Hindawi Publishing Corporation
Mathematical Problems in Engineering
Volume 2013, Article ID 363486, 9 pages
http://dx.doi.org/10.1155/2013/363486

Research Article

A Model for Assessing the Service Quality of University Library Websites

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Received 22 March 2013; Accepted 12 May 2013

Academic Editor: Tsan-Ming Choi

Evaluating the e-service quality is essential to organizations. The future of e-libraries has a vital place in universities. Libraries need to use websites as means to provide access to information resources, news and events. The importance of assessing e-service quality of libraries is significant. Previous researchers have developed many methods for assessing e-service quality. However, most of them only focus on the independent hierarchical structure. In this paper, we would like to figure out the criteria for assessing the service quality of library websites from university students' viewpoints. According to interdependent criteria, the analytic network process (ANP) approach is employed to (i) generate the priority weights of each criterion; (ii) measure the service quality of university library websites. 12 web-based service criteria are identified according to 3144 university students' viewpoints based on fuzzy Delphi method. On the basis of past studies, we divide 12 criteria into 3 perspectives, namely, system, efficiency, and information quality to measure the service quality of university library websites. On the basis of 3 perspectives and 12 important criteria, service quality of university library websites could be measured more effectively. Moreover, the practical application to measure the service quality of the old and new versions of one university library website presented in Section 5 is generic and also suitable to be exploited for Taiwanese universities.

1. Introduction

The Internet has contributed a convenient and efficient channel for distributing information and services [1]. E-service is becoming increasingly important when determining quality of service delivery in organizations. Evaluating the e-service quality is essential to organizations [2]. Researchers start to investigate the e-service quality of different industries. Libraries are increasingly delivering collections and services electronically [3]. Yalman and Kutluca [4] point out that the Internet is one of the basic tools to provide library services. It is necessary for universities to adopt the concept of e-library and to consider electronic librarianship while restructuring their services they provided. The future of e-libraries has a vital place in universities. Besides providing information about library collection and facilities, libraries need to use websites as means to provide access to information resources, news, and events [5]. The importance of assessing e-service quality of libraries is significant. In this paper, we have identified the criteria to assess the service quality of library websites from university students' viewpoints based on fuzzy Delphi method. Additionally, the ANP approach is employed to generate the priority weights of each criterion and to measure the service quality of university library websites.

Library websites should provide students with real concern contents, information of interest as the premise of the user's demand. Libraries must move away from the view of the click rate transfer to pay attention to the needs of users [6]. As the result, 12 web-based service criteria are identified according to 3144 university students' viewpoints based on fuzzy Delphi method, including choices for searching for information according to users' preference, protection of users'

personal information, availability of the website, promptness of taking care of problems, simple procedure of application, relevant content can be displayed for each item, downloading speed, promptness of search system response, accurateness of provided information, whether the website updates timely, whether the latest information is provided on the front page, and variety of electronic resources. On the basis of Hu [1], Parasuraman et al. [7], and Lee and Kozar [8], 12 criteria are taken into 3 perspectives to structure the hierarchy. Unlike previous researchers [8–11] who ignored the interdependence among criteria, this paper utilizes the ANP approach to capture the interdependence of the criteria as it appears to be one of the more feasible and accurate solutions for us to generate the priority weights of each criteria and to measure the service quality of university library websites. The result can provide a foundation for better understanding students' perceptions of e-service quality for libraries. This information is useful to universities libraries website designers and service providers and in the management of web-based services.

2. Service Quality of Website

For the purpose of this paper, the evaluating criteria are obtained by reviewing previous literatures as well as collecting students' opinions. The literatures, related to the evaluation of service quality, are described in the following. Hu [1] points out that traditional Likert scales cannot handle uncertain assessments according to human intuition for the service quality measurement, and so the fuzzy numbers is added and utilized to measure decision makers' subjective preferences. In the paper, Hu develops a genetic-algorithm-based approach to determine the importance of criteria for assessing the service quality of travel websites. Lin [10] reviews past studies to get 16 criteria for measuring the course website quality. Fuzzy analytic hierarchy process (AHP) is also applied to identify the relative weights of criteria between high and low online learning experience groups. Hu and Liao [11] employ fuzzy multiple criteria decision making approach to obtain important criteria for measuring service quality of Internet banking. Yu et al. [12] use AHP and fuzzy technique for order preference by similarity to ideal solution (TOPSIS) to rank business to consumer (B2C) e-commerce websites in e-alliance. Hsu et al. [13] proposed a process of algorithm that combined the consistent fuzzy preference relations method with ANP to evaluate e-service quality.

A set of initial criteria for measuring the service quality of university library websites are compiled from the above-mentioned literatures. As the ANP approach needs more calculations and additional pairwise comparisons, the computing process would be complex if there are too many criteria [14, 15]. Moreover, some of the initial criteria are unrelated to evaluating library websites. The advantage of fuzzy Delphi method is its simplicity. All the expert opinions can be encompassed in one investigation. Hence, this method can create more effective criteria selection [16]. This paper adopts fuzzy Delphi method to identify the criteria for assessing the service quality of library websites.

3. Fuzzy Delphi Method

The Delphi method is a traditional forecasting approach that does not require large samples. It can be utilized to generate a professional consensus for complex topics [17]. The Delphi method suffers from low convergence expert opinions and more execution cost. Murry et al. [18] integrate Delphi method and fuzzy theory. Membership degree is applied to establish the membership function of each participant. Ishikawa et al. [19] also introduce fuzzy theory into Delphi method. Max-min and fuzzy integration algorithm is developed. Hus and Yang [20] apply a triangular fuzzy number to encompass expert opinions and establish a fuzzy Delphi method. The max and min values of expert opinions are taken as the 2 terminal points of triangular fuzzy numbers, and the geometric mean is taken as the membership degree of triangular fuzzy numbers to derive the statistical unbiased effect and avoid the impact of extreme values. Kuo and Chen [21] point out that the advantage of fuzzy Delphi method for collecting group decision is that every expert opinion can be considered and integrated to achieve the consensus of group decisions. Moreover, it reduces the time of investigation and the consumption of cost and time. Ma et al. [16] describe the advantage of fuzzy Delphi method is its simplicity. All the expert opinions can be encompassed in one investigation. Hence, this method can create more effective criteria selection. This paper applies fuzzy Delphi method to identify the criteria for assessing the service quality of library websites.

4. Method: Analytic Network Process

In recent years, various researchers have applied the ANP approach in many managerial areas. Liao and Chang [22] apply the ANP approach to select televised sportscasters for Olympic Games. Liao and Chang [23] combine the ANP approach and balanced scorecard (BSC) to select key capabilities of Taiwanese TV-shopping companies. Liao and Chang [24] apply the ANP approach to choose public relations personnel for Taiwanese hospitals. Lin [25] combines ANP with fuzzy preference programming (FPP) to select supplier and then allocates orders among the selected suppliers by multi-objective linear programming (MOLP). Oh et al. [26] apply ANP, and BSC to evaluate the feasibility of a new telecom service. They point out that ANP can get more realistic results. Wu et al. [27] combine ANP with conjoint analysis (CA) to simplify ANP for hospital policymakers making appropriate management policies. Wu et al. [28] apply ANP to select strategic alliance partners for the LCD industry. J. K. Chen and I. S. Chen [29] apply decision-making trial and evaluation laboratory (DEMATEL), fuzzy ANP and TOPSIS to develop a new innovation support system. Liao and Chang [30] combine ANP with BSC for measuring the managerial performance of TV companies. Liao et al. [31] select program suppliers for TV companies using ANP. Lin and Tsai [32] integrate ANP and TOPSIS to select locations for foreign direct investments in new hospitals in China. Tsai and Hsu [33] combine DEMATEL with ANP to select cost of quality models. Tseng [34] uses ANP, DEMATEL, and fuzzy set theory to

obtain the relative weight of BSC factors for a university performance measurement. Yüksel and Dağdeviren [35] integrate fuzzy ANP and BSC to measure the performance of a manufacturing firm in Turkey. Liao et al. [36] use ANP and TOPSIS for assessing the performance of Taiwanese tour guides. Altuntas et al. [37] apply AHP and ANP to measure hospital service quality. Hu et al. [38] use ANP to evaluate the performance of Taiwan homestay industry. Hsu et al. [13] propose a process of algorithm that combined the consistent fuzzy preference relations method with ANP to evaluate e-service quality. They also point out that ANP is capable of addressing interdependent relationships among criteria. Kang et al. [39] apply fuzzy ANP and interpretive structural modeling (ISM) to select technologies for new product development (NPD).

From the previous literatures, we know that the ANP approach is widely applied in decision making. Compared with the AHP approach, the ANP approach is more accurate and feasible under interdependent situations. This is the reason we choose the ANP approach as our method for generating the priority weights of criteria and measuring the service quality of university library websites. The ANP approach is a comprehensive decision-making technique that captures the outcome of dependency between criteria [40]. The AHP approach serves as a starting point of the ANP approach. Priorities are established in the same way that they are in the AHP approach using pairwise comparisons. The weight assigned to each perspective and criterion may be estimated from the data or subjectively by decision makers. It would be desirable to measure the consistency of the decision makers' judgment. The AHP approach provides a measure through the consistency ratio which is an indicator of the reliability of the model. This ratio is designed in such a way that the values of the ratio exceeding 0.1 indicate inconsistent judgment [41].

5. Application

This section can be divided into 2 parts. First, the ANP approach is applied to generate the priority weights of criteria. Second, the ANP approach is employed to measure the service quality of the old and new versions of one university library website.

5.1. Generate the Priority Weights of Criteria. The ANP approach comprises the following steps [40].

Step 1 (model construction and problem structuring). The initial criteria for measuring the service quality of university library websites are compiled from the literatures mentioned in Section 2. Subsequently, the initial criteria are modified according to the opinions of university students using questionnaires developed based on Likert seven-point scale, with 1 as most unimportant and 7 as most important. Questionnaires are sent to 3144 university students to obtain their opinions about the importance of criteria. A demographic and behavioral characteristic profile of the respondents is shown in the appendix. Among the 3144 respondents, 1148 respondents (36.51%) are males and 1996 respondents are female (63.49%). About 19% of the respondents are at the graduate school level or above. Almost one-fourth of the respondents are from the College of Management, followed by the College of Social Sciences, the College of Liberal Arts, the College of Science, and the College of Life Science. 57 respondents (1.81%) access the library website more than 20 times per month. 7.63% of respondents use library website above 5 hours per week.

On the basis of fuzzy Delphi method, the geometric mean of each criterion is used to denote the consensus of the respondents' evaluation value of the criteria. According to the geometric mean values, top 12 web-based service criteria are identified, including choices for searching for information according to users' preference, protection of users' personal information, availability of the website, promptness of taking care of problems, simple procedure of application, relevant content can be displayed for each item, downloading speed, promptness of search system response, accurateness of provided information, whether the website updates timely, whether the latest information is provided on the front page, and variety of electronic resources. The contributors of the criteria are shown in Table 1. Based on Hu [1], Parasuraman et al. [7], and Lee and Kozar [8], this study proposes a hierarchy, illustrated in Figure 1, to evaluate the e-service quality of libraries in universities. Unlike previous researchers [8–11] who ignored the interdependence among criteria, in this paper, the ANP approach, which captures the interdependence, appears to be one of the more feasible and accurate solutions for us to generate the priority weights of each criteria and to measure the service quality of university library websites.

Only 44 students who access the library website more than 20 times per month and also use the library website above 5 hours per week are selected as respondents for the ANP questionnaires. We sent the ANP questionnaires to them by e-mail and personally. 34 ANP questionnaires are collected. Deducting questionnaires those consistency ratios exceeding 0.1, 25 ANP questionnaires are retained to generate the priority weights of criteria.

Step 2 (determine the perspectives and criteria weights). In this step, 25 students make a series of pairwise comparisons to establish the relative importance of perspectives. In these comparisons, a one-nine scale is applied to compare the 2 perspectives. The pairwise comparison matrix and the development of each perspective priority weight are shown in Table 2.

According to the interdependency of criteria, we apply pairwise comparisons again to establish the criteria relationships within each perspective. The eigenvector of the observable pairwise comparison matrix provide the criteria weights at this level, which will be used in the supermatrix. With respect to choices for searching for information according to users' preference, for example, a pairwise comparison within the system perspective can be shown in Table 3. According to this way, we can derive every criterion weight to obtain the supermatrix.

Table 1: Contributors of the criteria.

Criteria	Contributors
Choices for searching for information according to users' preference	[1, 13]
Protection of users' personal information	[1, 7–9, 11, 13]
Availability of the website	[1, 7]
Promptness of taking care of problems	[1, 2, 7, 11]
Simple procedure of application	[1–3, 10–13]
Relevant content can be displayed for each item	[1, 3]
Downloading speed	[3, 7, 13]
Promptness of search system response	[1–3, 10]
Accurateness of provided information	[1, 2, 8–11]
Whether the website updates timely	[10]
Whether the latest information is provided on the front page	Students proposed
Variety of electronic resources	[3, 8]

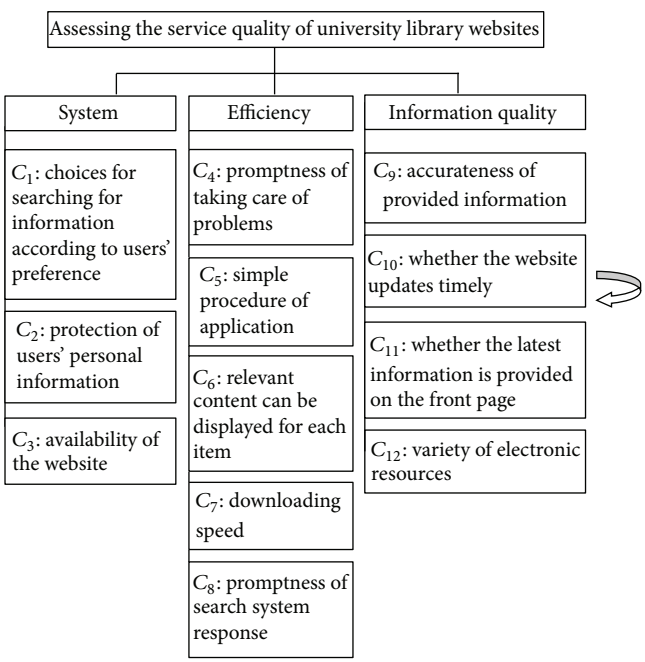

Figure 1: Hierarchy for assessing the service quality of university library websites.

Step 3 (construct and solve the supermatrix). An example of supermatrix is show in Figure 2. The components are C_k, $k = 1, \ldots, n$, and each component k has m_k elements, denoted by $e_{k1}, e_{k2}, \ldots, e_{kmk}$. The eigenvector obtained in Step 2 are grouped and located in appropriate positions in the supermatrix on the basis of the influences. The criteria weights derived from Step 2 are used to get the column of the supermatrix as shown in Table 4. Finally, the system solution is derived by multiplying the supermatrix of model variables by itself, which accounts for variable interaction, until the system's row values converge to the same value for each column of the matrix, as shown in Table 5.

$$
W = \begin{array}{c|c}
 & \begin{array}{ccccccccccc} C_1 & & \cdots & & C_k & & \cdots & & C_N & & \end{array} \\
 & \begin{array}{ccccccccccc} e_{11} & \cdots & e_{1n_1} & \cdots & e_{k1} & \cdots & e_{kn_k} & \cdots & e_{N1} & \cdots & e_{Nn_N} \end{array} \\
\begin{array}{c} C_1 \\ \\ \vdots \\ \\ C_k \\ \\ \vdots \\ \\ C_N \\ \\ \end{array} &
\begin{array}{c} e_{11} \\ \vdots \\ e_{1n_1} \\ \vdots \\ e_{k1} \\ \vdots \\ e_{kn_k} \\ \vdots \\ e_{N1} \\ \vdots \\ e_{Nn_N} \end{array}
\begin{bmatrix}
W_{11} & \cdots & W_{1k} & \cdots & W_{1N} \\
\vdots & & \vdots & \ddots & \vdots \\
W_{k1} & \cdots & W_{kk} & \cdots & W_{kN} \\
\vdots & & \vdots & \ddots & \vdots \\
W_{N1} & \cdots & W_{Nk} & \cdots & W_{NN}
\end{bmatrix}
\end{array},
$$

Figure 2: An example of supermatrix.

According to Tables 2 and 5, we can aggregate the total weight of criteria as shown in Table 6. According to Table 6, protection of users' personal information is the most important factor to measure the service quality of library website, followed by choices for searching for information according to users' preference, availability of the website, accurateness of provided information, whether the website updates timely, promptness of taking care of problems, variety of electronic resources, simple procedure of application, whether the latest information is provided on the front page, promptness of search system response, relevant content can be displayed for each item, and downloading speed.

5.2. Measure the Service Quality of University Library Websites. In the second part, the ANP approach is applied to measure the service quality of the old and new versions of one university library website.

Step 1 (model construction and problem structuring). According to hierarchy, the service quality of old and new versions of one university library website is evaluated. We sent the ANP questionnaires to 50 graduate school students personally. Deducting the ANP questionnaires that the consistency ratio is exceeding 0.1, 20 ANP questionnaires are retained to assessing the service quality of library websites.

Step 2 (determine the perspectives and criteria weights). In this step, 20 graduate school students make a series of pairwise comparisons to establish the relative importance of perspectives. In these comparisons, a one-nine scale is applied to compare the 2 perspectives. The pairwise comparison matrix and the development of each perspective priority weight are shown in Table 7. According to the interdependency of criteria, we apply pairwise comparisons again to establish the criteria relationships within each perspective. The eigenvector of the observable pairwise comparison matrix provide the criteria weights at this level, which will be used in the supermatrix.

Step 3 (construct and solve the supermatrix). The criteria weights derived from Step 2 are used to get the column of the

Table 2: The pairwise comparisons of perspectives.

	System	Efficiency	Information quality	Weights
	λ_{max} = 3.0010 C.R. = 0.0007			
System	1.0000	1.0118	1.0481	0.3399
Efficiency	0.9883	1.0000	0.9456	0.3258
Information quality	0.9541	1.0576	1.0000	0.3343

Table 3: The pairwise comparisons within system perspective with respect to choices for searching for information according to users' preference.

	Protection of users' personal information	Availability of the website	Weights
	λ_{max} = 2.0000 C.R. = 0.0000		
Protection of users' personal information	1.0000	1.0524	0.5128
Availability of the website	0.9502	1.0000	0.4872

Table 4: The supermatrix before convergence.

	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	C_{11}	C_{12}
C_1	0.0000	0.5046	0.4843									
C_2	0.5128	0.0000	0.5157									
C_3	0.4872	0.4954	0.0000									
C_4				0.0000	0.4018	0.3300	0.3206	0.2975				
C_5				0.3358	0.0000	0.3008	0.2648	0.2598				
C_6				0.2482	0.1830	0.0000	0.2121	0.2547				
C_7				0.1584	0.1763	0.1862	0.0000	0.1880				
C_8				0.2576	0.2389	0.1830	0.2026	0.0000				
C_9									0.0000	0.4345	0.3194	0.4406
C_{10}									0.3778	0.0000	0.3963	0.2941
C_{11}									0.2949	0.2348	0.0000	0.2653
C_{12}									0.3273	0.3307	0.2843	0.0000

Table 5: The supermatrix after convergence.

	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	C_{11}	C_{12}
C_1	0.3309	0.3309	0.3309									
C_2	0.3396	0.3396	0.3396									
C_3	0.3295	0.3295	0.3295									
C_4				0.2549	0.2549	0.2549	0.2549	0.2549				
C_5				0.2282	0.2282	0.2282	0.2282	0.2282				
C_6				0.1836	0.1836	0.1836	0.1836	0.1836				
C_7				0.1494	0.1494	0.1494	0.1494	0.1494				
C_8				0.1840	0.1840	0.1840	0.1840	0.1840				
C_9									0.2870	0.2870	0.2870	0.2870
C_{10}									0.2624	0.2624	0.2624	0.2624
C_{11}									0.2101	0.2101	0.2101	0.2101
C_{12}									0.2405	0.2405	0.2405	0.2405

supermatrix as shown in Table 8. Finally, the system solution is derived by multiplying the supermatrix of model variables by itself, which accounts for variable interaction, until the system's row values converge to the same value for each column of the matrix, as shown in Table 9.

Step 4 (select the best alternative). The weight of each alternative with respect to the criteria is shown in Table 10. According to Tables 7, 9, and 10, we can aggregate the total weight of each alternative as shown in Table 11. Therefore, it is obvious that the e-service quality of new version is better than old one.

6. Conclusion

The importance of assessing e-service quality of libraries is significant. Researchers have developed many methods for

Table 6: The total weight of criteria.

	Weight of supermatrix after convergence	Perspective priority weight	Total weight
C_1	0.3309	0.3399	0.1125
C_2	0.3396	0.3399	0.1154
C_3	0.3295	0.3399	0.1120
C_4	0.2549	0.3258	0.0831
C_5	0.2282	0.3258	0.0743
C_6	0.1836	0.3258	0.0598
C_7	0.1494	0.3258	0.0487
C_8	0.1840	0.3258	0.0600
C_9	0.2870	0.3343	0.0960
C_{10}	0.2624	0.3343	0.0877
C_{11}	0.2101	0.3343	0.0702
C_{12}	0.2405	0.3343	0.0804

Table 7: The pairwise comparisons of perspectives.

	System	Efficiency	Information quality	Weights
		λ_{max} = 3.0047 C.R. = 0.0036		
System	1.0000	1.0845	1.1914	0.3623
Efficiency	0.9221	1.0000	0.8941	0.3119
Information quality	0.8394	1.1184	1.0000	0.3257

Table 8: The supermatrix before convergence.

	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	C_{11}	C_{12}
C_1	0.0000	0.4063	0.4343									
C_2	0.4563	0.0000	0.5657									
C_3	0.5437	0.5937	0.0000									
C_4				0.0000	0.4276	0.3184	0.2582	0.2985				
C_5				0.2912	0.0000	0.3404	0.2756	0.2563				
C_6				0.2426	0.1826	0.0000	0.2348	0.2789				
C_7				0.1377	0.1532	0.1551	0.0000	0.1663				
C_8				0.3284	0.2366	0.1860	0.2314	0.0000				
C_9									0.0000	0.5189	0.3672	0.4794
C_{10}									0.3553	0.0000	0.4205	0.2999
C_{11}									0.2902	0.1663	0.0000	0.2207
C_{12}									0.3546	0.3148	0.2123	0.0000

Table 9: The supermatrix after convergence.

	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	C_{11}	C_{12}
C_1	0.2961	0.2961	0.2961									
C_2	0.3406	0.3406	0.3406									
C_3	0.3632	0.3632	0.3632									
C_4				0.2511	0.2511	0.2511	0.2511	0.2511				
C_5				0.2257	0.2257	0.2257	0.2257	0.2257				
C_6				0.1894	0.1894	0.1894	0.1894	0.1894				
C_7				0.1321	0.1321	0.1321	0.1321	0.1321				
C_8				0.2017	0.2017	0.2017	0.2017	0.2017				
C_9									0.3168	0.3168	0.3168	0.3168
C_{10}									0.2616	0.2616	0.2616	0.2616
C_{11}									0.1872	0.1872	0.1872	0.1872
C_{12}									0.2344	0.2344	0.2344	0.2344

Table 10: The weight of each alternative with respect to criteria.

	New version of library website	Old version of library website
C_1	0.5993	0.4007
C_2	0.4453	0.5547
C_3	0.5000	0.5000
C_4	0.5547	0.4453
C_5	0.5689	0.4311
C_6	0.5000	0.5000
C_7	0.5346	0.4654
C_8	0.4453	0.5547
C_9	0.5000	0.5000
C_{10}	0.5255	0.4745
C_{11}	0.4453	0.5547
C_{12}	0.6322	0.3678

Table 11: The total weight of alternatives.

	Weight of supermatrix after convergence	Perspective priority weight	New version of library website	Old version of library website
C_1	0.2961	0.3623	0.0643	0.0430
C_2	0.3406	0.3623	0.0550	0.0685
C_3	0.3632	0.3623	0.0658	0.0658
C_4	0.2511	0.3119	0.0435	0.0349
C_5	0.2257	0.3119	0.0401	0.0304
C_6	0.1894	0.3119	0.0295	0.0295
C_7	0.1321	0.3119	0.0220	0.0192
C_8	0.2017	0.3119	0.0280	0.0349
C_9	0.3168	0.3257	0.0516	0.0516
C_{10}	0.2616	0.3257	0.0448	0.0404
C_{11}	0.1872	0.3257	0.0271	0.0338
C_{12}	0.2344	0.3257	0.0483	0.0281
	Total weight		0.5199	0.4801

assessing e-service quality. However, most of them only focus on the independent hierarchical structure. In this paper, we figure out the criteria for assessing the service quality of library websites from university students' viewpoints based on fuzzy Delphi method. The ANP approach is employed to generate the priority weights of criteria and to measure the service quality of university library websites. 12 web-based service criteria are identified according to 3144 university students' viewpoints, including choices for searching for information according to users' preference, protection of users' personal information, availability of the website, promptness of taking care of problems, simple procedure of application, relevant content can be displayed for each item, downloading speed, promptness of search system response, accurateness of provided information, whether the website updates timely, whether the latest information is provided on the front page, and variety of electronic resources. According to past studies, 12 criteria are taken into 3 perspectives to structure the hierarchy. Unlike previous researchers who ignored the interdependence among criteria, in this paper, the ANP approach capturing the interdependence appears to be one of the most feasible and accurate solutions for us to generate the priority weights of each criterion and measure the service quality of university library websites.

Finally, we find that protection of users' personal information is the most important factor to measure the service quality of library website, followed by choices for searching for information according to users' preference, availability of the website, accurateness of provided information, whether the website updates timely, promptness of taking care of problems, variety of electronic resources, simple procedure of application, whether the latest information is provided on the front page, promptness of search system response, relevant content can be displayed for each item, and downloading speed. The design of university library websites and services should be in accordance with characteristics of users. This result also helps universities libraries website designers and service providers to put extra emphasis on to maintain or increase students' perception of overall e-service quality. For example, university library websites should spend more effort on the ease of use of their websites for finding information and keeping user information safer. Library website should

Table 12: Demographic and behavioral characteristic profile of respondents ($n = 3144$).

Variable	N	%
Gender		
Male	1148	36.51
Female	1996	63.49
Age		
18–28	2626	83.52
29–39	471	14.98
40–49	47	1.50
Education		
University	2547	81.01
Graduate school	496	15.77
Ph.D. student	101	3.22
Field of Study		
College of Liberal Arts	378	12.02
College of Engineering	192	6.11
College of Medicine	141	4.48
College of Science	287	9.13
College of Electrical Engineering and Computer Science	194	6.17
College of Social Sciences	542	17.23
College of Management	753	23.95
College of Law	144	4.58
College of Life Science	247	7.86
College of Education	209	6.65
College of Bioresources and Agriculture	57	1.82
Frequency of library website visit per month		
<5	1941	61.74
5–10	564	17.93
11–15	412	13.11
16–20	170	5.41
More than 20	57	1.81
Hours of library website usage per week		
<1	1755	55.82
1–3	675	21.47
3.1–5	474	15.08
More than 5	240	7.63

get users the right information in minimal time and effort. Established online instructions can help users to search for the needed information. Provided easy access to a well-organized collection of information resources is also vital. When user assesses the library website, he or she approaches it by perceiving how easy it is to gain access to the service, in terms of the convenience of using the websites. Moreover, the practical application to measure the service quality of the old and new versions of one university library website presented in Section 5 is generic and also suitable to be exploited for Taiwanese universities.

The hierarchy proposed in this paper considers 12 critical criteria. We suggest that future research studies can incorporate more criteria in order to conduct more accurate estimates. Moreover, follow-up researchers could analyze this topic with the concept of fuzzy sets or combining ANP with other multiple criteria decision making (MCDM) approaches such as DEMATEL and TOPSIS.

Appendix

See Table 12.

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