Research on Multi-level Extension Optimal Decision Analysis of Network Digital Library Resources

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Abstract. Network digital libraries have exploded in recent years, with numerous and complicated evaluation indicators. The main body of evaluation is gradually showing the diversification characteristics of evaluation objects, and comprehensive evaluation standards. In order to better ensure the overall quality and construction level of network digital library resources, this research innovation incorporates multi-level extension optimization evaluation. Based on the network digital library, a multi-level extension optimization decision-making mechanism combining qualitative and quantitative is proposed. It has developed a new direction and provided new ideas for the resource quality and data evaluation of the future network digital library.

Keywords: Network Digital Library, Multi-level Extension, Optimization Method, Comprehensive Evaluation

1. Introduction
With the development of network technology, the application of computers has become more diverse, which also indicates that the era of network information technology has arrived. The application of network technology has revolutionized the traditional information transmission mechanism and has become an important carrier for social information storage and release. It is widely used in important social organizations and industries such as government, schools, culture, etc., effectively promoting the development of society [1]. In recent years, the hot application area is the network digital library. However, with the increasing complexity of information and cultural resources and the diversified development of information services, people's scientific and objective evaluation of online book information resources has become a major problem that plagues development. Therefore, this research will integrate extension optimization decision-making in the research of network digital library resources, strengthen the current evaluation ability of network digital library resources, and build a multi-level extension optimization decision model to strengthen the multi-level evaluation index angle of the network digital library [2].

2. Construction of Evaluation Index System
There are many factors that affect the resources of online digital libraries which have complexities. High-quality network digital library resources are based on the level of software and hardware,
personnel, and user interaction. Therefore, the quality of the network digital library is closely related to the composition of the library. The most important of these are the four aspects of network facilities, contents, service methods and service effects of the network library, as shown in Figure 1.

![Figure 1. Resource Evaluation Index System of Network Digital Library](image)

3. **Multi-level Extension Evaluation Mode**

Extension theory was first proposed by Chinese scholar Cai Wen in 1983, and extension evaluation is one of the most commonly used theories in extension theory. The extension evaluation method used in the past can only perform a single evaluation on the evaluated object. While researching the integration of multi-level evaluation systems, a single extension evaluation can no longer meet the current evaluation needs [3]. The multi-level extension evaluation used in this research can effectively evaluate the second-level indicators, and then start the first-level evaluation on the basis of the second-level evaluation. Extension evaluation based on multi-level evaluation can not only obtain the grade attribute of the evaluated object, but also obtain the secondary evaluation index, so as to understand the actual state of the evaluated object more comprehensively.

3.1. **Determine the Relative Importance of Evaluation Indicators and Construct a Judgment Matrix**

3.1.1. **Determine the judgment matrix.** The importance of the calibration index is the first step in the development of qualitative evaluation to quantitative evaluation. The relative degree of importance is based on the comparison of the two indicators. The values of the importance of these evaluation indicators are provided by relevant professionals or experts, or pre-consulted data, so as to construct a judgment matrix on this basis [4].

The creation of the judgment matrix is an important step before the evaluation index weight judgment. Each element in the judgment matrix represents the ratio of the relative importance of the
evaluation index to the overall goal of the network digital library resource evaluation. When constructing the judgment matrix, a team of experts familiar with the network digital library should be formed to provide relevant index values. The following is the resource evaluation index system of network digital library constructed in this research. The standard layer A in the district is the judgment matrix for evaluating the overall target U, which is shown as below.

\[
R = \begin{pmatrix}
A1/A1 & A1/A2 & A1/A3 & 1/4 & 1/5 & 1/7 \\
A1/A4 & 4 & 1/4 & 1/5 \\
A2/A1 & A2/A2 & A2/A3 & 1 & 4 & 1/4 \\
A2/A4 & 2 & 1 & 4 & 1
\end{pmatrix}
\]

3.1.2. Calculate the weight. The method of weight calculation in this study is the AHP geometric average algorithm. The first is to take the continuous multiplier of each element in the matrix and extract the square to obtain the average value of different elements, and then normalize the obtained average value, and then the obtained value is the required weight value. Take the A layer of the resource evaluation system of the network digital library in this study as an example:

The average value obtained according to the judgment matrix is as follows:

\[
\begin{align*}
A'1 &= 4\sqrt{1 \times 1/4 \times 1/5 \times 1/7} = 0.0286 \\
A'2 &= 4\sqrt{4 \times 1 \times 1/4 \times 1/5} = 0.4 \\
A'3 &= 4\sqrt{1 \times 4 \times 1 \times 1/4} = 4 \\
A'4 &= 4\sqrt{2 \times 1 \times 4 \times 1} = 22.6274
\end{align*}
\]

The calculation formula for normalization is:

\[
W_i = W'_{ji} / \sum W'_{ji}
\]  

Substituting the values obtained from the judgment matrix into the formula will obtain the following data:

\[
\begin{align*}
\sum W'_{ji} &= 0.0286 + 0.4 + 4 + 22.6274 = 27.056 \\
W1 &= 0.0286/27.056 = 0.0011 \\
W2 &= 0.4/27.056 = 0.0148 \\
W3 &= 4/27.056 = 0.1478 \\
W4 &= 22.6274/27.056 = 0.8363
\end{align*}
\]

Therefore, the four weights of the obtained A-level criteria A1, A2, A3, and A4 are 0.0011, 0.0148, 0.1478, and 0.8363, respectively.

3.2 First-level Evaluation
The first-level evaluation is carried out for each A-level data, and the correlation matrix of each resource in the first-level index is calculated through the second-level index weight \(A_i = (A_{ik})\) and the correlation matrix \(K(B_{ik}) = (k_i(B_{ik}))\) of each corresponding sub-factor.
Among level 1 indicators, weight is determined through analysis, scoring by professionals, and then the final score is obtained by multiplying the score and the weight value [5]. According to the digital library information service quality evaluation system, after evaluating a certain digital library, the grades and scores of various indicators are shown in the following table.

Through Table 1, the multi-level extension selection decision adopted in this research can not only evaluate the various indicators of the library, but also evaluate and compare different modules of the library. The final scores can be combined to obtain a comprehensive library index [6].

\[
K_{1}(B_{1}) \quad K_{2}(B_{1}) \quad \ldots \quad K_{m}(B_{1})
\]

\[
K(B_{j}) = (K_{j}(B_{1})) = [w_{1j}, w_{2j}, \ldots, w_{mj}]
\]

\[
K_{1}(B_{2}) \quad K_{2}(B_{2}) \quad \ldots \quad K_{m}(B_{2})
\]

Where \( k_{j}(B_{ik}) \) is the relevance degree of the k-th second-level index in the i-th first-level index with respect to level j, calculated as follows:

\[
k_{j}(B_{ik}) = \frac{p(v_{ik}, V_{j})}{p(v_{ik}, V_{j}) - p(v_{ik}, V_{j})}
\]

\[
p(v_{ik}, V_{j}) = \left| v_{ik} - \frac{a_{ji} + b_{ji}}{2} \right| - \frac{1}{2}(b_{ji} - a_{ji})
\]

\[
p(v_{ik}, V_{u}) = \left| v_{ik} - \frac{a_{ui} + b_{ui}}{2} \right| - \frac{1}{2}(b_{ui} - a_{ui})
\]

3.3 Secondary Evaluation

Among them, the second-level indicators are calculated through the weight vector \( w = (w_{j}) \) of the first-level indicators and the correlation degree \( K(B) = (K(B_{j})) \) of the first-level indicators to each risk level.

\[
K_{1}(B_{1}) \quad K_{2}(B_{1}) \quad \ldots \quad K_{m}(B_{1})
\]

\[
K(t) = [w_{1}, w_{2}, \ldots, w_{m}]
\]

\[
K_{1}(B_{2}) \quad K_{2}(B_{2}) \quad \ldots \quad K_{m}(B_{2})
\]

\[
= [-0.6052 \quad -0.2209 \quad -0.1399 \quad -0.1594]
\]
Table 1. Multi-level evaluation decision table for digital library resources

| Index | A1 | A2 | A3 | A4 |
|-------|----|----|----|----|
| Weights | 4.6 | 10 | 22.4 | 45.9 |
| Grades | B1 | B2 | B3 | B4 | B5 | B6 | B7 | B8 | B9 | B10 | B11 | B12 | B13 | B14 | B15 |
| Scores | 85 | 88 | 80 | 70 | 75 | 85 | 90 | 90 | 85 | 70 | 88 | 90 | 85 | 86 | 75 |
| Sum | 78.3 |

5. Opinions on the Optimization and Improvement of Digital Library Resources

5.1. Automation and Network Construction
The network digital library is a cultural service integrated website based on the Internet. Its automation, intelligence, and network development are the foundation for building informational book services. Among them, attention should be paid to the book management system, server construction, website structure, online reading, and network environment optimization.

5.2. Information Technology Construction
The construction of a network digital library requires the close integration of various functions, and the construction of a digital library cannot do without advanced technical means. Information technology is an important support for the operation of digital libraries, which is the basic technology construction for libraries to achieve resource opening and sharing [7].

5.3. Information Resource Construction
The information resources of the network digital library are the basic data structure and core resources of the library. It is the necessary foundation for the normal operation of the digital library, which is mainly divided into the following two types. The first is to carry out the data construction of traditional offline library resources and purchase various online digital information; the other is to collect and process a variety of information online [8]. In view of the forward-looking tendency of more and more scholars and users in the demand for book resources at this stage, online libraries should focus on primary literature, supplemented by secondary bibliographic database construction. This allows users to use the Internet to quickly retrieve the required bibliographies and documents, rather than simple document addresses [9].

6. Conclusion
The multi-level extension optimization decision analysis research carried out in this research uses the establishment of a complete network digital library evaluation index system, analyzes the weight of each index, and determines the importance of each index resource. In this way, a more comprehensive and complete assessment of the quality of network digital library resources can be carried out. This method can be realized by computer, which is faster, more convenient, and more reliable, and the final result has higher credibility. It provides a reliable and quantitative data basis for the overall evaluation of network digital library resources. Because of the particularity of the network digital library, the construction of the resource evaluation index system of the network digital library should conform to the actual inclusion of the digital library, so as to achieve a reasonable and comprehensive optimization of the index system [10].

Acknowledgments
This work was financially supported by:
1. The subject of Hunan Provincial Social Science Achievement Review Committee. Research on Multi-level Extension Optimal Decision Analysis of Network Digital Library
Resources.(NO.XSP21YBC460)
2. Collaborative Education Program of Industry and Education of Ministry of Education in 2019. Practice of school-enterprise cooperative innovation and entrepreneurship education reform in computer specialty.(No.201902167047)
3. Research project of teaching reform in universities of Hunan province in 2020,Research on the Practice of "Professional +" Innovation and Entrepreneurship Education under the Background of Innovative Industry Cluster.(No.HNJF-2020-0934)

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