

## Research Article

# Strategies for the Architectural Space Design of Special Education Resource Center in China

Xin Ge <sup>1</sup> and Xin Tian<sup>2</sup>

<sup>1</sup>College of Landscape Architecture & Arts, Northwest A&F University, Yangling 712100, China

<sup>2</sup>Shaanxi Province Institute of Water Resources and Electric Power Investigation and Design, Xi'an 710004, China

Correspondence should be addressed to Xin Ge; [xjtugexin@163.com](mailto:xjtugexin@163.com)

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In view of the current problems in China's special education resource centers, such as lack of functional cognition and unreasonable architectural function and spatial organization, which result in the inability to coordinate regional education resources, the formulation and implementation of special education ISP program are undertaken, and the development of integrated education is promoted. This paper draws on the concept of integrated education in developed areas and the design wisdom of resource centers. The research is carried out from the perspective of meeting the behavior patterns and special needs of different users, and the perfect and reasonable functional composition and the key points of special space design are put forward, and the feasible design strategies are expressed through establishing the model and plane layout.

## 1. Introduction

Disabled students not only have special needs due to physical and mental disabilities but also vary according to the degree of disability, recovery, and social adaptability of individual. Western countries have incorporated individualized education plans into the law and carried out the construction of special education resource centers. As early as 1975, the United States Education Law stipulated that every student with a disability should be provided with an individual support plan for education program adapted to his or her personal development needs. Later, European countries also included it as a mandatory requirement in the Act successively, and schools and other relevant educational and medical institutions formed resource centers to develop long-term, medium-term, and short-term individual education plan for each disabled student and to implement educational intervention through the combination of collectivized and individualized teaching [1]. China's special education started late, and it was not until 2017 that the implementation of individual education plan was listed in the Education Regulations for Persons with Disabilities and

also put the implementation of individualized education plans and the construction of special education resource centers as the top priority of current work [2].

In recent years, 26 provinces (cities) in China have established special education guidance centers; in addition to Shanghai, Beijing special education development leading areas established entities and other areas are still to be implemented. Based on the latest "Statistics of the Ministry of Education," there are now more than 2,200 special education schools in China with about 800,000 students [3]. About 80 percent of school-age children receive instruction in regular or special schools. These special students almost all receive collectivized education in school and urgently need to implement the one-person-one-case diagnosis, treatment, and rehabilitation individual education program [3].

The special education resource center is a new type of building, and the research in the field of architecture has not been carried out in China. At present, Shanghai special education resource center, a typical representative of the advanced level in China, has a certain scale and can operate independently, but there are many problems in architectural function configuration, planning layout, spatial

organization, and other aspects, which cannot form an effective linkage with other schools in the region to provide individual tracking support [4, 5]. Resource center plays a crucial role for special children's physical and mental health development in order to solve the present problems existing in the resource center building function and space at the early age of special education development in China and to provide theoretical basis and practice guidance on architectural space design for the future. It is urgent and necessary for this paper to make an in-depth study of the space structure of special education resource center in view of its current situation and demand of space using.

## 2. Development and Function Orientation of Special Education Resource Center

*2.1. Development and Evolution of Special Education Resource Centers.* Throughout the development history of special education, it develops towards integration education. Students with physical and mental disorders have the dual special needs of "medical treatment" and "teaching" [6]. The combination of medical treatment and education under the concept of integrated education is the trend of its development. The history of special education in the west has always covered the concept of medicine, and its development has mainly experienced three periods [7]. First of all, it is originated in medicine in the early 16th century, involving individual interventions by doctors and missionaries. By the end of the 16th century, it had gradually developed into a conservation institution based on the monastery, which carried out special medical treatment and rehabilitation for the children of the nobility. It was not until the 18th century that the world's first schools for the deaf and the blind were established and that the transformation from medicine to special education combining medicine and education began. Since the 1960s, the education of special students and ordinary students has been integrated, which advocates the return to the mainstream of society. The ISP program was proposed in 1975. In order to promote the implementation, the international Salamanca Declaration and Programme of Action in 1994 specifically proposed the construction of a special education resource center. Since the beginning of the 21st century, the United States, Norway, Australia, and other developed countries have set up special education resource centers to provide services and support for a series of personalized programs (ISP) in families, schools, hospitals, and communities.

China's special education derived from pedagogy and later developed into the combination of medical education under the concept of integrated education. It is proposed to establish the regional special education resource center, promote the integration and individualized development of education, and advocate the return to society with socialized development of each student with physical and mental disabilities [6, 8–11] (Figure 1).

*2.2. Function Orientation of Special Education Resource Center.* Special education schools in the west are generally

taken as resource centers, which provide rehabilitation training for students and consultation and training for parents and even teachers and also carry out multidisciplinary integrated academic research. On the one hand, it provides students with diagnostic assessments and individualized education plan services; on the other hand, it assumes the function of subject research and integrates all kinds of resources, playing a core role in the professional support of special education. For example, the Perkins School for the Blind in the United States has set up four departments, including Comprehensive Centers, Regional Education Laboratories, Vocation, and Raise. which provides ISP programs to families, schools, and districts with disabled children, including technology, funding, education training, as well as rehabilitation and employment assistance services (Figure 2).

China's special education system only includes education resources [12]; the functions of resource center are diagnostic evaluation, experiment research, rehabilitation training, demonstration, information consultation, and management services, including research, formulation, and implementation of individual support plan, tracking guidance for students of all ages, demonstration teaching and guidance for all kinds of schools and teachers along with physicians in the region, as well as participation in the organization of related social resource activities [13–15].

The Resource Center provides professional support to students from special schools, ordinary schools, family education, and other groups with disabilities of all ages, guides the construction of resource classrooms in various schools, and promotes the development of in-class study and integrated education [16–19] (Figure 3).

## 3. Status Survey of Special Education Resource Centers in Shanghai, China

*3.1. Investigation on the Status of Space Use.* It is typical to select resource centers in Shanghai for investigation, among which the first entity resource center in China was established in Changning District of Shanghai in 2011 [20–22]. According to the field investigation, the resource center plays a role in information consultation and rehabilitation training. However, due to the lack of cognition and research on its functions, there are many unreasonable architectural spaces, and the functions of diagnosis and evaluations, tracking and guidance, experimental research, and teaching demonstration cannot meet the expectations. The results of the survey on the frequency of use of various types of houses in the existing resource centers, the satisfaction, and demands of users are shown in Figure 4.

Teachers and doctors reflect that (1) the current functions are not perfect. The centers can only carry out the most basic diagnostic evaluations for a small number of students with mild impairment, and the diagnostic evaluation and experimental research for the vast majority of complex conditions cannot be carried out. Therefore, it is not possible to develop ISP programs for students, implement individual follow-up assessments and guidance, and teach demonstration and guidance to other schools. (2) As for students'

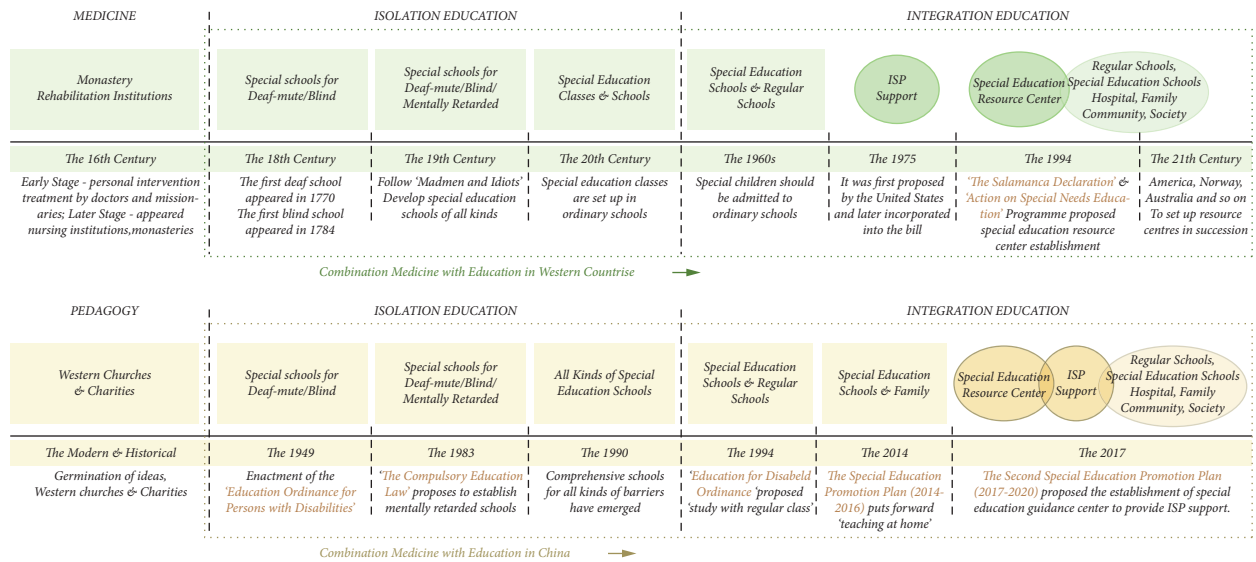


FIGURE 1: Development stages of integrated education.

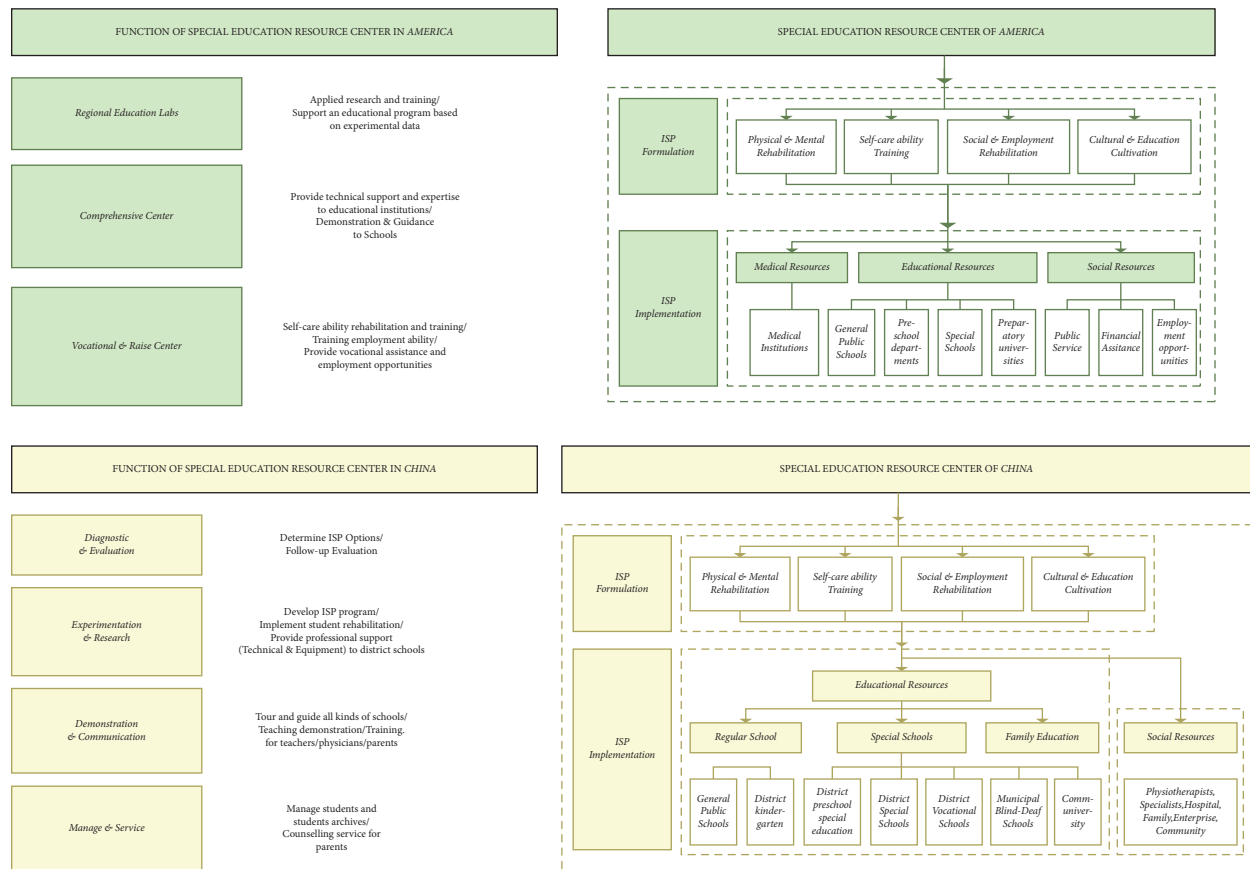


FIGURE 2: Resource center function and ISP program support system.

psychological and physiological rehabilitation treatment means, the combination of medical education and art, game therapy is more popular than the simple medical means, with better effects, especially for the psychological mood,

communication and expression, language correction, and other rehabilitation training.

Parents all expressed their hope that the guidance center could develop targeted ISP programs for their children, but

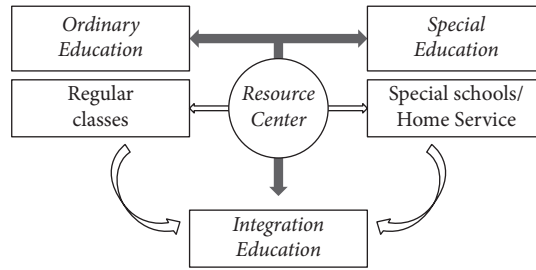
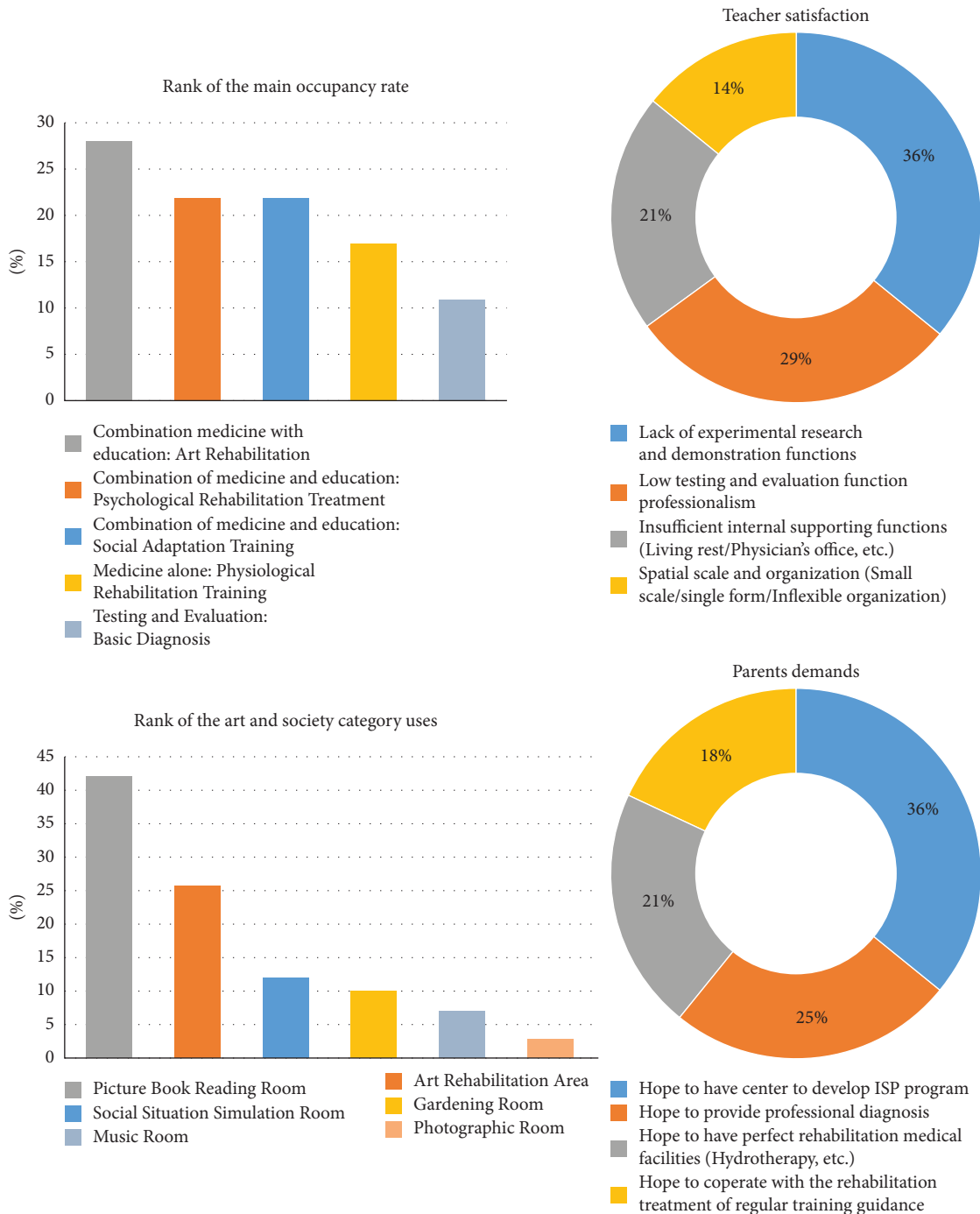


FIGURE 3: Relationship of special education resources in China.



(a)

FIGURE 4: Continued.

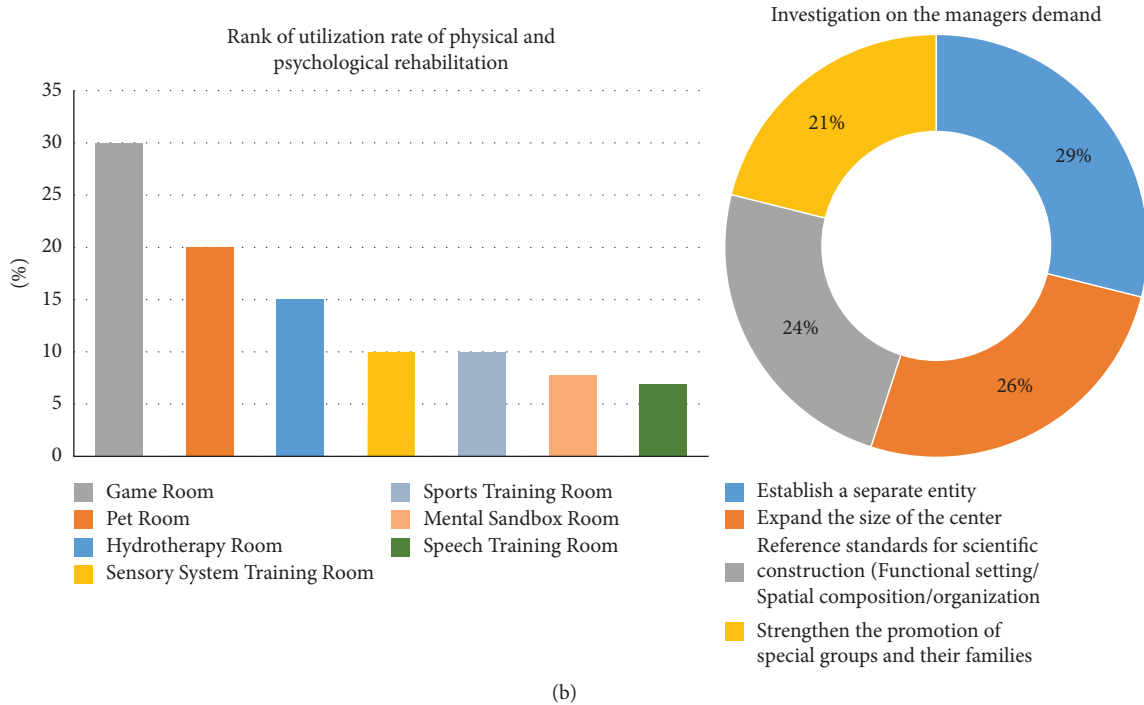


FIGURE 4: Survey chart of user satisfaction and appeal.

the professional diagnosis and rehabilitation facilities were not perfect, so it was impossible to carry out research, diagnosis, and treatment plans for different types of physical and mental disorders.

Managers reflect that the current construction departments and design agencies do not understand the functions and needs of the center, resulting in some problems: (1) Most of the centers do not have their independent entities; they only can borrow space from the school building that totally cannot achieve their functions. (2) The scale of the existing centers with independent entities is too small and the internal functional configuration is greatly limited, especially the function of making individual education plans and demonstration teaching through experimental research cannot be realized [23].

Specific problems of the current use of architectural space are shown in Table 1 and Figure 5.

**3.2. Research Analysis of Basic Research Data.** There are three ways of layout and location of resource centers within the region: (1) set in the central position to form an effective radiation range; (2) the proximity of a special school in the community can improve the degree of resource utilization, integration, cooperation, and communication; and (3) set in a special school; they can use the school resources but their own development may be limited (Figure 6).

The resource center is mainly composed of four functional areas, but at present, various functional space organizations cross each other, resulting in the use of different groups of flow line interference shown in Table 2.

#### 4. The Behavior Patterns and Functional Requirements of Resource Center Users

The analysis of the behavior rules of different users is an important basis for scientific design [24]. The main users of the resource center include students, teachers, physicians, and parents. On the one hand, in the resource center, teachers and physicians can carry out testing, evaluation, and experimental research to develop ISP programs for special children; on the other hand, teachers and physicians can conduct external tracking, guidance, and evaluation of the plan implementation, guidance and technical resource support to schools, as well as demonstration and communication for teachers and parents. According to the investigation and study of its complex functions, the functional composition and behavioral flow of the corresponding functions of each part (Figure 7) and the behavioral flow of the user (Figure 8) are obtained.

**4.1. Behavioral Patterns and Spatial Needs of Disabled Students.** As can be seen from Figure 8, the population with disabilities is mainly divided into preschool children aged 0–3, school-age children, and post-school-age children [25]. The students with disabilities mainly refer to school-age children, whose behavior pattern is based on their age and preliminary detection and assessment, and they are placed in corresponding schools (such as students with moderate cerebral palsy to schools with intellectual disabilities). Each student obtains a plan of personal rehabilitation and education through medical and educational diagnostic assessment and experimental research [26].



TABLE 1: Space usage status issues.

Lack of functional types	Lack of experimental research and demonstration teaching space	Developmental assessment (language and development) and professional testing (audio-visual and body movement) from both educational assessment and medical assessment, but most of them are assessed by ordinary machines and scales. Only Qingpu District has a professional hearing test evaluation room worth 1.5 million yuan (Figure 5(a)).
	Lack of professional testing function	
Incomplete functional configuration	Lack of teachers and physicians living and working space	The office is set in the rehabilitation training room. Microwaves and refrigerators can only be set at the corner of the stairwell for daily use (Figure 5(b)).
	Single internal function	
Unreasonable scale and organization	Insufficient space scale	Pet room only sets up feeding area, lack of activity area (Figure 5(c)). It is attached to a special education school, with unclear relationship positioning, large limitations of existing building reconstruction, and unable to effectively allocate special education resources. The total scale and the single spatial scale are small (Figure 5(d)).
	Improper functional partitioning	
Single form and function solidification	Unable to extend functionality	Different functions are interspersed with each other, resulting in great interference.
	Unable to expand space	
		The art rehabilitation training area adopts the layout of classrooms, which lacks flexible expansion areas, and it is not conducive to various forms of teaching and communication and interaction (Figure 5(e)). Small space separation, fixed facilities, lack of flexibility to expand. For example, the picture book reading room in Changning District is transformed at the expense of the director's room (Figure 5(f)).

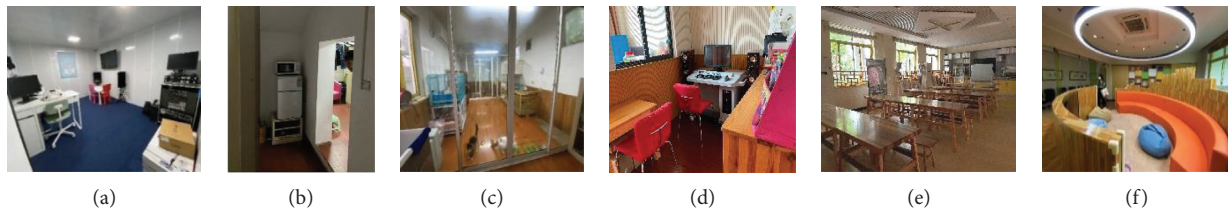


FIGURE 5: (a) Hearing testing room. (b) Domestic installation. (c) Pet room. (d) Psychotherapy indoor office. (e) Art district classroom. (f) Picture book reading room.

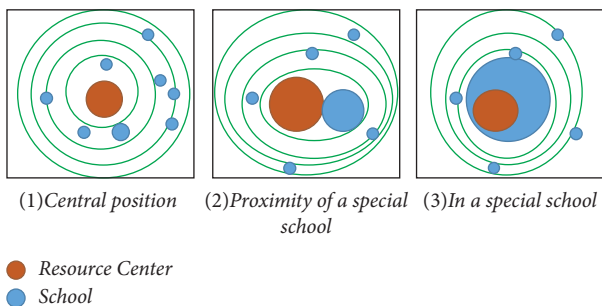


FIGURE 6: Location and layout of special education resource center.

According to the plan, it will be implemented in the special education schools or hospitals in the region. If the conditions are insufficient, the center can provide technical support for special training. And they regularly receive follow-up evaluation of rehabilitation effect to obtain timely adjustment plan (shown in Figure 7).

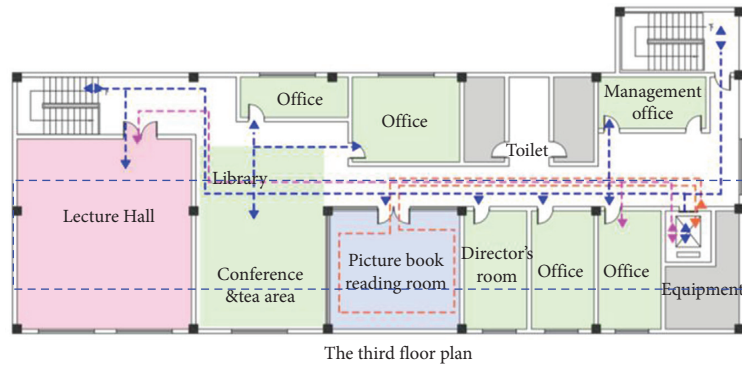
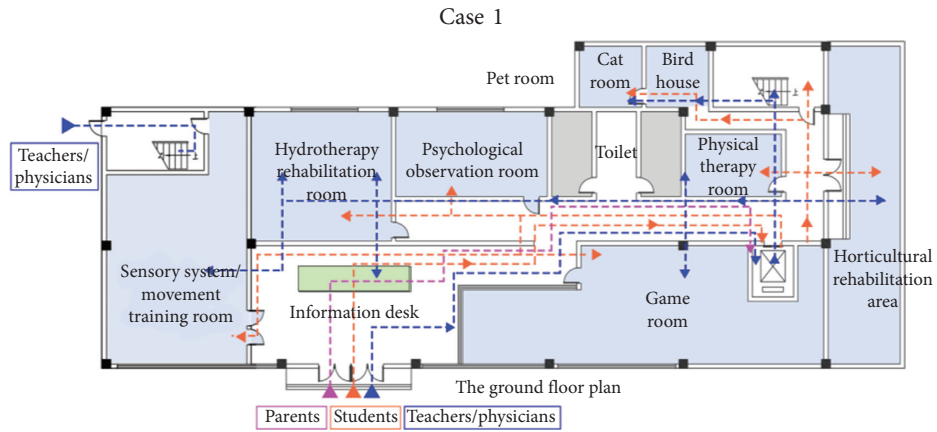
Therefore, according to the medical appraisal evaluation form, the students with various disabilities can be evaluated from four aspects: physical, nervous, social, and intellectual [27–29]; the types and characteristics of different disorders are shown in Table 3.

As shown in Table 3, ISP experimental research and plan formulation were conducted according to different types of disorders and performance characteristics (Table 4) [28, 29]. For example, ISP rehabilitation training and course formulation for children with cerebral palsy were carried out in accordance with the red area, and other types of characteristics could also be formulated according to Table 4.

The ISP program for students with different types of disorders is determined through testing, evaluation, and experimental research on the rehabilitation and treatment effects of physiological development, cognitive development, and social adaptability [29], with the purpose of preparing for work and family life, social role, and career choice [29, 30]. Therefore, its functional requirements and space requirements for the resource center are shown in Table 5. Functional spaces of special students include the following: (1) testing and evaluation space and (2) experimental research space.

4.2. Behavioral Patterns of Teachers and Physicians and Their Spatial Needs. Teachers and physicians in special education center are mainly responsible for making ISP programs for each student and guiding their implementation,

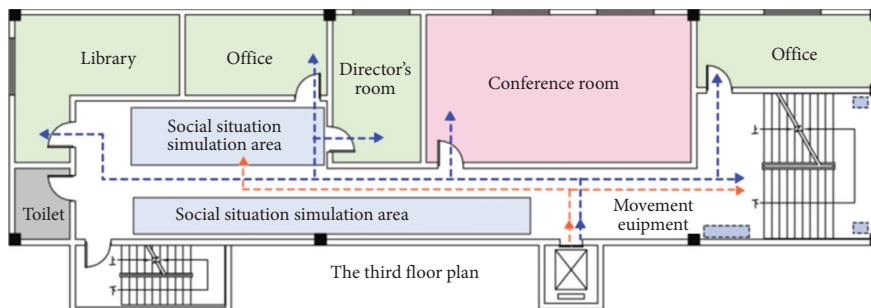
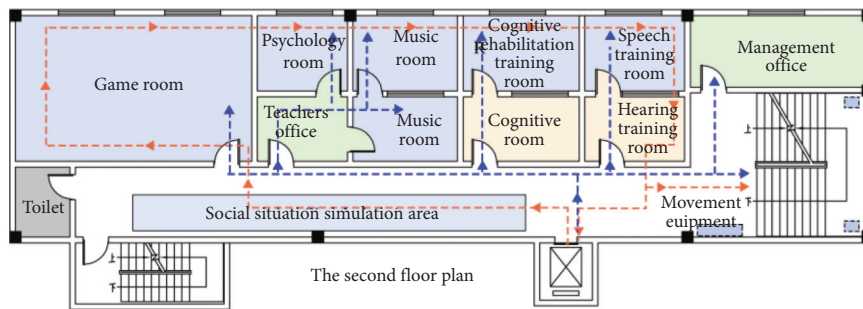
TABLE 2: Layout and functional organization.



- |   |   |
|---|---|
| <span style="display: inline-block; width: 15px; height: 10px; background-color: #f4a460; border: 1px solid black;"></span> Testing & evaluation          | <span style="display: inline-block; width: 15px; border-bottom: 1px dashed red;"></span> Students             |
| <span style="display: inline-block; width: 15px; height: 10px; background-color: #a4c6e0; border: 1px solid black;"></span> Experimental research         | <span style="display: inline-block; width: 15px; border-bottom: 1px dashed pink;"></span> Parents             |
| <span style="display: inline-block; width: 15px; height: 10px; background-color: #f4a4a4; border: 1px solid black;"></span> Demonstration & communication | <span style="display: inline-block; width: 15px; border-bottom: 1px dashed blue;"></span> Teachers/physicians |
| <span style="display: inline-block; width: 15px; height: 10px; background-color: #a4d4a4; border: 1px solid black;"></span> Management services           |   |

Changing District Special Education Resource Center

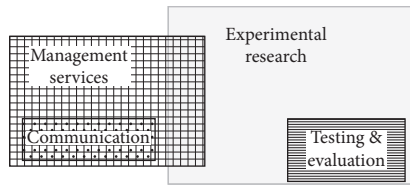
Case 2



Qingpu District Special Education Resource Center

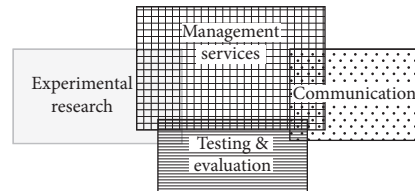
TABLE 2: Continued.

Case 1



The testing and evaluation rooms are located in the experimental research area, which crosses with the office management rooms.

Case 2



The testing and evaluation rooms are mixed with experimental research rooms, and all kinds of functional areas are intersected.

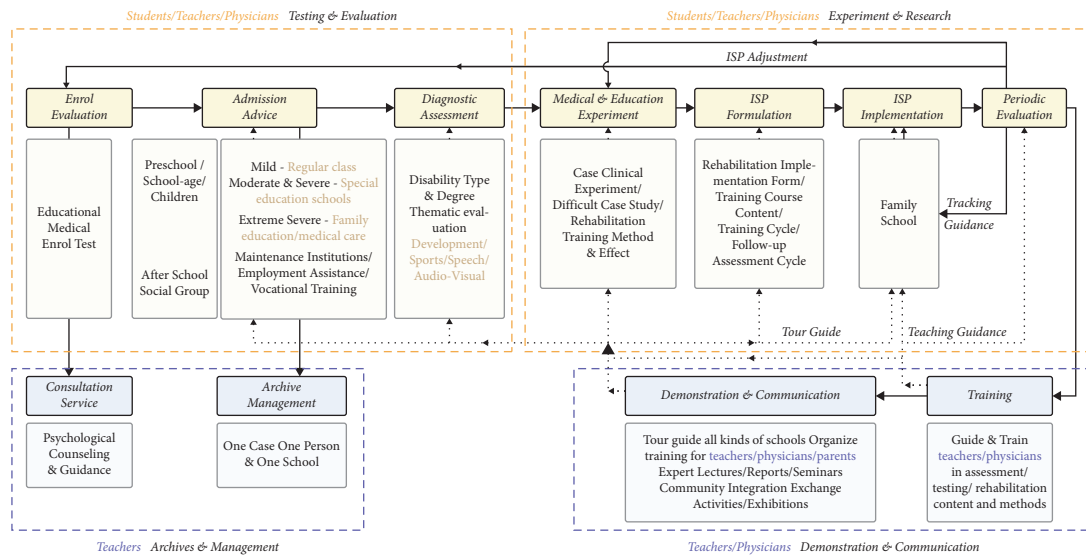


FIGURE 7: Function composition and behavior flow chart.

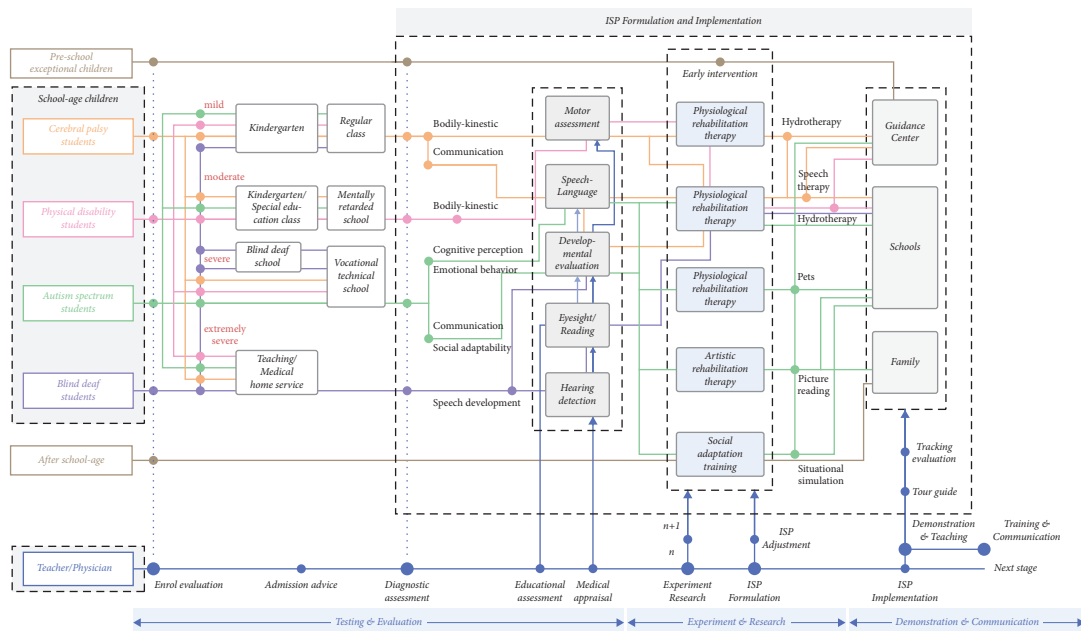


FIGURE 8: Flow chart of behavior of various users.



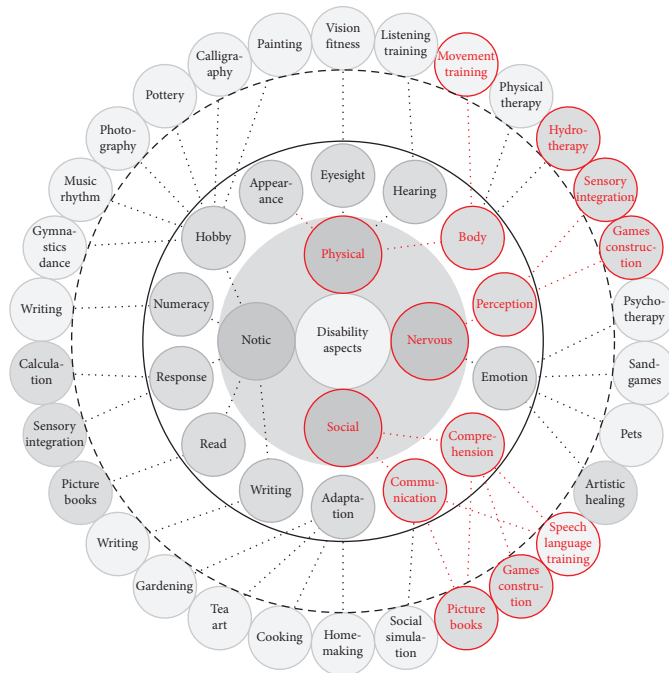
TABLE 3: Types and characteristics of disorders in exceptional children.

Performance characteristics	Disability type											
	Dysgnosia	Cerebral palsy	Infantile autism	Speech and language	Emotional behavior	Writing disorder	Reading disorder	Dyscalculia	Visual impairment	Hearing disorder	Intellectual giftedness	Multiple disabilities
Body	●●●	○○○	○○○	○○○	○○○	○○○	○○○	○○○	○○○	○○○	○○○	●○○
Special appearance	●●●	○○○	○○○	○○○	○○○	○○○	○○○	○○○	○○○	○○○	○○○	●○○
Body movement	○○○	●●●	○○○	○○○	○○○	○○○	○○○	○○○	○○○	○○○	○○○	●●○
Hearing and sight organ	○○○	○○○	○○○	○○○	○○○	○○○	○○○	○○○	●●●	●●●	○○○	●●○
Neuro	○○○	●●●	●●●	○○○	○○○	○○○	○○○	○○○	●●○	●●○	○○○	●●○
Cognitive perception	○○○	●●●	●●●	○○○	○○○	○○○	○○○	○○○	●●○	●●○	○○○	●●○
Emotional behavior	○○○	○○○	●●●	○○○	●●●	○○○	○○○	○○○	○○○	○○○	○○○	●●○
Social contact	●●●	●●○	●●●	●●●	●●○	○○○	○○○	○○○	○○○	○○○	○○○	●●○
Language comprehension	●●●	●●○	●●●	●●●	●●○	○○○	○○○	○○○	○○○	○○○	○○○	●●○
Communication	●●●	●●○	●●●	●●●	●●○	○○○	○○○	○○○	○○○	○○○	○○○	●●○
Written expression	○○○	○○○	○○○	●●○	○○○	●●●	○○○	○○○	○○○	○○○	○○○	●○○
Text reading	○○○	○○○	○○○	●●○	○○○	○○○	●●●	○○○	○○○	○○○	○○○	●○○
Mathematical calculation	○○○	○○○	○○○	○○○	○○○	○○○	○○○	●●●	○○○	○○○	○○○	●○○
Intelligence	●●●	○○○	●●○	○○○	●●○	○○○	●○○	●○○	○○○	○○○	○○○	●○○
Learning ability	●●●	○○○	○○○	○○○	○○○	○○○	○○○	○○○	○○○	○○○	○○○	●○○
Understand the reaction	●●●	○○○	○○○	○○○	○○○	○○○	○○○	○○○	○○○	○○○	○○○	●○○
Genius	○○○	○○○	●○○	○○○	○○○	○○○	○○○	○○○	○○○	○○○	●●●	●○○

Annotation: ●●● indicates that this disorder type has typical and obvious performance characteristics; ●●○ indicates that the type of disorder has moderate performance characteristics; ●○○ indicates that the degree of expression characteristics is low; and ○○○ indicates that there are no corresponding barriers and performance characteristics.

TABLE 4: ISP experimental research and planning roadmap.

ISP experimental research and formulation



For students with moderate cerebral palsy, for example, the ISP plan for the study is shown in red: body movement training; perceptual cognitive training; social skills training

TABLE 5: Function structure of the resource center

Functional composition		Space requirement
Testing and evaluation	Educational assessment Medical identification Physical therapy Physical training	Development assessment, speech assessment Exercise evaluation, audio-visual testing Hydrotherapy, physiotherapy Sensory integration, exercise training, speech therapy, listening training
Experimental research and demonstration teaching	Psychotherapy Art rehabilitation	Psychotherapy, game, pet Art rehabilitation area, photography/music, picture book, ceramic craft, fine arts, dance rhythm
Communication training	Social adaptation Demonstration communication Administration	Cooking, housekeeping, scenario simulation, tea art, horticulture Training classroom, exhibition hall, conference room, multifunction lecture hall Books and archives, consultation and reception, office management

tracking, and adjusting them, as well as training and guiding other schools, teachers, and parents to implement ISP programs (Figure 8). Therefore, functional spaces need to be set up include the following: (1) testing and evaluation space which includes educational assessment (including language and development assessment rooms) and medical appraisal (including hearing and language, vision and reading, and exercise assessment rooms); (2) experimental research space (including medical education experiment and teaching and training demonstration); and (3) communication and demonstration space which includes theoretical training classroom, practice training room (set in combination with research rooms), multifunctional lecture hall, exhibition hall, and library and reference room (Table 5).

### 5. Function and Space Composition of Resource Center

5.1. *Function Composition and Organization.* Based on functional and spatial demands analysis, the functions of the special education resource center include testing and evaluation area, experimental research area, demonstration and communication area, and management area. According to the behavior rules of main users, its function division is shown in Figure 9.

The core function of the special education resource center is to develop individual support plan for diagnostic assessment and experimental research. According to the types and degrees of obstacles of students, the individual rehabilitation training plan is formulated in three aspects,

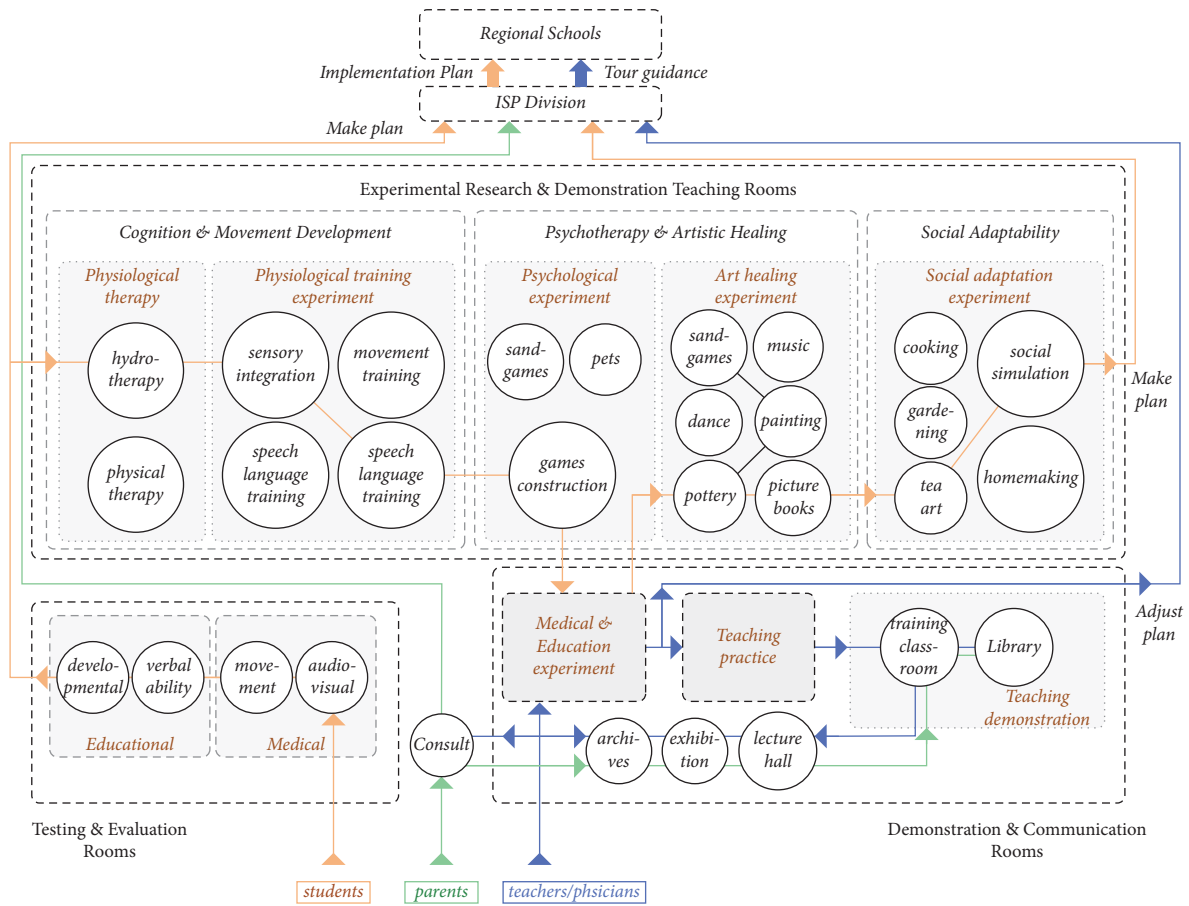


FIGURE 9: Functional partition of the guidance center.

such as perception and movement development, psychology and art therapy, and social adaptation and vocational rehabilitation, based on the experimental data and effects of physiological therapy and training, psychological therapy, art rehabilitation, and social adaptation [30, 31]. The main functions are developing program through diagnosis and experimental results and conducting demonstration through experimental research to guide other schools and parents for plan implementation. Secondly, it should be equipped with complete facilities to provide resources and technical support for special training and rehabilitation programs in other schools in the region.

5.2. *Space Composition.* According to the physical and psychological characteristics of special children, they have special needs such as resting at any time, accompanied by parents and avoiding interference. Therefore, teaching area, observation area, and rest area should be set up for the rooms for evaluation and experimental research. Observation area can be set separately or in combination with experiment and demonstration area according to the requirements of specific functions [31]. The spatial compositions, organization patterns, and design essentials of several main special function rooms are shown in Figure 10 and Table 6.

Based on the above analysis results of functional space composition, the model is established and the architectural

layout is designed, as shown in Figure 11. It can be divided into four types of areas for functional organization of various spaces (Figure 12), which can meet the streamline organization of students, parents, teachers, and physicians (Figure 13). Among them, consulting service as the main hub space, all kinds of functions can be clearly divided and achieve good interaction with each other (Figure 14). The behavioral streamlines of different groups are separated from each other without cross-interference (Figure 15).

5.3. *Expansion of Function and Space.* As the service objects of the resource center are diversified and the use functions are not invariable, the functions and spaces are required to be flexible, which need extension, as follows:

- (1) *Set Multifunctional Space.* For example, it should have both demonstration training and demonstration communication function (Figures 16(a)-16(b)). Reading clubs, parent-child activities, and training spaces for parents can be held in the picture book area (Figure 16(c)). Art rehabilitation area and music room are equipped with exhibition area and performance area can also organize regular art exhibition, photography exhibition, artistic performance, and other community communication activities (Figure 16(d)).

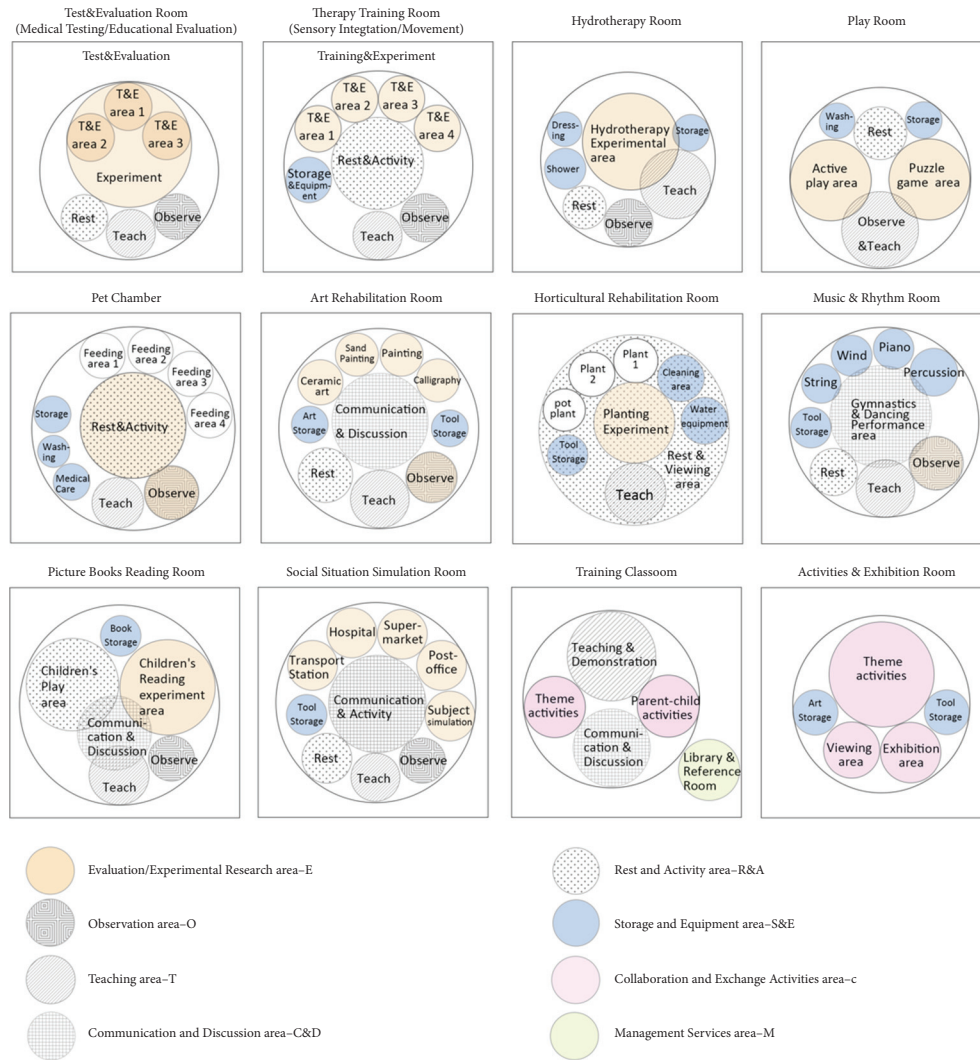


FIGURE 10: Space composition pattern of special function rooms.

TABLE 6: Design essentials of special functional rooms [31].

Special function room	Design points
Physiological rehabilitation Multisensory/movement training/hydrotherapy room	(1) The training area is used for experimental research. It needs storage space for large instruments and equipment. The sensory room should equip with multimirror space to help for cognitive rehabilitation. (2) In the hydrotherapy experiment, parents should accompany; it can combine with the teaching area, close to the physiotherapist's office and also can combine with the speech, cognitive, psychology, and other functional rooms.
Psychological therapy Game room/pets room	(1) According to different game content, it is divided into dynamic area and static area. Observation areas can be combined with teaching areas. (2) The room should be kept ventilated and clean for different animals, and children should wash their hands at any time and treat accidental wounds.
Artistic rehabilitation Music room/art therapy room/picture reading room	(1) It should adopt large space, flexible partition, and configure enough storage space. (2) It not only meets individual and group training but also uses small artistic performance space.



TABLE 6: Continued.

Special function room	Design points
Social adaptation Horticulture rehabilitation room/ social situation simulation room	(3) The communication area space should pay attention to the sense of enclosure and interaction and can be combined with the teaching area. (4) It can be combined with the external courtyard, terrace, and other outdoor space to set up psychological healing space.
Demonstration and communication Training classroom/activity and exhibition room	(1) It should meet the training of different subjects, combined with the library reference room. (2) It can be combined with the multifunctional lecture hall to hold theme salons, principals' meeting, and parent-child activities.



FIGURE 11: Design model of functional rooms.

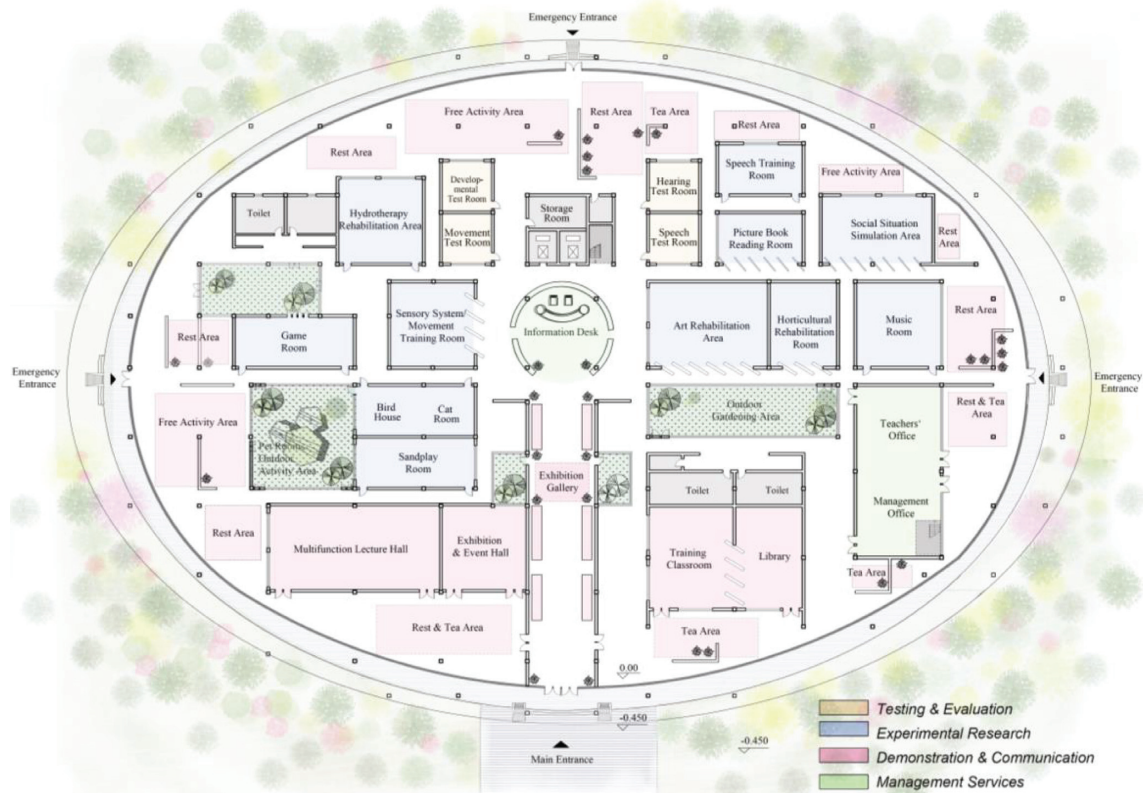


FIGURE 12: Function organization of four parts.



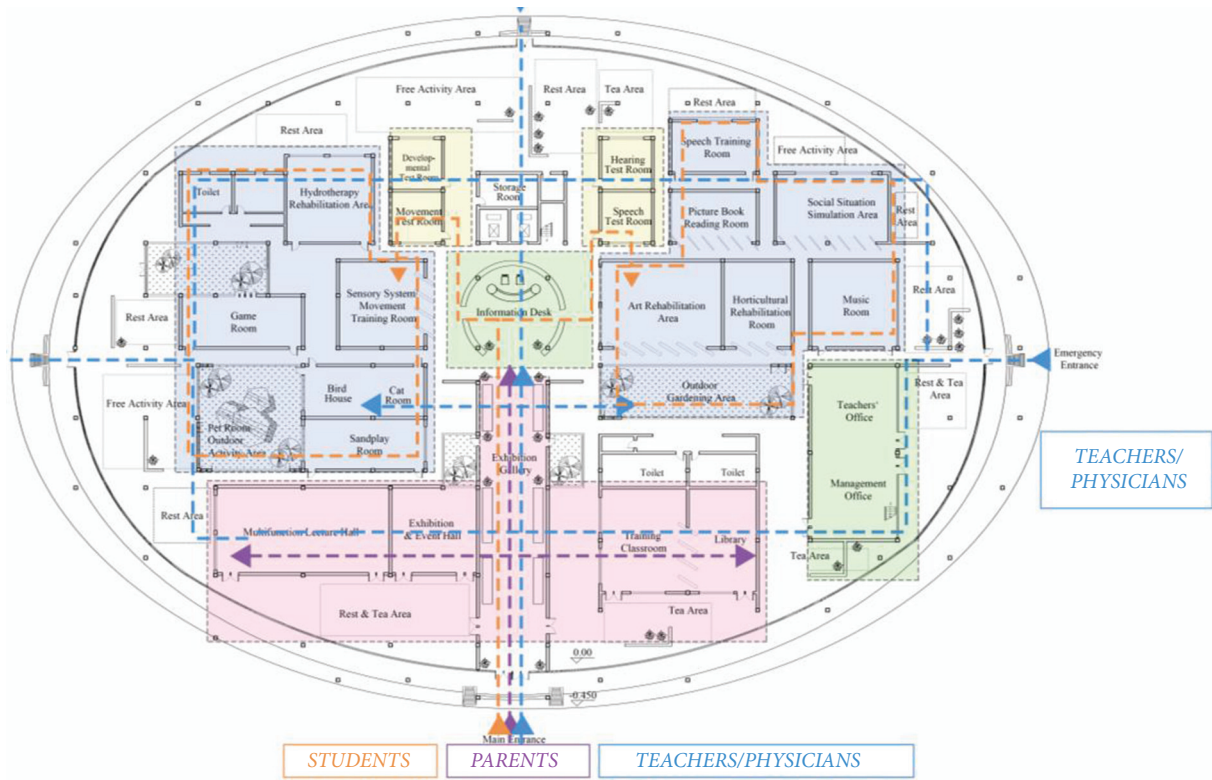


FIGURE 13: Streamline organization of three kinds.

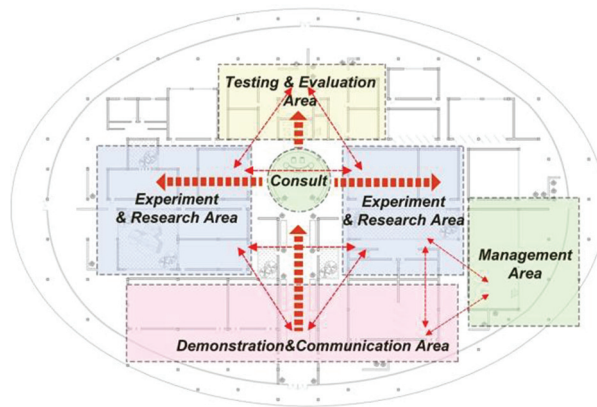


FIGURE 14: Relationship of function.

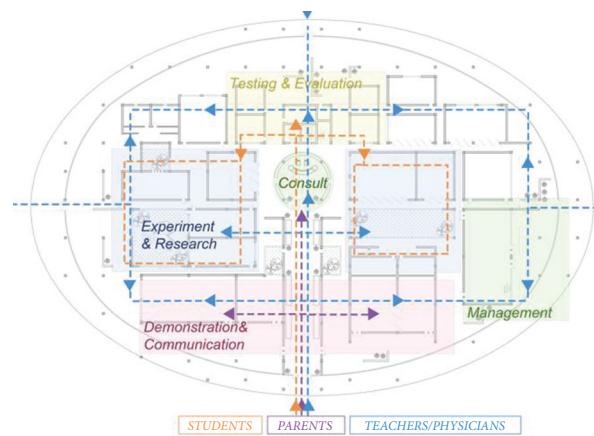


FIGURE 15: Using of function.



FIGURE 16: Function and space expansion (photo taken by the author): (a) game room; (b) library communication area; (c) picture book room; (d) music room performing area; (e) integrated area; (f) hydrotherapy room storage space; (g) horticultural rest area; (h) rooftop gardening area.

- (2) *Adjacent Integration of Similar Functions.* For example, the function such as teachers and parents training, topic discussion, and tea break can be set in a separate or combined manner (Figure 16(e)).
- (3) Adopt the form of large space, so the internal partitions can be arranged flexibly (Figure 16(f)).
- (4) *Indoor and Outdoor Extension Space.* For example, the space of indoor gardening rehabilitation area limits the species of plants that can be cultivated. The roof platform and outdoor courtyard planting area are conducive to plant cultivation, along with the difficulties on water facilities and equipment storage. Therefore, the combination of indoor and outdoor can give consideration to both planting needs and good viewing and rest space creations (Figures 16(g)-16(h)).

## 6. Difficulties and Challenges

There are some difficulties in the data collection; because of the preliminary exploration stage in special education, most of the previous studies in China focused on the field of pedagogy; there were few theoretical and practical cases to study and few references for students' architectural space needs and behavioral scale characteristics.

This study starts from the existing limited building codes of special education schools and related aspects of pedagogy and medicine and combines with the architectural space requirements. It focuses on the function and spatial composition mode of the resource center, and further research should deeply analyse the disabled students' characteristics and space requirements.

## 7. Conclusion

The realization of individual support plan is the strategic policy of development of integration education, and the special education resource center is the key to promote

education integration and overall planning of regional special education resources as well as realization of individualized education. The scientific design and construction of the special education resources center should be based on the full cognition of the architect and the management of its functions and the rules of uses and behaviors.

Based on the analysis of functions and users, the function composition and spatial organization strategies of the resource center are summarized, and a model is established for the layout design of the resource center, which mainly includes three aspects:

- (1) Four functional areas are clearly divided, and all kinds of functional rooms required are well configured
- (2) Streamlines of three kinds of users are independent
- (3) Design technique of function expansion and space extension is used

This study has certain theoretical value and practical guiding significance for the construction of China's future education resource center under the concept of integrated education.

## Data Availability

The data used to support this study are available at [http://www.moe.gov.cn/http://www.moe.gov.cn/jyb\\_xwfb/s6192/s222/moe\\_1740/](http://www.moe.gov.cn/http://www.moe.gov.cn/jyb_xwfb/s6192/s222/moe_1740/).

## Conflicts of Interest

The authors declare that they have no conflicts of interest.

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