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Discussion on the Construction of SWPU Smart Library Evaluation Indicator System

Yihan Xu, Yunjie Dai

Faculty of Economics and Management, Southwest Petroleum University, Sichuan, China

Abstract: With the rapid development of information technology, especially the wide application of artificial intelligence, big data and cloud computing and other technologies, the management mode of libraries is also undergoing a profound change. From the traditional management mode based on paper books, it is gradually transformed into a smart library mode characterized by digitization and intelligence. In this context, the construction of SWPU smart library has become an important issue. In order to ensure that the construction of SWPU smart library can keep pace with the times and meet the needs of teachers and students, this paper adopts the Delphi method to construct the evaluation indexes as well as the weights of the indexes, aiming to provide scientific and reasonable guidance for the construction level of SWPU smart library. In this paper, we first determined the evaluation index system of SWPU smart library, including smart technology and facilities, smart resources, smart services and other aspects. Then, we invited experts in the fields of library management and information technology to evaluate these indicators and their weights using the Delphi method. Through several rounds of solicitation and feedback, the experts reached a relatively unanimous opinion on the evaluation indicators and their weights of SWPU's smart libraries. On this basis, we conducted a comprehensive evaluation of the construction level of SWPU Smart Library and put forward corresponding suggestions for improvement. These suggestions will provide strong support for the future development of SWPU Smart Library so that it can better serve the students and faculty and promote the development of university education.

Keywords: Smart library, Evaluation index system, Delphi method.

1. Introduction

At present, China's college libraries are experiencing the transformation from the automation mode to the smart mode, the smart library is the inevitable trend of the development of college libraries, which is a higher stage of the development of traditional automated libraries and digital libraries, and is characterized by the establishment of an innovative form of fusion and development between the Internet of Things, Artificial Intelligence, Big Data, and other higher-level information technologies, and the management of libraries [1]. The construction of the evaluation index system can be used as a means to detect the operational efficiency and service level of intelligent library management, so as to improve its construction level. Aiming at this goal, this paper collects literature about smart libraries at home and abroad from various sources, combines the research experience of previous researchers, and explores the evaluation index system of SWPU smart library construction.

2. Analysis of the Current Situation of the Evaluation System Research of University Smart Libraries

The term smart library was first proposed by Aittola et al. as a mobile library service that is not limited by space and can be perceived, which can help users find the books and related materials they need [2]. Deng Lijun et al [3] proposed a smart library evaluation index system for user satisfaction based on the four modules of platform, space, resources, and services; Ye Jiyuan et al [4] constructed a quality evaluation index system that can be used for different levels and types of university libraries in China based on the theory of "full evaluation". The relevant research in foreign countries can be traced back to the last century. As early as the 1970s, R.H. Orr clearly put forward the evaluation of library service quality, and constructed a general framework of evaluation including six elements such as appropriateness, information, effectiveness and so on [5].

3. SWPU Smart Library Evaluation Index System Construction

Smart library is one of the important components of a university's smart campus construction, the State Council, the Ministry of Education and other institutions on the construction of smart campus and smart library construction issued a series of relevant standards and policy documents, according to these relevant standards and policy documents can be extracted key indicators for the evaluation of smart library.

3.1. Selection of Evaluation Indicators

The evaluation index system is composed of a series of interrelated evaluation indicators, which can be used to dynamically monitor the quality of economic activities and their effectiveness. The construction of the evaluation index system of the intelligent library should firstly meet the conditions linked to the characteristics of the intelligent library [6], so the first step in the selection of the evaluation index system is to extract the key indexes from the relevant policy documents and literature, as shown in Table 1 and Table 2.

Table1. Screening of key indicators based on relevant literature

Literature sources	Key indicators
A Survey of the Current Status of Intelligent Services in European and American Libraries	Smart Librarians, Smart Services, Smart Technologies and Facilities, Static Unpersonalized Recommendations, and Dynamic Unpersonalized Recommendations
Research on Evaluation Indicators of Comprehensive Capabilities of Smart Librarians	Intelligent environments, data analysis capabilities, competency evaluation

Table 2. Screening of key indicators against relevant policies and standards

Policy documents	Key indicators
Alliance for Building a New Generation Library Services Platform	Smart Resources, Disciplinary Services, Shared Data, Information Ecosystem, Cloud Service Platform, Intelligent Management, Smart Librarians, Librarian Satisfaction, Reader Satisfaction
Action Plan for Education Informatization 2.0	Networking, digitization, intelligence, personalization

In the process of establishing the indicator system, most of the existing studies use the Delphi method [6], while according to the subdivision of the research object, there is also a choice of methods such as the balanced scorecard (e.g., the establishment of the performance evaluation indicator system). The essence of the establishment of the indicator system is convergent, and all of them are centered on the goal of the system to set up the indicator system. The research objective of this paper is to evaluate the smart library of SWPU. Based on the establishment of the evaluation elements of smart library, combined with the relevant documents and standards of the Central People's Government, the Ministry of Education, the Ministry of Culture and Tourism, the National Development and Reform Commission, the Ministry of Finance, and the "Smart Library Co-innovation Alliance", and combined with the problems and development trends of the smart libraries of colleges and universities as mentioned in the literature, we will evaluate the smart libraries of colleges and universities by means of the following methods problems and development trends of libraries mentioned in the current literature, through two rounds of expert consultation, the evaluation index system framework for SWPU smart libraries was designed, and the results are shown in Table 3.

Table 3. SWPU Smart Library Evaluation Indicator System

Level 1 indicators	Level 2 indicators	Level 3 indicators	Level 4 indicators
smart library of SWPU	y1-Smart Technologies and Facilities	y11-Smart Technologies and Platforms	y111-5G, WIFI, IoT and other communication technologies
			y112-Intelligent Sensing Technology
			y113-Cloud computing technologies such as laas, Paas, Saas, etc.
		y12-Intelligent Devices	y121-Scanners, 3D printers and other equipment
			y122-Intelligent terminals for self-service borrowing and returning
			y123-Warehouse Intelligent Bookstore
	y2-Wisdom Resources	y21-resource building	y211-Staying on top of publishing
			y212-Ability to rationally screen users to recommend resources
		y22-Quality of resources	y221-Rapid download of electronic resources
			y222-Adequate paper resources
		y23-Resource environment	y231-Comfortable and clean environment
			y232-Signage is clear and aesthetically pleasing
	y3-Intelligent Services	y31-Think Tank Services	y311-Research Evaluation Services
			y312-Expert advice
		y32-Smart Referral Service	y321-Personalized Recommendations
			y322-Dynamic non-personalized recommendations as well as static non-personalized recommendations
	y4-intelligent librarian	y41-Core business competencies	y411-Reference advisory capacity
			y412-User Information Behavior Analysis Capability
		y42-overall quality	y421-service attitude
			y422-Professional Ethics
	y5-customer satisfaction	y51-Satisfaction with Intelligent Devices	y511-Own a smart device
			y512-Intelligent System Terminal Ease of Use
		y52-Intelligent Service Satisfaction	y521-Smart Library Portal
			y522-Self-service function

3.2. Setting the weights of evaluation indicators

There are many methods for setting the weights, and in this paper, we propose to use the AHP method. AHP is a simple decision-making method that decomposes the relevant factors that have an impact on the decision into three layers: objectives, criteria and programs, and makes quantitative and qualitative analysis through the relationship between these

factors. This method is widely suitable for integrated decision making with multiple levels and multiple objectives, and is used as a mathematical method to select the best one from the candidate plans influenced by multiple factors [7].

At the same time, in the subjective view of each decision maker, the different factors in the guideline layer in the relative to the target judgment in different proportions, because different people on the two-two comparison of the importance of the factors when the awareness of different people, so it should be established two-two judgment matrix, comprehensive assessment of the importance of the factors, the use of the saaty1-9 scaling method, the importance of matrix factors two-two comparisons and assignment of values are shown in Table 4:

Table 4. Definition of importance and assignment of values for matrix factor comparisons

scale	meaning
1	The element Ci is of equal importance compared to the element Cj
3	The Ci element has a slightly stronger impact than the Cj element
5	Ci elements compared to Cj elements, with the former having a strong impact
7	Ci elements compared to Cj elements, with the former having a significantly stronger influence
9	Ci elements compared to Cj elements, with the former definitely having a strong influence
2, 4, 6, 8	Ci elements compared to Cj elements, with the former having an impact between the two neighboring classes mentioned above
1,1/2, … …, 1/9	The ratio of the impact of element Ci compared to element Cj is exactly the reciprocal of aij

The judgment matrix is expressed in the form:

$$B=\begin{pmatrix} b11 & b12 & \cdots & b1n \\ b21 & b22 & \cdots & b2n \\ \cdots & \cdots & \cdots & \cdots \\ \cdots & \cdots & \cdots & \cdots \\ bn1 & bn2 & \cdots & bnn \end{pmatrix} \quad (1)$$

In this paper, the expert scoring method is used to determine the weight coefficients in the evaluation index system of SWPU smart library, and the questionnaire is distributed to 10 experts, each of whom identifies the indexes according to his or her own understanding. It should be noted here that each expert has a different value for the comparison between Ci and Cj, so the arithmetic average of each value will be processed in advance when forming the judgment matrix. In this paper, a total of 10 research questionnaires were distributed, 8 were recovered, and 5 were valid questionnaires. The weights are calculated in the following steps:

(1) Regularize each column of the judgment matrix (where Aij denotes the element of the jth column of the ith row of the judgment matrix; bkj denotes the element of the jth column of the kth row of the judgment matrix).

$$\overline{Aij}=\frac{Aij}{\sum_{k=1}^{n} bkj};i=1,2,\ldots\ldots,n \quad (2)$$

(2) Sum each column of the judgment matrix after regularization by rows (W refers to the weights and bij is the value of the ith row and jth column of the regularized judgment matrix).

$$Wi=\frac{1}{n}\sum_{j=1}^{n}\overline{bij};i=1,2,\ldots\ldots,n \quad (3)$$

(3) The maximum eigenvalue is calculated and used for consistency test later. Here the largest eigenroot must be greater than 0, then the corresponding eigenvector is positive and any other eigenroot |λ| of A must be less than the largest eigenroot λmax.

$$\lambda_{\max}=\frac{1}{n}\sum_{i=1}^{n}\frac{\left(\sum_{j=1}^{n} a_{ij}W_j\right)}{W_j};i,j=1,2,\ldots,n \quad (4)$$

(4) Consistency test, mainly calculate the consistency index CI and consistency ratio CR, CR < 0.1, judgment matrix consistency test passed.

$$CI=\frac{\lambda_{\max}-n}{n-1}$$

$$CR=\frac{CI}{RI} \quad (5)$$

The average consistency indicator RI is shown in Table 5:

Table 5. Average Consistency Indicator RI

ordinal number	1	2	3	4	5	6	7	8	9
RI	0.00	0.00	0.52	0.89	1.12	1.24	1.36	1.41	1.46

After completing the calculation of the single weight of each indicator, the next step is to carry out the calculation of the integrated weight of the indicator, which refers to the weight of the sub-criteria layer relative to the elements of the top layer [8], and is calculated by the formula:

$$W=W^{(1)}*W^{(2)}*W^{(3)} \quad (6)$$

W (1) denotes the weight of a level 2 indicator relative to a level 1 indicator, W (2) denotes the weight of a level 3 indicator relative to a level 2 indicator, and W (3) denotes the weight of a level 4 indicator relative to a level 3 indicator.

The final result is obtained as follows:

Table 6. SWPU Smart Library Evaluation Indicator Weights

Level 1 indicators	weights	Level 2 indicators	weights	Level 3 indicators	weights	Level 4 indicators	weights
smart library of SWPU	100%	y1-Smart Technologies and Facilities	34.74%	y11-Smart Technologies and Platforms	11.58%	y111-5G, WIFI, IoT and other communication technologies	7.50%
						y112-Intelligent Sensing Technology	2.66%
						y113-Cloud computing technologies such as laas, Paas, Saas, etc.	1.41%
				y12-Intelligent Devices	23.16%	y121-Scanners, 3D printers and other equipment	9.93%
						y122-Intelligent terminals for self-service borrowing and returning	9.93%
						y123-Warehouse Intelligent Bookstore	3.30%
		y2-Wisdom Resources	34.74%	y21-resource building	6.95%	y211-Staying on top of publishing	1.15%
						y212-Ability to rationally screen users to recommend resources	5.79%
				y22-Quality of resources	20.84%	y221-Rapid download of electronic resources	10.42%
						y222-Adequate paper resources	10.42%
				y23-Resource environment	6.95%	y231-Comfortable and clean environment	3.48%
						y232-Signage is clear and aesthetically pleasing	3.48%
		y3-Intelligent Services	12.02%	y31-Think Tank Services	3.00%	y311-Research Evaluation Services	0.75%
						y312-Expert advice	2.25%
				y32-Smart Referral Service	9.01%	y321-Personalized Recommendations	6.75%
						y322-Dynamic non-personalized recommendations as well as static non-personalized recommendations	2.25%
		y4-intelligent librarian	12.02%	y41-Core business competencies	1.50%	y411-Reference advisory capacity	1.24%
						y412-User Information Behavior Analysis Capability	0.25%
				y42-overall quality	10.51%	y421-service attitude	8.75%
						y422-Professional Ethics	1.75%
		y5-customer satisfaction	6.48%	y51-Satisfaction with Intelligent Devices	4.86%	y511-Own a smart device	3.64%
						y512-Intelligent System Terminal Ease of Use	1.21%
				y52-Intelligent Service Satisfaction	1.62%	y521-Smart Library Portal	0.81%
						y522-Self-service function	0.81%

4. Conclusion

The smart library is an important part of the smart campus construction and is the forerunner of the smart campus construction. The development of smart libraries leads the dynamic change of the evaluation system, which in turn can dynamically detect the construction level of smart libraries. This paper, by combing relevant literature and policy documents, and then combining the Delphi method, firstly, derives the evaluation indexes of SWPU's smart libraries; secondly, by using a combination of expert scoring and questionnaire research, we derive the weights of the evaluation indexes; finally, we derive that in the evaluation of smart libraries in SWPU, the importance of smart technologies and facilities and smart resources is the greatest, the importance of smart services and smart librarians is the second greatest and the importance of user satisfaction is relatively low. This conclusion has some guiding significance for the construction of smart libraries. At the same time, there are many shortcomings in this paper, the smart library is a dynamic development process, with its development, the evaluation index system should also have timely and appropriate updates, so the sustainable development of the evaluation index system has to continue to study.

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