

Evaluation Method Of Rehabilitation Education For Children With Intellectual Disabilities Based On Fuzzy Comprehensive Evaluation Model -A Case Study Of A District In A City

Ke Zhao^{1,a}, Liyuan Cai^{2,b}, Pan Du^{3,c}, Yanan Miao^{4,d*}

^a38024084@qq.com, ^b8415708@qq.com, ^c23692035833@qq.com

* Corresponding author: ^dmiaoyanan33@163.com

¹Chengdu Technological University, Department of Network & Communication Engineering, Chengdu, China

²Chengdu Technological University, Department of Big Data and Artificial Intelligence, Chengdu, China

³Chengdu Technological University, Department of Big Data and Artificial Intelligence(Graduate), Chengdu, China

⁴Chengdu Technological University, Department of Network & Communication Engineering, Chengdu, China

Abstract—With the implementation of the policies of rehabilitation assistance and rehabilitation education for disabled children in our country, the number of rehabilitation institutions for disabled children is increasing rapidly. Strengthening the supervision of rehabilitation education institutions for disabled children and ensuring the quality of rehabilitation education has become an urgent problem to be solved. In this paper, three private rehabilitation institutions for children with intellectual disabilities in a certain district of a city are taken as the research object. Based on on-site investigation data of the institutions, nine indices from three dimensions included the hardware facilities, business development, and personnel configuration are selected to establish an evaluation index system for rehabilitation education in rehabilitation institutions for children with intellectual disabilities to construct and solve the evaluation model of rehabilitation education in rehabilitation institutions for children with intellectual disabilities based on fuzzy comprehensive evaluation method.

Keywords-children with intellectual disabilities; rehabilitation education; evaluation index system; evaluation model introduction

1. Introduction

The issue of rehabilitation assistance and education services for disabled children has received considerable attention over the years in our country. Since 2017, the State Council has issued the "Regulations on Disability Prevention and Rehabilitation of Disabled Persons" "Opinions on Establishing a Rehabilitation Assistance System for Disabled Children". The state provides rehabilitation assistance and education to disabled children and autistic children aged 0-6 years old with vision, hearing, speech, limbs, and intelligence. The social institutions actively respond to the call and establish the disability rehabilitation institutions. By the end of 2021, the total number of disability rehabilitation institutions in China has reached 11,260, and the number of

on duty personnel in rehabilitation institutions has also reached 318,000. 363,000 disabled children aged 0-6 has received the basic rehabilitation services [1]. However, how to strengthen and standardize the management of rehabilitation service institutions for disabled children and ensure the level of rehabilitation education has become an urgent problem to be solved.

The existing studies mostly adopted the third-party evaluation methods to improve the management efficiency and enhance the educational effectiveness. At present, many explorations have been conducted on this issue both domestically and internationally. However, most of them apply the SPSS related statistical software to analyze the subjective-objective dimensions that affect educational effectiveness, and the practicality of combining with practice needs to be strengthened. Firstly, this paper constructs an evaluation index system of rehabilitation education in rehabilitation institutions for children with intellectual disabilities, and calculates the weight set of the index system by combining subjective and objective weight. Then, constructs a factor set evaluation comment set of rehabilitation education evaluation of rehabilitation institutions for children with intellectual disabilities, and obtains the single factor evaluation matrix of each index through the membership function, and the evaluation model is finally solved to construct and solve the evaluation model of rehabilitation education in rehabilitation institutions for children with intellectual disabilities based on fuzzy comprehensive evaluation method. The reasonable and feasible evaluation method of rehabilitation education is explored and constructed to further standardize management and strengthen supervision.

2. Rehabilitation Education Evaluation Problem Description and Evaluation Index Selection

2.1 Problem Description and Technical Route of Rehabilitation Education Evaluation

In recent years, the standardization of rehabilitation education for disabled children from the aspects of object, content, process and fund guarantee has realized the universal welfare. The demands for rehabilitation education and other services for children with intellectual disabilities are diversified and personalized in our country, and as high as 98.26 % [2]. The government adopts the way of government purchase services to meet the demands, entrusts the professional rehabilitation education to hospitals, rehabilitation centers, special education schools, and rehabilitation equipment companies, establishes and improves the management system of rehabilitation education for disabled children, and introduces the third-party institutions as a supervisor of the quality of education services to carry out rehabilitation education quality evaluation [3]. However, the existing measure for supervision is only the "Implementation Measures for the Agreement Management of Fixed-point Service Institutions for Rehabilitation and Assistance of Disabled Children (Trial)" issued by China Disabled Persons' Federation in 2021, which still lacks accuracy and practicality in the actual evaluation. In this paper, the fuzzy comprehensive evaluation method combining subjective and objective weight calculation is used to evaluate and analyze the on-site rehabilitation education investigation data from three rehabilitation institutions for children with intellectual disabilities in a certain district of a city. The evaluation model of rehabilitation education for children with intellectual disabilities based on fuzzy comprehensive evaluation method is established, and a reasonable and feasible evaluation method of rehabilitation education is explored. These three institutions are

represented by institution A, institution B and institution C respectively. The specific work is shown as follows:

- Construct the index weight set A;
- Construct a fuzzy evaluation matrix R;
- Conduct a multi-level fuzzy comprehensive evaluation system.

The specific technical route is shown in Fig. 1.

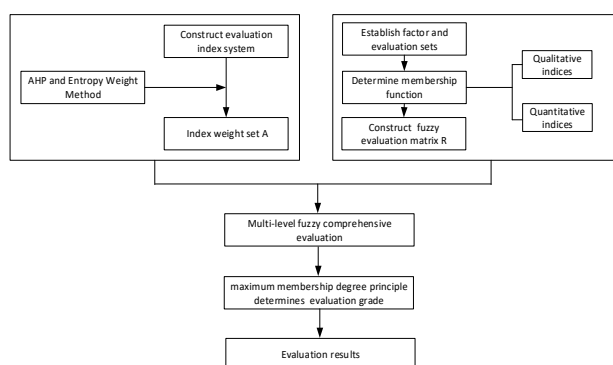


Figure 1. Fuzzy comprehensive evaluation model.

2.2 Index Selection of Rehabilitation Education Evaluation

Three types of evaluation factors that affect the rehabilitation education of rehabilitation institutions for intellectual disabilities are selected in this paper.

- The evaluation indices related to equipment, facilities and locations include the per capita usable area of collective training room, per capita usable area of group training room, and per capita usable area of individual training room.
- The evaluation indices related to rehabilitation education function include the total duration of rehabilitation education for children in training, daily rehabilitation education duration, and the number of social integration activities per month.
- The evaluation indices related to personnel configuration include the education background of rehabilitation education personnel, professional background information, and the teacher-student ratio of children in training.

Since the influence of each index on the comprehensive evaluation of institutional rehabilitation education is different, this paper adopts the combination of Analytic Hierarchy Process (AHP) and Delphi Method to determine the weight of each evaluation index and generate the weight set A. The specific methods are shown as follows.

- Collect relevant data of rehabilitation schools and establish a hierarchical structure of evaluation indices. They include: the evaluation indices related to equipment, facilities and locations include the settings and facilities, scale, various types of rooms, training rooms, and per capita usage data; the evaluation indices related to business function include the duration, frequency and quality of rehabilitation education, and social integration activities; the

evaluation indices related to personnel configuration include the education background of rehabilitation education personnel, professional background information, the teacher-student ratio of children in training, and education background and professional background of backbone teachers. Each evaluation index is divided into four levels: better, good, general and bad.

- The weight set is determined after completing the index selection. The analytic hierarchy process and entropy weight method are applied to calculate weight set of evaluation indices of rehabilitation institutions for children with intellectual disabilities from both subjective and objective perspectives after establishing a hierarchical structure model, constructing a comparison matrix, sorting a single-layer and testing the consistency. The final weight set A can be obtained by the multiplicative normalization assignment method. The final weight value of each index is shown in Table 1.

Table 1. Evaluation index weight set of rehabilitation institutions for children with intellectual disabilities based on combined weight method

Index	Weight
Per capita usable area of collective training room(C1)	0.135
Per capita usable area of group training room(C2)	0.067
Per capita usable area of individual training room(C3)	0.073
Total duration of rehabilitation education for children in training(C4)	0.181
Daily rehabilitation education duration(C5)	0.054
Number of social integration activities per month(C6)	0.118
Education background of rehabilitation education personnel(C7)	0.159
Professional background of rehabilitation education(C8)	0.133
Ratio of rehabilitation personnel and children in training(C9)	0.084

The final weight set A can be obtained as follows:

$$A = (0.135, 0.067, 0.073, 0.181, 0.054, 0.118, 0.159, 0.133, 0.084) \quad (1)$$

3. Establishment of rehabilitation education evaluation model

The membership function of quantitative index is established by adopting trapezoidal and semi-trapezoidal functions after many calculations and tests. The unreasonable phenomenon caused by the sudden change of adjacent grading points can be eliminated by selecting the data of adjacent grading points for transition since the influencing factors of grading points on the evaluation of rehabilitation education in rehabilitation institutions for children with intellectual disabilities have ambiguity which is not a sudden change [4]. The triangular function is used to establish the membership function of qualitative index in this paper which is convenient to construct the membership function and construct the fuzzy relation matrix. It can be seen from equation (2) to equation (4).

The first level can be described as:

$$A_{i1} = \begin{cases} 1, x \leq k_{i1} \\ \frac{k_{i2}-x}{k_{i2}-k_{i1}}, k_{i1} < x < k_{i2} \\ 0, x \geq k_{i2} \end{cases} \quad (2)$$

The second and third levels can be described as:

$$A_{ij} = \begin{cases} \frac{x-k_{ij}}{k_{ij+1}-k_{ij}}, k_{ij} < x \leq k_{ij+1} \\ \frac{k_{ij+2}-x}{k_{ij+2}-k_{ij+1}}, k_{ij+1} < x < k_{ij+2} \\ 0, x \leq k_{ij} \text{ or } x \geq k_{ij+2} \end{cases} \quad (3)$$

The fourth level can be described as:

$$A_{i1} = \begin{cases} 0, x \leq k_{i4} \\ \frac{x-k_{i4}}{k_{i5}-k_{i4}}, k_{i4} < x < k_{i5} \\ 1, x \geq k_{i5} \end{cases} \quad (4)$$

A single factor fuzzy set $r_i = \{r_{i1}, r_{i2}, \dots, r_{im}\}$ can be obtained by evaluating each index of the membership function constructed above[5]. Among them, $r_{i1}, r_{i2}, \dots, r_{im}$ respectively represent the membership degrees of the i -th factor at better level, good level, general level and bad level.

The following membership matrix R can be obtained, as shown in equation (5).

$$R = \begin{bmatrix} r_{11} & r_{12} & \dots & r_{14} \\ r_{21} & r_{22} & \dots & r_{24} \\ \dots & \dots & \dots & \dots \\ r_{91} & r_{92} & \dots & r_{94} \end{bmatrix} \quad (5)$$

The membership degree of each evaluation index is obtained by the membership function constructed by Python. There are a total of 9 evaluation indices, and each single factor index has 4 spatial fuzzy evaluation results, and finally a 9×4 matrix is obtained.

4. Solution of rehabilitation education evaluation model

The fuzzy change model for the comprehensive evaluation of rehabilitation education in rehabilitation institutions for children with intellectual disabilities in this paper is shown in equation (6).

$$B = A \cdot R = (a_1, a_2, \dots, a_9) \begin{bmatrix} r_{11} & r_{12} & \dots & r_{14} \\ r_{21} & r_{22} & \dots & r_{24} \\ \dots & \dots & \dots & \dots \\ r_{91} & r_{92} & \dots & r_{94} \end{bmatrix} = (b_1, b_2, \dots, b_4) \quad (6)$$

Python is used to perform fuzzy transformation on the single factor fuzzy sets of institution A, institution B and institution C, and the evaluation results are shown in Table 2.

Table 2. Fuzzy transformation results of rehabilitation institutions A, B and C for children with intellectual disabilities

Institution name	Level 1	Level 2	Level 3	Level 4
A	0.437	0.146	0.248	0.169
B	0.220	0.498	0.180	0.102
C	0.174	0.268	0.439	0.119

It can be concluded that the level of Institution A is Level 1 (better), Institution B is Level 2 (good), and Institution C is Level 3 (general) from Table 2.

5. Conclusions

The comprehensive evaluation of fuzzy comprehensive evaluation process is realized by Python in this paper. The on-site data of rehabilitation institutions for children with intellectual disabilities are collected to conduct fuzzy comprehensive evaluation and analysis and establish a rehabilitation education evaluation model of rehabilitation institutions for children with intellectual disabilities. Three private rehabilitation institutions for children with intellectual disabilities in a certain district of a city are taken as the research object. Based on on-site investigation data of the institutions, combined with the research results of relevant scholars and relevant national policies and documents, nine indices from three dimensions included the hardware facilities, business development, and personnel configuration are selected to establish an evaluation index system for rehabilitation education in rehabilitation institutions for children with intellectual disabilities. The weight values are calculated by the combination of Analytic Hierarchy Process (AHP) and Entropy Weight Method for comprehensive evaluation and analysis. Finally, the evaluation results of rehabilitation education in the evaluated institutions are obtained. A reasonable and feasible evaluation method of rehabilitation education is explored and constructed. According to the evaluation indices and conclusions, the rehabilitation education guidance will be carried out in the following aspects.

- Rehabilitation institutions need to play a crucial role in further improving the education evaluation, functional training, improvement of rehabilitation education level and professional service quality.
- "Internet +" rehabilitation education service and rehabilitation education service model need to be developed and innovated. It will play an important role in science and technology by making full apply of new technologies such as Big Data, Internet of Things, and Cloud Computing.
- Evaluation method of rehabilitation education needs to be improved to play a regulatory role. The accuracy and practicability of this evaluation method need to be further studied and improved.

References

- [1] H. M. Zhang. Rehabilitation assistance for disabled children in China: evolution, path characteristics and institutionalization. *Social Security Review*, 2023, 3, pp. 106-120.

- [2] R. X. Ding, Y. F. Cheng, and X. Y. Zheng. Analysis of health service utilization and demand of mentally disabled children in China. *Theory and practice of social rehabilitation*, 2021,2, pp. 243-248.
- [3] K. Cheng. Promote full coverage of education for eligible disabled children and adolescents. *Special Education in China*, 2021,7, pp. 3-5.
- [4] B. Song, S. Hao, and S. Murakamil. Comprehensive Evaluation Method on Earthquake Damagelsing Fuzzy Theory. *Journal of Urban Planning and Development*, 1996, pp. 122.
- [5] G. Annadurai, R. Babu, and V. R. Srinivasam. Mathematical modeling of pheno1 degradation system using fuzzy comprehensive evaluation. *Bioprocess Engineering*, 2000, 23, pp. 599-606.