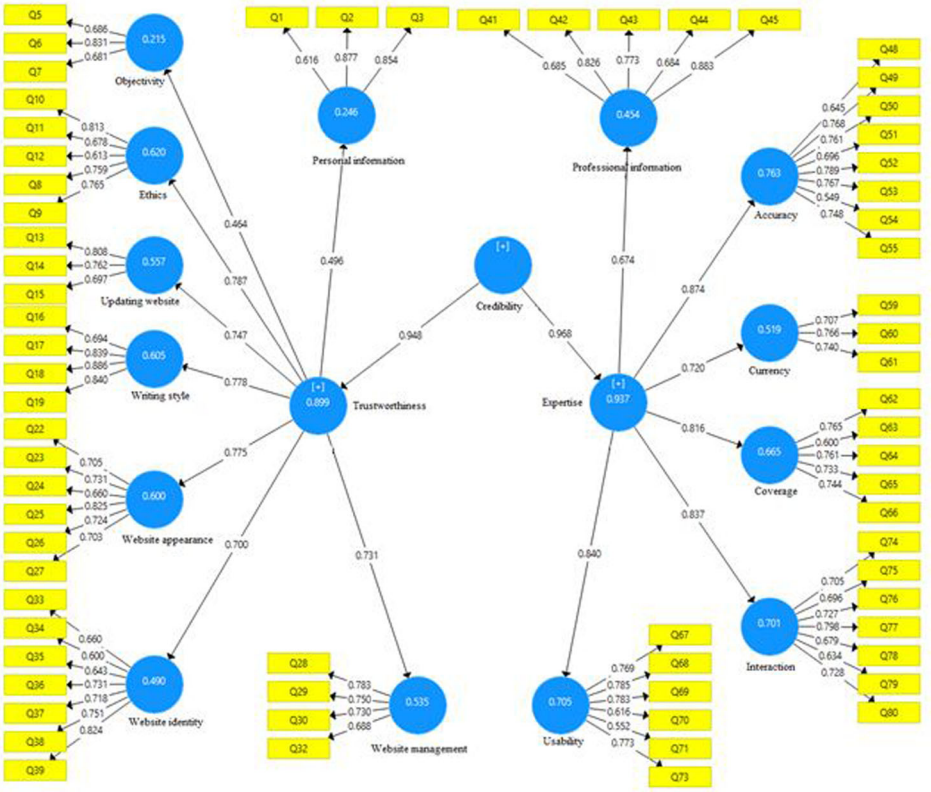

Figure 1. PLS-Path analysis (path coefficients, outer loadings and R^2 values) as indicated by student questionnaire (n = 487).

exogenous variable and one endogenous variable, in which three values of 0.19, 0.32, and 0.67 are considered as the criterion for weak, medium and strong values (Chin, 1998). Table 5 indicates that the majority of components have strong and medium values, which show considerable effects from exogenous variables to endogenous ones.

Q^2

The predictive power of the model is measured in the sense that if the value of Q^2 for an endogenous construct obtains three values of 0.02, 0.15, and 0.35, it indicates the weak, medium, and strong predictive power of endogenous constructs. The results of Table 6 show the appropriate predictive power of the model for the endogenous constructs of research and confirm the appropriate structural model fit.

Redundancy

This index is a criterion for measuring the structural model quality for each endogenous variable with respect to its measurement model. It is

Table 3. Factor loadings for trustworthiness.

Hidden variable	Observed variable	Factor loading	t statistics	Result
Personal information	Q1	0.616	3.708	supported
	Q2	0.877	27.427	supported
	Q3	0.854	19.447	supported
Objectivity	Q5	0.686	5.350	supported
	Q6	0.831	13.154	supported
	Q7	0.681	6.054	supported
Ethics	Q8	0.813	23.337	supported
	Q9	0.678	9.096	supported
	Q10	0.613	8.649	supported
	Q11	0.759	17.105	supported
	Q12	0.765	14.945	supported
Updating website	Q13	0.808	20.067	supported
	Q14	0.762	11.019	supported
	Q15	0.697	9.244	supported
Writing style	Q16	0.694	9.534	supported
	Q17	0.839	23.001	supported
	Q18	0.886	36.143	supported
	Q19	0.840	25.368	supported
Website appearance	Q22	0.705	11.501	supported
	Q23	0.731	14.539	supported
	Q24	0.660	10.435	supported
	Q25	0.825	25.700	supported
	Q26	0.724	12.757	supported
	Q27	0.703	13.625	supported
Website management	Q28	0.783	17.588	supported
	Q29	0.750	17.784	supported
	Q30	0.730	14.327	supported
	Q32	0.688	8.032	supported
Website identity	q33	0.660	11.200	supported
	q34	0.600	6.202	supported
	q35	0.643	8.616	supported
	q36	0.731	14.655	supported
	q37	0.718	12.021	supported
	q38	0.751	15.890	supported
	q39	0.824	17.892	supported

obtained from the multiplication of commonalities of constructs by their related values, which indicates the variability of indexes of an endogenous construct that is affected by one or more exogenous constructs. The greater the amount of redundancy, the more appropriate fit has the corresponding structural part of the model. Findings inserted in Table 7 are based on a formula as follows:

Model fit

The Goodness of Fit (GoF) criterion depends on the general part of the structural equation models. This means that by this criterion, the researcher can also control the fit of the general part next to examining the fit of the measurement and the structural parts of the research. The GOF criterion was developed by Tenenhaus, Amato, and Vinzi (2004) and is formulated as follows:

$$\text{GoF} = \sqrt{\overline{R^2} * \overline{COMMUNALITY}}$$

Table 4. Factor loadings for expertise.

Hidden variable	Observed variable	Factor loading	t statistics	Result
Professional information	Q41	0.685	9.625	Supported
	Q42	0.826	18.751	Supported
	Q43	0.773	15.792	Supported
	Q44	0.684	9.577	Supported
	Q45	0.883	45.923	Supported
Accuracy	Q48	0.645	9.590	Supported
	Q49	0.768	18.315	Supported
	Q50	0.761	15.086	Supported
	Q51	0.696	10.344	Supported
	Q52	0.789	17.183	Supported
	Q53	0.765	16.221	Supported
	Q54	0.549	4.992	Supported
	Q55	0.748	14.791	Supported
Currency	Q59	0.707	14.192	Supported
	Q60	0.766	14.148	Supported
	Q61	0.740	11.296	Supported
Coverage	Q62	0.765	14.937	Supported
	Q63	0.600	5.759	Supported
	Q64	0.761	15.478	Supported
	Q65	0.733	10.924	Supported
	Q66	0.744	413/12	Supported
Usability	Q67	0.769	19.355	Supported
	Q68	0.785	19.561	Supported
	Q69	0.783	16.955	Supported
	Q70	0.616	8.475	Supported
	Q71	0.552	6.463	Supported
	Q73	0.773	17.190	Supported
Interaction	Q74	0.705	11.192	Supported
	Q75	0.696	11.087	Supported
	Q76	0.727	12.852	Supported
	Q77	0.798	20.272	Supported
	Q78	0.679	8.968	Supported
	Q79	0.634	8.991	Supported
	Q80	0.728	14.526	Supported

Table 5. Results of the criterion R^2.

Components	R^2	Result
Ethics	0.620	strong
Professional information	0.454	strong
Personal information	0.246	medium
Trustworthiness	0.899	strong
Objectivity	0.215	medium
Expertise	0.937	strong
Currency	0.519	strong
Accuracy	0.763	strong
Updating website	0.557	strong
Writing style	0.605	strong
Website appearance	0.600	strong
Usability	0.705	strong
Interaction	0.701	strong
Website management	0.535	strong
Website identity	0.490	strong
Coverage	0.665	strong

For this fit index, values of 0.01, 0.25, and 0.36 are presented as weak, medium, and strong values. Based on the data in Table 8, the overall GOF of the model can be extracted, which is shown as follows:

Table 6. Results of the criterion R^2.

Components	Q^2	Result
Ethics	0.317	strong
Professional information	0.264	medium
Personal information	0.138	medium
Trustworthiness	0.234	medium
Objectivity	0.097	weak
Expertise	0.312	strong
Currency	0.276	medium
Accuracy	0.377	strong
Updating website	0.304	strong
Writing style	0.393	strong
Website appearance	0.310	strong
Usability	0.355	strong
Interaction	0.344	strong
Website management	0.278	medium
Website identity	0.229	medium
Coverage	0.341	strong

Table 7. Redundancy results.

Components	R^2	Communality	Redundancy
Ethics	0.620	0.532	0.329
Professional information	0.454	0.599	0.271
Personal information	0.246	0.626	0.153
Trustworthiness	0.899	0.554	0.498
Objectivity	0.215	0.542	0.116
Expertise	0.937	0.530	0.496
Currency	0.519	0.545	0.282
Accuracy	0.763	0.518	0.395
Updating website	0.557	0.573	0.319
Writing style	0.605	0.669	0.404
Website appearance	0.600	0.527	0.316
Usability	0.705	0.517	0.364
Interaction	0.701	0.506	0.354
Website management	0.535	0.546	0.292
Website identity	0.490	0.500	0.245
Coverage	0.665	0.523	0.347
Total redundancy 0.324			

Table 8. Results of the general model fit.

GOF	R^2	Communality
0.571	0.594	0.549

Given that the obtained goodness of fit index is 0.571 (greater than 0.36), the model had a high goodness of fit.

Hypothesis testing

Path coefficients and t-values with 0.01 significance level were used to test the hypotheses. The results are shown in Tables 9–11.

By comparing the path coefficient and the t-statistic for the two main dimensions of trustworthiness and expertise, it can be stated: Given that the t-statistic is greater than 2.57, trustworthiness and expertise are the

Table 9. Results of path analysis for credibility.

Factors	Path coefficient (β)	t statistics
Trustworthiness	0.948	**69.023
Expertise	0.968	**129.394

**$p < 0.01$ *$p < 0.05$

Table 10. Results of path analysis for trustworthiness.

Components	Path coefficient (β)	t statistics
Personal information	0.496	**6.168
Objectivity	0.464	**5.258
Ethics	0.787	**21.257
Updating website	0.747	**16.232
Writing style	0.778	**21.134
Website appearance	0.775	**17.550
Website management	0.731	**12.175
Website identity	0.700	**10.902

**$p < 0.01$ *$p < 0.05$

Table 11. Results of path analysis for expertise.

Components	Path coefficient (β)	t statistics
Professional information	0.674	**11.152
Accuracy	0.874	**33.082
Currency	0.720	**15.543
Coverage	0.816	**22.325
Interaction	0.837	**23.182
Usability	0.840	**19.498

**$p < 0.01$ *$p < 0.05$

main dimensions contributing to the credibility of website information at 99% confidence level (Table 9).

Having explored the path coefficient and the t-statistic for each component, it was found that as the t-statistic is greater than 2.57, all identified components are among the factors contributing to trustworthiness at a 99% confidence level (Table 10).

Finally, the path coefficient and the t-statistic for each component showed that the t-statistic is greater than 2.57, all identified components are among the factors contributing to expertise at a 99% confidence level (Table 11).

Relationships and priorities

For answering the research question 2, a correlation test was used. Table 12 shows the coefficients of correlation and divergent validity. On the main diameter of this matrix, the second root of the average variance extracted (AVE) is shown. Based on the Fornell–Larcker (FL) criterion (Fornell & Larcker, 1981), divergent validity is confirmed if the second root value of the average variance extracted is greater than all the correlation coefficients of the relevant variable with the other variables. For example, the second

Table 12. Correlation matrix and discriminant validity index.

Components	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1.Ethics	0.729																
2.Professional information	0.418	0.774															
3.Personal information	0.378	0.375	0.791														
4.Trustworthiness	0.717	0.566	0.496	0.744													
5.Credibility (overall)	0.725	0.655	0.429	0.728	0.736												
6.Objectivity	0.432	0.209	0.183	0.464	0.441	0.736											
7.Expertise	0.625	0.674	0.351	0.714	0.718	0.393	0.728										
8.Currency	0.408	0.543	0.277	0.607	0.696	0.279	0.720	0.738									
9.Accuracy	0.554	0.545	0.287	0.725	0.704	0.418	0.674	0.510	0.720								
10.Updating website	0.522	0.297	0.320	0.717	0.638	0.228	0.512	0.528	0.385	0.757							
11.Writing style	0.522	0.229	0.333	0.718	0.654	0.267	0.514	0.325	0.418	0.659	0.718						
12.Website appearance	0.474	0.402	0.241	0.715	0.710	0.246	0.712	0.493	0.645	0.668	0.628	0.726					
13.Usability	0.540	0.396	0.210	0.679	0.700	0.395	0.640	0.509	0.695	0.402	0.410	0.598	0.719				
14.Interaction	0.516	0.422	0.278	0.695	0.706	0.304	0.717	0.568	0.598	0.391	0.492	0.584	0.722	0.711			
15.Website management	0.520	0.424	0.287	0.731	0.731	0.337	0.673	0.462	0.543	0.428	0.467	0.446	0.623	0.589	0.739		
16.Website identity	0.502	0.687	0.335	0.700	0.702	0.285	0.710	0.547	0.642	0.324	0.341	0.365	0.474	0.546	0.540	0.707	
17.Coverage	0.516	0.466	0.309	0.726	0.707	0.212	0.716	0.608	0.664	0.550	0.543	0.641	0.589	0.624	0.559	0.538	0.723

Note: Grey cells on the diagonal are the square roots of AVE.

root of the average variance extracted for the ethics variable is 0.729, which is greater than the correlation value of this variable with the other variables. Below the main diameter, Pearson correlation coefficients are shown. All correlation coefficients are significant at the error level of less than 0.05.

According to the values presented in the above table, it can be said that the information credibility variable was correlated with the trustworthiness variable (0.728) and with the expertise variable (0.718). In addition, the trustworthiness dimension correlated with ethics (0.717), personal information (0.496), objectivity (0.464), updating (0.717), writing appearance (0.718), website appearance (0.715), website management (0.731), and website identity (0.700). In other words, the trustworthiness dimension has been most strongly correlated with the component website management. The dimension expertise component was correlated with professional information (0.674), currency of references (0.720), accuracy (0.674), usability (0.640), interaction (0.718), and coverage (0.716). In other words, expertise has been most strongly correlated with the currency of the references component.

Regarding the value of path coefficients as shown in Tables 9–11, research question 3 can be answered. Therefore, expertise with a path coefficient of 0.968 is the first priority and trustworthiness with a path coefficient of 0.948 is the second one for information credibility. Moreover, ethics with a path coefficient of 0.787 is the first and objectivity with a path coefficient of 0.464 is the second priority for dimension trustworthiness. Finally, accuracy with a path coefficient of 0.874 is the first and professional information with a path coefficient of 0.674 is the second priority for the dimension expertise.

Discussion

The findings of confirmatory factor analysis showed that the factor loadings of all the items had good reliabilities for the model and the ability to describe the variances. To evaluate the measurement model fit, Cronbach's alpha, factor loadings, and convergent and divergent validity all indicate the fit of the data obtained to use the structural model for analysis. Regarding the structural model fit, it was found that all items and relationships between variables were significant at a 95% confidence level. It can be concluded therefore, that the scale has good fit and quality in terms of three aspects of model fit, structural model fit, and overall model fit, and reliability to be used in different research contexts. Of course, the final analysis is also specific to the data obtained and sample studies.

The correlations with a 95% confidence level were statistically significant because their significance level is approximately zero and is less than the

test error value (0.05). These correlations were estimated as strong. An appropriate level of correlation between the credibility of information and its two main dimensions, and between the two dimensions of trustworthiness and expertise, indicated a significant relationship with one another. This finding implies that different dimensions of information credibility have good relationships with each other. Specifically, the trustworthiness had the highest correlation with the component website management. Furthermore, the expertise dimension had the highest correlation with the component currency. As such, the two components of website management and currency of references have a high relationship with their dimension that should be considered in evaluating the credibility of web resources.

By examining the quantitative findings, it was generally found that students value expertise more than trustworthiness. The present finding creates the question as to why students consider expertise as a priority over trustworthiness. According to previous research (e.g., Flanagin, Winter, & Metzger, 2020), one answer is that it is difficult to assess the trustworthiness criteria in the web environment because everyone has access to technology and can provide a resource with an appropriate appearance and form without having to pay attention to specialised and precise discussions. Broadly speaking, when the quality of website design, layout, graphics, and overall appearance is high (and easy to achieve), the credibility of websites cannot be easily measured because of its professional design. However, it is only the professional and technical experts that can guide the sensitive searcher to the best information.

Students knew that while designing and producing content is convenient, they should focus on quality, accuracy, and expertise in delivering content rather than emphasising the appearance and visual structure of web resources. Such a distinction is significant to academic librarians, in that it is important in teaching information literacy skills and the evaluation of web information. It should be noted, however, that various studies have yielded contradictory findings (Flanagin et al., 2020) in that some have concluded that users' visual and representational considerations are more important than semantic, content, and specialised features (e.g., Robins & Holmes, 2008). A more accurate investigation is needed in order to specify what makes different evaluations among different users. In other words, it is necessary to do extensive research over long periods to determine which features are a priority for the users. Whether the appearance and representation is a priority or expertise, content and accuracy in the presentation.

Other findings of the study show that the trustworthiness dimension has been most strongly correlated with the website management component while expertise has been most strongly correlated with the currency of references component. This explains that managing a website including its

policy in organising webpages and information, protecting the privacy of users or advertising could strongly affect the acceptance of a given website. Furthermore, the currency of content in terms of its reference and links was considered an influential factor, which many researchers have also supported (e.g., Lucassen et al., 2013).

The results showed that among the components constituting the dimension of trustworthiness, ethics and objectivity had the highest and lowest priorities among students. The fact that students care more about ethics and pay less attention to objectivity is an area for further considered. Participants paid close attention to the ethics and commitment of a website writer or webmaster in a web environment and considered it as a very important basis for their evaluation. As indicated in previous research (e.g., Aladhadh et al., 2019), one of the major challenges in assessing the credibility of websites' information is the lack of clarity and the ability to identify the content producers. In a web environment, in which itis easy for anyone to produce content, users pay more attention to other criteria such as ethics. Such a finding is important because users need to be proficient in identifying authors' obligations to ethics for content provision e.g., honesty, fairness, and good intention. With such importance to identify authors and their commitment to ethics, it would be even more important to teach students how to identify related signs by having tips and skills in their hands.

In terms of the expertise dimension, accuracy was found to be the highest priority, and professional information the lowest priority. This means that professional information about content producers is less important for students than accuracy in producing and documenting the latest scientific achievements. In addition, the investigation of path coefficients showed that among all the components, accuracy with 0.874 was the highest among the fourteen components, which indicated the high importance of accuracy among academic users. Such findings have some significant implications. Firstly, The lack of importance placed on content producers, while predictable, should be the focus of stakeholders involved in scientific website design, including designers, policymakers, educators, and even users themselves.

Similarly, although the status of the author is not identifiable as in print environments, as shown in some studies like Lucassen et al. (2013), it is always regarded as one of the fundamental criteria in evaluating information. On the other hand, attention to criteria such as accuracy showed their importance to students as well. Understanding the complications in scientific advances, students always want the most accurate professional information, and that is why they pay more attention to the professional information of the websites' owners, managers and content producers.

Limitations and implications

Because the issue of information credibility is generally dependent on human evaluation, which has many complex features, it is difficult to explain the causal relationships and paths for predicting information credibility assessment behaviour. However, the scope of this research study did not include the human factors and features present in the process of evaluating the credibility of website information. It was initially decided to focus only on the credibility and quality of web resources and set aside these human dimensions for future research. Future research studies might consider human features and factors which influence the evaluation of the credibility of information contained within scientific websites. This might include age, gender, education, personality differences, personality traits, job duties, etc. and may result in demonstrating causal relationships.

The final model of the present study could be a checklist of the most important criteria for evaluating web information, which many web users and designers across different populations and sectors could use. Importantly, evaluating information credibility on scientific websites can be considered an essential skill for student users of university libraries. Therefore, the proposed model could be regarded as a checklist providing such students with some practical criteria useful for online information evaluation. Information providers could also consider using the framework underlying the model for designing quality information in general and concerning students in particular.

Likewise, as the measured model covers various aspects, it could be considered as a guideline for library managers and librarians alike. The special attention of the library managers to the indicators found, particularly in academic settings, would make it more practical in making actual supports. As providing proper information services to library users requires a high level of online information evaluation skills, the model could be used as a framework or at least a starting point for and the provision of this kind of information literacy instruction. Moreover, scholars could use the model and its relationships and priorities as a research tool for further research or evaluation. Specifically, research tools like scales or evaluation criteria could be derived from the model for upcoming research designs.

Conclusion

Based on the final model developed, some practical recommendations can be made that are of interest to those involved in the field, such as web designers, information literacy trainers, academic librarians, information providers or even policy-makers. Some of the points that can be taken away from this study are around: using the final research model in web information evaluation; training users with web information evaluation skills; using the model

in conducting related research; and providing organisations such as university libraries with a information credibility evaluation framework.

Based on the findings of the current research which have been validated in a systematic way, a standard or international instrument can be designed for future studies based on the model's relationships and priorities. Due to the increasing changes in web-based information and media, it is necessary to design and apply new evaluation tools practical for web practitioners based on the findings of this current and other related research.

While the research conducted in a national scale limited to several universities located in Iran, its modelling approach and findings could be applied in other contexts. Since the scientific websites will be dominant in research and education as associated with the university libraries, the credibility evaluation would be regarded essential in coming decades. As a result, university libraries could consider exploring the criteria, approach and findings of the current research to optimise the quality of library websites and to help students evaluate scientific websites more properly. Furthermore, scholars and policymakers in university libraries could take the model measured in this research as a basic tool for further investigation and implementation.

Funding

The work of Hamid Keshavarz was (partially) funded from the Basic Research Program at the National Research University Higher School of Economics.

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