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Abstract

Purpose – This paper aims to apply the decision-making trial and evaluation laboratory (DEMATEL) to validate the service factors of an academic library.

Design/methodology/approach – First, the service criteria were extracted from the SERVQUAL model and then their values were examined in the user's mind. Second, the DEMATEL was applied to estimate the importance of the criteria and identify the causal factors. Next, an empirical study was conducted to demonstrate and validate the proposed approach. Finally, this paper offers some practical suggestions for academic libraries based on the analysis.

Findings – According to the analysis' results, "Empathy" is the causal factor in the cause–effect diagram; i.e. the library should pay more attentions to "Empathy" rather than "Reliability", "Responsiveness" and "Assurance" factors.

Originality/value – DEMATEL is a useful tool to identify the prominence and relationship of service factors; the evaluation is easy to apply and has not been used before in the discussion of library service. This paper provides an alternative for libraries to sort out the priorities of service improvement. The correspondence improvement can be addressed based on the causal analysis to make notable enhancement in service quality.

Keywords Academic libraries, SERVQUAL model, DEMATEL, Service quality

Paper type Research paper

Introduction

Service quality faces three major challenges: improving service quality, increasing assessment and reliability, while competition constantly increases and try to acquire and retain customers (Tseng, 2009). Delivering better service quality and developing a service quality model based on customer expectations are important issues for service organizations. Historically, the quality of library services in an academic library was described in terms of its collection and measured by the size of the library's holdings and by various counts of its use. The traditional orientation, focusing on the collection, is no longer appropriate for satisfying users in the present era. Thus, identifying a new model

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to measure library service quality and designing a systemic method to enhance quality are necessary for academic libraries.

The purpose of an academic library is to support teaching, research and promote services to enhance the school's research and development abilities. Each academic library needs to provide correct, plentiful and effective service. With the increasingly drastic competition between information services and diversified society requirements, libraries must emphasize service quality to attract more users and enhance utilization. However, a library's utilization is affected by user experiences and perceptions, such as their assessment of the surroundings, facilities, size of collections, staff attitudes and related reading activities. With the development of Internet applications, the perception of libraries by users is being negatively affected. For instance, greater demand for digital services provides users with faster and more varied data retrieval and sharing, but users do not realize these digital services are being provided by the library. Except for traditional services provided by libraries, enrichment of electronic services is being perceived by users as a more important task.

Reader satisfaction is a surrogate indicator of better service quality, as it will keep users loyal and willing to revisit (Kotler, 1997). The higher the number of users who are willing to revisit is, the greater the opportunity for public resources to be utilized. Thus, many scholars offer methods to measure or evaluate service quality and achieve reader satisfaction. Parasuraman *et al.* (1988) developed a multi-factor scale (SERVQUAL) for measuring service quality and reduced the ten categories of service quality to five dimensions: tangibles, reliability, responsiveness, assurance and empathy. SERVQUAL is a useful diagnostic tool to measure service quality, defined as the difference between customer perceptions and expectations of service. Later, Nitecki (1996) and Cook and Thompson (2000) utilized the conceptual model of service quality – proposed by the Parasuraman, Zeithaml and Berry model – to measure and enhance library service quality. Further, Nitecki and Hernon (2000) examined a new approach to measuring library service quality based on SERVQUAL. Previous research shows that most scholars used SERVQUAL to build a measurement model for library managers to measure or evaluate service quality. However, these studies' results only address the current service situation; they do not advise managers on how to improve or solve the service failures and enhance service quality by using concrete techniques or combine or merge organizational resources for setting up a strategy with the results. Hence, this study tries to harmonize user needs with library resources to improve library service quality.

Most evaluation models cannot solve the above issue and do not have an evaluation guideline for service quality enhancement. Service quality is evaluated based on different criteria; thus, the multiple criteria decision-making (MCDM) approach is suitable for evaluating service quality expectation. Among MCDM techniques, the decision-making trial and evaluation laboratory (DEMATEL) method has been successfully used to illustrate the interrelations among criteria (Lin and Tzeng, 2009; Shieh *et al.*, 2010). DEMATEL can help decision makers identify the central criteria to reveal the effectiveness of criteria and avoid overfitting for evaluation (Tzeng *et al.*, 2007). The main goal of this paper is to explore the interdependence of library service quality. Accordingly, the research applies the DEMATEL method for academic libraries to identify the focus of service quality enhancement.

Service quality in libraries

Service managers need to understand how perceptions of their performance on the service quality dimensions influence levels of customer satisfaction (Finn, 2011). Harvey (1998) used a pool party to exemplify that service quality can comprise four aspects: quality of process and results, search and experiential quality, perceptions and expectations. The quality of service can be represented by customer satisfaction and technical quality. Customer satisfaction can be measured inversely by the gap between perceptions and expectations. Both of them can be measured separately from the process and results. Technical quality can also be measured inversely by the gap between ideal and achieved technical quality. The author also presented several approaches and techniques to improve performance quality. He indicated that customer contact and intangibility are the two most important distinguishing features of services. Service quality is often conceptualized as the comparison of service expectations with actual performance perceptions (Zeithaml *et al.*, 1990). Kotler *et al.* (2004) noted that quality consists of two parts, technical and functional. Technical quality refers to tangible aspects of the service. It describes the product or service delivered to the customers in the service encounter. Functional quality refers to the intangible aspects of the service. It describes how the service is delivered, specifically the interaction between employees and customers during service encounters.

In Taiwan, in the early 1980s, library service quality improvement was primarily concentrated on the results from user satisfaction surveys. Extensive reader satisfaction research was conducted in academic and public libraries by service quality scales in the 1990s. Chang and Xie (1995) presented the results on customer perceptions of service quality in public libraries. Yu and Wu (2005) developed a comprehensive model and instrument for measuring library service quality in the Internet context. To determine service quality for a library, one must start with understanding the essence and distinct characteristics of library services. The features of library services include shifting to the web environment, difficulty predicting user requirements, difficulty obtaining funding, meeting non-profit objectives and providing better quality services (Einasto, 2009).

The service measurement model was originally developed in a commercial environment and adapted to the non-commercial environment of the academic library by scholars (Hernon and Calvert, 1996; Nitecki, 1996; Quinn, 1997). New measures of library quality and accountability are needed to better reflect the quality and impact of the academic research library on its institutional setting (Kyrillidou and Crowe, 2001; Weiner, 2005). Parasuraman *et al.* (1994) reshaped the concept of service quality in a library context from the traditional definition of service quality. They pointed out that service quality was a form of attitude – related, but not equivalent to satisfaction – that results from comparing expectations with perceptions of performance. SERVQUAL has been productively used as the theoretical basis for many empirical studies measuring customers' perceptions of service quality (Einasto, 2009; Garibay *et al.*, 2010; Keralapura, 2009).

Another measure, LibQUAL^{+TM}, has been widely used to measure library users' expectations and perceptions of library quality. LibQUAL$+^{TM}$ was developed utilizing the SERVQUAL instrument first developed by Parasuraman *et al.* (1988). After using a modified SERVQUAL for several years, Texas A&M University and other libraries saw the need for an adapted tool focusing on libraries. The information gathered through the

revised survey will help management understand users' perceptions and develop a plan for addressing areas needing improvement.

Several researchers developed various criteria to measure library service quality. Andaleeb and Simmonds (1998) showed that perceived quality of library resources, the responsiveness of library staff and perceived overall physical appearance of library facilities influence reader satisfaction with the university library. Lincoln (2002) proposed the dimensions of place, service and self-reliance as indicators of quality. Landrum and Prybutok (2004) suggested that three dimensions of service quality are service environment, service performance quality and service delivery or customer care. As the requirements for electronic resources are developing, information technology development is considered to be an important service quality criterion.

The aim of this study is to develop a model to provide information on how one service quality factor affects another in an academic library and then to improve and upgrade academic library service quality. More and more studies adopt the original SERVQUAL form in discussing the service quality of a library. This study adopted the modified version of SERVQUAL for further discussion.

Application of DEMATEL

There are many MCDM techniques commonly used in research; the analytic hierarchy process (AHP), proposed by Saaty (1980), has been widely used to evaluate alternatives; however, AHP assumes that criteria are independent which is not realistic in real-world circumstances. To overcome this, Saaty (1996) later proposed an extension model, the analytic network process (ANP), to represent the interdependence and feedback among criteria or alternatives. The DEMATEL method was originally developed between 1972 and1979 by the Science and Human Affairs Program of the Battelle Memorial Institute of Geneva, with the purpose of studying complex and intertwined issues. It has also been successfully applied in many topics, such as marketing strategies, control systems and safety problems, developing the competencies of global managers and group decision-making (DM) (Chiu *et al.*, 2006; Lin and Wu, 2008; Wu and Lee, 2007). Moreover, many researchers proposed a hybrid model which combined DEMATEL and ANP in various fields, such as e-learning evaluation (Tzeng *et al.*, 2007), airline safety measurement (Liou *et al.*, 2007), information security control assessment system (Yang *et al.*, 2008) and hot spring hotels (Chen *et al.*, 2011). Liou *et al.* (2014) further addressed the shortcomings of prior models and adopted an integral model to emphasize the interdependence among various criteria. The combination approach not only deals with the problems of intertwined relationships but also improves the normalized super matrix of ANP.

In recent studies, researchers frequently applied the DEMATEL method in DM problems. Shieh *et al.* (2010) conducted a survey based on the SERVQUAL model to identify seven major criteria and apply the DEMATEL method to understand hospital management evaluating the importance of criteria and constructing causal relations among the criteria. Tsai *et al.* (2010) applied the DEMATEL method to cope with the interdependencies between evaluation criteria for improving national park website quality in Taiwan. Hu *et al.* (2011) used the DEMATEL method to analyse the cause–effect relationship and level of influence among different quality characteristics to find the core problems involved in obtaining orders. Lin *et al.* (2011) analysed the in-depth interrelationship among the core competences by utilizing the DEMATEL method.

Particularly, many researchers applied DM techniques to supplier selection. Chai *et al.* (2013) conducted a systematic review of DM techniques in supplier selection and they highlighted 26 DM techniques from three perspectives. DEMATEL is one of the techniques used in generating the mutual relationships of interdependencies among criteria (Büyüközkan and Çifçi, 2012). Certainly, other researchers used a modified DEMATEL with fuzzy concepts to increase the robustness of the analysis.

In summary, DEMATEL is a structural model for analysing the influential relationship among complex evaluation criteria. The DEMATEL method has been successfully used in many fields; however, there has been no such application to measure library service quality. It is interesting to develop a full understanding of the cause–effect relationships of library service quality by applying DEMATEL in that it is different from prior library studies. This paper determines cause and effect groups, enabling readers to gain a better understanding of the interactive relationship between them, as well as making suggestions for improvement to enhance their overall performance.

Research method

Questionnaire design

The questionnaire was divided into two parts; one covered personal background, such as sex, age, education and occupation and the other service quality criteria. There were 20 service criteria designed based on SERVQUAL and Nitecki's (1996) work, as depicted in Table I. The questionnaire adopted a five-point Likert scale for users to specify their level of attitudes towards each service criterion; 1 represented least important and 5 most important. Six academic experts and professional librarians gave their views on the draft and minor modifications were made based on their comments.

DEMATEL analysis

The DEMATEL method is practical and useful for visualizing the structure of complicated causal relationships with matrices or diagrams. The matrices or diagrams portray a contextual relationship between the elements of the system, in which a numeral represents the strength of the influence. The essentials of the DEMATEL method suppose a system contains a set of criteria $C = \{C_1, C_2, C_3, \ldots, C_n\}$, and the particular pair-wise relationships are determined for modelling with respect to a mathematical relationship. The steps are outlined below.

Step 1: compute the average direct-relation matrix. To measure the influential degree among criteria, the evaluation scale was designed with four levels: "0: no influence", "1: very low influence", "2: low influence", "3: high influence" and "4: very high influence". Let a_{ij}^k, $k = 1, 2, \ldots, t$; $\forall i, j = 1, 2, \ldots, n$, be the influential degree of criterion C_i to criterion C_j given by expert E_k. Then, the direct-relation matrix of all criteria can be constructed as follows:

$$A = [a_{ij}]_{n \times n}$$

Where,

$$a_{ij} = 0, \quad \forall i = j$$

Factors	Criteria	Cronbach's α	Importance	Rank
F1. Tangibles	R1. Library has modern-looking equipment	0.8020	4.098	19
	R2. Library's physical facilities are visually appealing		4.325	**4**
	R3. Librarians are neat appearing		4.147	16
	R4. Materials associated with the services (such as pamphlets or statements) are visually appealing at the library		4.233	10
F2. Reliability	R5. When the library promises to do something by a certain time, it does so	0.7563	4.264	8
	R6. When a user has a problem, the library shows a sincere interest in solving it		4.313	**5**
	R7. The library performs services right the first time		4.282	6
	R8. The library insists on error-free records		4.399	**1**
F3. Responsiveness	R9. Librarians tell you exactly when services will be performed	0.7521	4.129	17
	R10. Librarians give prompt services		4.264	8
	R11. Librarians are always willing to help you		4.331	**2**
	R12. Librarians are never too busy to respond to your requests		4.196	14
F4. Assurance	R13. The behaviour of librarians' unit instills confidence in users	0.7426	4.227	12
	R14. You feel safe in your transactions with the library		4.233	10
	R15. Librarians are consistently courteous to you		4.282	6
	R16. Librarians have the knowledge to answer your questions		4.215	13
F5. Empathy	R17. The library gives you individual attention	0.7305	3.945	20
	R18. The library's operating hours are convenient for you		4.331	**2**
	R19. The library has your best interests at heart		4.123	18
	R20. Librarians understand your specific needs		4.178	15

Note: Values in bold are top five importance

Table I.
Factor reliabilities and attribute importance

$$a_{ij} = 1/t\left(\sum_{k=1}^{t} a_{ij}^{k}\right), \quad \forall i \neq j$$

Step 2: build a normalized direct-relation matrix. Based on direct-relation matrix$A$, the normalized direct-relation matrix X can be obtained by $X = A \times \lambda$, where $\lambda = 1/(\max_{1 \le t \le n} \{\Sigma_{j=1}^{n} a_{ij}\})$.

Step 3: build a direct/indirect matrix T. The direct/indirect matrix T can be acquired by equation as following: $T = \lim_{s->\infty}(X^1 + X^2 + \ldots + X^s) = X(I - X)^{-1}$.

Where, I is an identity matrix.

Step 4: derive the prominence and relation among features. Matrix T provides information on how one criterion affects another. The decision makers can set up a threshold value to filter out some negligible effects.

Let D_i be the sum of ith row in matrix T. Then it can be utilized to denote the total effects given by criterion C_i to the other criteria. Similarly, define R_i as the sum of ith

column from matrix T. R_i conveys the total effects received by C_i from the other criteria.

The sum of $(D_i + R_i)$ shows the total effects given and received by criterion C_i. The $(D_i + R_i)$ value identifies a *prominence*, indicating the degree of importance that criterion C_i has on the entire system. In addition, the $(D_i - R_i)$ depicts the net effect that criterion C_i has on the system. The $(D_i - R_i)$ value tells the *relation* of criteria. If the $(D_i - R_i)$ is negative, criterion C_i is a net receiver or the one impacted. The criterion C_i is a net cause, while $(D_i - R_i)$ is positive.

Step 5: draw a causal diagram. By estimating the figures of the coordinates $(D_i + R_i, D_i - R_i)$, using the prominence $D_i + R_i$ as the horizontal axis and the relation $D_i - R_i$ as the vertical axis, a causal diagram is built where the coordinates are concerned. This converts a complex causation to a simplified visual configuration.

Empirical study and discussion

Case library

The library of National Chin-Yi University of Technology (NCUT) was selected as the case library to demonstrate the empirical discussion. NCUT is located in Central Taiwan; the library has 11 librarians currently serving the main users, including nearly 10,000 students (the day-time program has 7,000 students and evening program 3,000 students), 278 full-time faculty members and 226 staff members. The original library building at NCUT collapsed in Taiwan's 921 Earthquake in 1999; subsequently, the library was temporarily placed in another outdated building with limited space. A new library building was designed and construction started in January 2007 and it opened in October 2009. Alongside continuous efforts at resource collection, the library formulates its development strategies in several ways:

- providing an obstacle-free learning environment;
- building an information retrieval system;
- enhancing users' exposure to education;
- joining the resource sharing coalition;
- combining service learning and volunteer groups; and
- connecting societies and implementing ideas for sharing resources.

In a rapidly changing era, it is necessary for an organization to constantly review the service it provides regarding whether or not it is meeting readers' needs, even in a new library. Therefore, this study adopts DEMATEL to help the case library identify the influential network relationships of its service criteria as the basis for further improvement planning.

Sampling

The population consisted of all main users of the university using a proportional stratified random sampling to conduct the survey. A total of 300 respondents were selected which included 11 teachers, 9 staff members and 280 students. In all, 283 questionnaires were returned, with 25 invalid questionnaires because of missing values. Thus, 258 questionnaires were included for further discussion. The overall response rate was 86 per cent.

Reliability and validity

First, reliability, as a measure of internal consistency, was calculated. Cronbach's α values were statistically determined to provide a summary measure of the inter-correlations existing among a set of items. In this study, Cronbach's α values of each dimension exceed 0.7 (Table I); each dimension achieves a satisfactory level of reliability (Nunnally, 1978). The content of the questionnaire was established through a literature review, along with interviews with professional academics and professional library staff. In addition, a pre-test was carried out. Therefore, the content validity of this questionnaire is supported.

Empirical analysis and results

The empirical analysis was processed according to the proposed method with the steps described in the previous section. Step 1, the six non-negative matrices of service quality, including factor-to-factor and criteria-to-criteria, were constructed by six experts. The average matrix A (Table II) is constructed. Step 2 calculates the normalized direct-relation matrix X, depicted in Table III. Step 3 calculates the direct and indirect effects among five factors (Table IV) and among 20 criteria (Table V). Step 4 calculates the sum of influences given and received based on the threshold value in the previous step (Table VI). Finally, for the last step, casual diagrams are drawn. The cause and

	F1	F2	F3	F4	F5
F1	0.000	1.750	2.000	2.000	1.500
F2	1.500	0.000	2.250	3.000	2.250
F3	1.500	2.500	0.000	2.500	2.250
F4	2.000	2.750	2.750	0.000	2.250
F5	1.750	2.750	2.500	2.250	0.000

F1	R1	R2	R3	R4	F2	R5	R6	R7	R8
R1	0.000	3.571	1.143	3.143	R5	0.000	3.000	3.286	2.714
R2	3.429	0.000	1.714	3.143	R6	3.143	0.000	3.000	2.857
R3	1.286	1.571	0.000	1.143	R7	3.571	3.143	0.000	3.143
R4	3.143	3.429	1.429	0.000	R8	3.143	2.857	3.286	0.000

F3	R9	R10	R11	R12	F4	R13	R14	R15	R16
R9	0.000	2.857	2.571	2.571	R13	0.000	3.714	2.429	3.000
R10	2.857	0.000	3.000	3.000	R14	3.714	0.000	3.000	3.000
R11	2.714	3.143	0.000	3.571	R15	2.571	2.857	0.000	2.571
R12	2.571	3.000	3.286	0.000	R16	3.429	3.429	2.571	0.000

F5	R17	R18	R19	R20
R17	0.000	3.286	3.571	3.286
R18	3.429	0.000	3.429	3.143
R19	3.571	3.429	0.000	3.143
R20	3.143	3.000	3.143	0.000

Table II.
The average direct relationship matrix

	F1	F2	F3	F4	F5
F1	0.000	0.179	0.205	0.205	0.154
F2	0.154	0.000	0.231	0.308	0.231
F3	0.154	0.256	0.000	0.256	0.231
F4	0.205	0.282	0.282	0.000	0.231
F5	0.179	0.282	0.256	0.231	0.000

F1	R1	R2	R3	R4	F2	R5	R6	R7	R8
R1	0.000	0.417	0.133	0.367	R5	0.000	0.304	0.333	0.275
R2	0.400	0.000	0.200	0.367	R6	0.319	0.000	0.304	0.290
R3	0.150	0.183	0.000	0.133	R7	0.362	0.319	0.000	0.319
R4	0.367	0.400	0.167	0.000	R8	0.319	0.290	0.333	0.000

F3	R9	R10	R11	R12	F4	R13	R14	R15	R16
R9	0.000	0.313	0.281	0.281	R13	0.000	0.371	0.243	0.300
R10	0.313	0.000	0.328	0.328	R14	0.371	0.000	0.300	0.300
R11	0.297	0.344	0.000	0.391	R15	0.257	0.286	0.000	0.257
R12	0.281	0.328	0.359	0.000	R16	0.343	0.343	0.257	0.000

F5	R17	R18	R19	R20
R17	0.000	0.324	0.352	0.324
R18	0.338	0.000	0.338	0.310
R19	0.352	0.338	0.000	0.310
R20	0.310	0.296	0.310	0.000

Table III.
The normalized direct relationship matrix

	F1	F2	F3	F4	F5
F1	1.262	1.884	1.858	1.901	1.650
F2	1.667	2.106	2.239	2.340	2.030
F3	1.627	2.256	1.999	2.255	1.983
F4	1.786	2.443	2.386	2.222	2.133
F5	1.705	2.356	2.284	2.323	1.869

Table IV.
Direct and indirect effects among factors

effect among the factors is shown in Figure 1, and causal relationships among the criteria of each factor are portrayed in Figures 2-6.

Prominence and relation among factors

(D + R) values indicate the prominence among factors; the greater the (D + R) value, the more important the factor. First, take a look at the five factors. Table VI shows the importance of the order of the five factors, F4 > F2 > F3 > F5 > F1, accordingly. The most important factor is F4 (assurance) with the greatest (D + R) value (22.011). The least important factor is F1 (tangibles) with the smallest (D + R) value (16.602). This is consistent to the situation of the case library. The building is brand new, all tangible

F1	R1	R2	R3	R4	F2	R5	R6	R7	R8
R1	1.687	2.076	1.089	1.892	R5	3.987	3.953	4.146	3.841
R2	1.998	1.809	1.148	1.916	R6	4.223	3.714	4.124	3.844
R3	1.030	1.102	0.522	0.985	R7	4.532	4.221	4.169	4.120
R4	1.956	2.069	1.112	1.624	R8	4.325	4.034	4.240	3.712

F3	R9	R10	R11	R12	F4	R13	R14	R15	R16
R9	5.437	6.112	6.034	6.173	R13	2.529	2.849	2.360	2.521
R10	6.123	6.358	6.541	6.691	R14	2.903	2.684	2.483	2.614
R11	6.407	6.931	6.609	7.049	R15	2.467	2.528	1.937	2.254
R12	6.122	6.624	6.578	6.465	R16	2.840	2.890	2.416	2.340

F5	R17	R18	R19	R20
R17	10.329	10.245	10.590	10.126
R18	10.477	9.898	10.477	10.017
R19	10.596	10.259	10.336	10.124
R20	9.893	9.576	9.893	9.237

Table V.
Direct and indirect effects among criteria

facilities or equipment are least important in improvement regarding service quality; patrons care about assurance the most.

On the other hand, (D − R) values indicate the relationship among factors; the greater the (D − R) value, the greater the impact the factor makes; the smaller the (D −R) value, the greater the impact the factor receives. Hence, factors F2 (reliability), F3 (responsiveness) and F4 (assurance) are *net receivers*; and F1 (tangibles) and F5 (empathy) are *net causes* as their (D − R) values are positive. This highlights that the empathy factor is the main cause influencing the other factors.

Moreover, the cause–effect diagram provides more information about the importance and relationships among factors. Figure 1 shows any pair of factors F2 (reliability), F3 (responsiveness), F4 (assurance) and F5 (empathy) is mutually influenced, except F3 to F5 (dotted line). This also indicates that factor F1 (tangibles) is more independent than the others. Hence, the tangible factor is not an important issue in terms of the current library situation. F5 (empathy) is a net cause that can be derived based either on the greatest (D − R) values shown in Table VI, or as the cause–effect diagram once again demonstrates that the empathy factor is the major factor affecting the others.

Prominence and relation among criteria in individual factors

Factor 1 tangible. The following illustrates the importance and relationships among the criteria for each factor. Figure 2 shows any pair of criteria R1 (The library has modern-looking equipment), R2 (The library's physical facilities are visually appealing) and R4 (Materials associated with the services are visually appealing) are mutually influenced, except R3 (Librarians are neat-appearing). Criterion R3 is more independent than the others. Thus, it shows R3 is not an important issue in the tangible factor and R4 is the major criterion affecting the others.

Factors	D + R	D − R
F1. Tangibles	16.602	0.508
F2. Reliability	21.427	−0.663
F3. Responsiveness	20.886	−0.646
F4. Assurance	**22.011**	−0.071
F5. Empathy	20.202	**0.872**

Factor	Criteria	D + R	D − R
F1	R1. The library has modern-looking equipment	13.415	0.073
	R2. The library's physical facilities are visually appealing	**13.927**	−0.185
	R3. Librarians are neat appearing	7.510	−0.232
	R4. Materials associated with the services (such as pamphlets or statements) are visually appealing at the library	13.178	**0.344**
F2	R5. When the library promises to do something by a certain time, it does so	32.994	−1.14
	R6. When a user has a problem, the library shows a sincere interest in solving it	31.827	−0.017
	R7. The library performs services right the first time	**33.721**	0.363
	R8. The library insists on error-free records	31.828	**0.794**
F3	R9. Librarians tell you exactly when services will be performed	47.845	−0.333
	R10. Librarians provide prompt services	51.738	−0.312
	R11. Librarians are always willing to help you	**52.758**	**1.234**
	R12. Librarians are never too busy to respond to your requests	52.167	−0.589
F4	R13. The behaviour of librarians instills confidence in users	20.998	−0.480
	R14. You feel safe in your transactions with the library	**21.635**	−0.267
	R15. Librarians are consistently courteous with you	18.382	−0.010
	R16. Librarians have the knowledge to answer your questions	20.215	**0.757**
F5	R17. The library gives you individual attention	82.585	−0.005
	R18. The library's operating hours are convenient to you	80.847	**0.891**
	R19. The library has your best interests at heart	**82.611**	0.019
	R20. Librarians understand your specific needs	78.103	−0.905

Note: Bold values indicate the highest value for individual factor

Table VI.
The sum of influences given and received

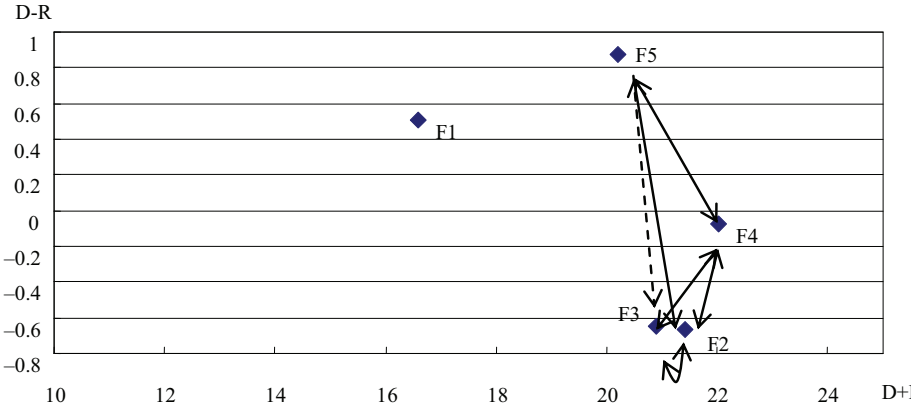

Figure 1.
Cause–effect among factors

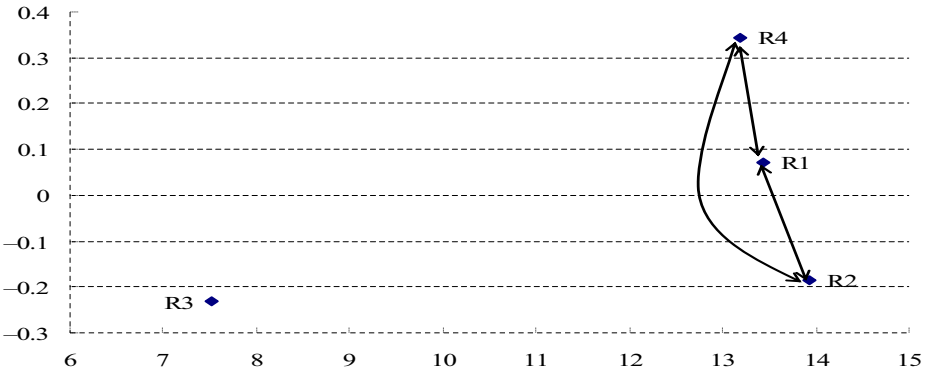

Figure 2.
Cause–effect among criteria of factor 1

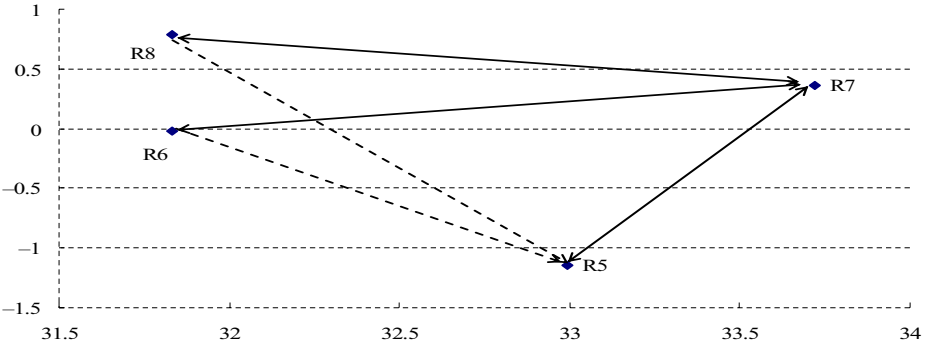

Figure 3.
Cause–effect among criteria of factor 2

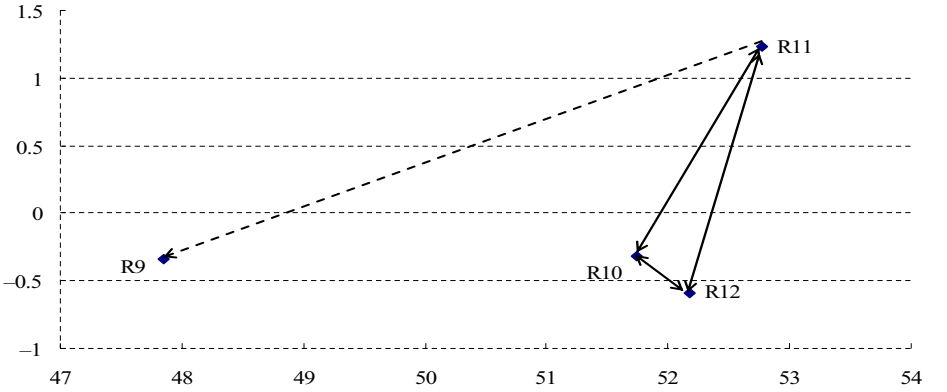

Figure 4.
Cause–effect among criteria of factor 3

Factor 2 reliability. Figure 3 shows any pair of criteria R5 (The library promises to do something by a certain time and it does so), R6 (When a user has a problem, the library shows a sincere interest in solving it), R7 (The library performs services right the first time) and R8 (The library insists on error-free records) are mutually influenced. The (D + R) value of R7 is the greatest, thus clarifying that R7 is the most

Figure 5.
Cause–effect among criteria of factor 4

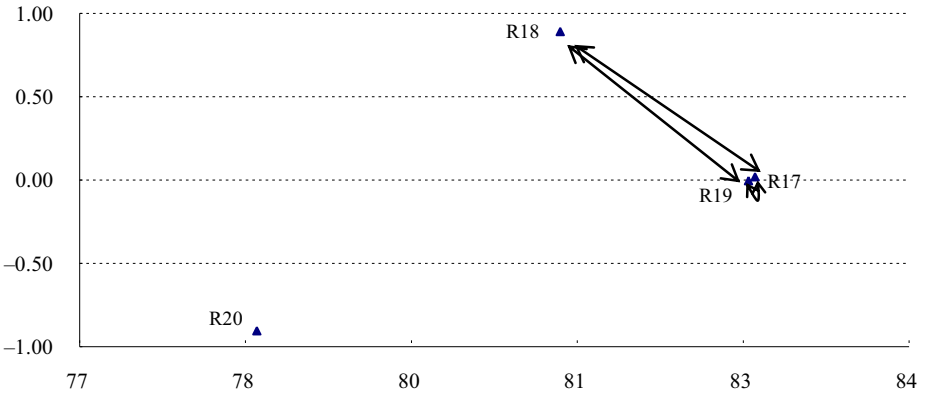

Figure 6.
Cause–effect among criteria of factor 5

important among these criteria. The (D − R) value of R8 is positive and the largest, thus showing it is the major criterion affecting others regarding the reliability factor.

Factor 3 responsiveness. Figure 4 shows any pair of criteria R9 (Librarians tell you exactly when services will be performed), R10 (Librarians provide prompt services), R11 (Librarians are always willing to help you) and R12 (Librarians are never too busy to respond to your requests) are mutually influenced. Criterion R11 is the most important and it is also the major criterion affecting others in the responsiveness factor.

Factor 4 assurance. Figure 5 shows any pair of criteria R13 (The behaviour of librarians instills confidence in users.), R14 (Readers feel safe in library transactions) and R16 (Librarians have the knowledge to answer your questions) are mutually influenced, except R15 (Librarians are consistently courteous with you). Criterion R15 is more independent than the others are. Therefore, it shows R15 is not an important issue in the assurance factor and R13 is the major criterion affecting the others.

Factor 5 empathy. Finally, looking at Factor 5, Table VI shows the (D + R) value of R19 (The library has your best interests at heart) is 82.611, which is the most important criterion in the empathy factor. Figure 6 also shows any pair of criteria R17 (The library gives you individual attention), R18 (The library's operating hours are convenient to

you) and R19 (The library has your best interests at heart) are mutually influenced. Likewise, based on the (D − R) value in Table VI, R18 is the major criterion affecting the others in the empathy factor.

Conclusion

In summary, the results show that the library should pay more attention to assurance, as it will lead to significantly improved results in library service quality. Factor empathy is a critical factor affecting the others, and the improvement of empathy can also result in better performance of other factors. This highlights the importance of initially understanding users' needs and then providing them with convenient and accurate service at the right time. Therefore, to enhance user satisfaction, it is necessary to train librarians to possess professional knowledge, communication skills and problem-solving abilities to respond to users at the right time. Based on the results, this study presents three improvement dimensions for library management to enhance service quality in the following areas:

Enthusiasm enhancement

There are two ways internal management can enhance staff enthusiasm. First, to address the concept of employee-oriented management: respect and trust for employees are fundamental to enhancing librarians' loyalty. Second, management should emphasize consideration as the central idea to deliver professional service and dedicated attention to patrons, as this will be the main approach to enhance service quality. Additionally, exploring librarians' innate ability to provide consistent work in their specialized fields by providing appropriate rewards will inspire librarians to be more enthusiastic.

Librarian training and standard operation

The best ways to reduce the gap between strategic goals and service performance are planning, designing, implementing and monitoring training programs on a regular basis. Gap analysis, training curriculum and final examination not only help upgrade skills to serve users but also help librarians understand the policies and to carry out the service concept in their daily work. Moreover, standardization is always the basis of management to make processes efficient. The four major dimensions that should be considered in developing standards are procedure, time, cost and quality. Each department should identify its standard operating procedures to guide librarians to be more efficient and also achieve consistent quality. By standardizing process time, the library can establish a clear service policy to strengthen readers' confidence in library processes. Cost standards can accompany operation and time standards, making it easy for management to analyse their performance and control costs and further establish service benchmarks. In particular, cost control is always a weapon used by organizations to strengthen its competitive edge. Finally, combining the three standards above with employee training will meet service quality standards and enhance reader satisfaction.

Prevention strategies

Websites, e-mail and customer comment cards are channels used to collect user complaints and opinions and to promote the efficiency of communication. Learning from experience and establishing better reporting systems and early warning mechanisms

prevents the repetition of mistakes. Thus, this paper suggests establishing a performance measurement system of service quality and linking it to the employee's reward system to motivate librarians and increase their vigilance.

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