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RESEARCH ARTICLE

Children autism rehabilitation space design. The stories from China

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ABSTRACT

China, with a population of 1.42 billion, has 10 million individuals with autism, including over 2 million children. The increasing prevalence of autism, coupled with a 40-year lag in awareness and research compared to developed nations, has led to significant challenges in providing effective interventions. Although private rehabilitation institutions have proliferated, 90% being privately operated, the quality of these centers varies greatly, often relying on parents and educators without standardized practices. Poorly designed rehabilitation environments may hinder or worsen therapeutic outcomes This study examines autism rehabilitation spaces in Guangzhou, Nanchang, Jiangxi and Beijing using a case study approach, incorporating methods such as observations and interviews. It identifies key principles for designing functional, modular, and structured spaces that cater to the sensory needs of autistic children, emphasizing natural rehabilitation and simulated community scenarios. The research integrates modern design trends and technological advancements to propose a scientifically sound framework for creating autism rehabilitation spaces in China. This framework supports therapy, learning, and societal integration while addressing the unique spatial needs of older autistic children. By bridging the gap between China's practices and international standards, this study contributes to the United Nations' Sustainable Development Goals, particularly quality education and equality, offering a replicable model for inclusive and impactful rehabilitation design.

Keywords: autism rehabilitation; sensory-friendly design; spatial planning, inclusive environments; China; sustainable development; therapeutic spaces

1. Introduction

"Design allows people to live with dignity." This powerful statement by Takafumi Honma, a renowned Japanese architect, encapsulates the profound impact of thoughtful design on individuals, particularly those with unique challenges. Honma's work on residential spaces for autistic families in China, featured in the television program *Dream Home Transformation*, highlights the intersection of architectural innovation and compassion. Autism, a complex and lifelong neurodevelopmental condition, exemplifies the necessity of such tailored design solutions. While symptoms can be mitigated through interventions, autism remains incurable, manifesting as social interaction impairments, challenges in emotional expression, and repetitive behaviors[1,2]. Diagnosed predominantly in early childhood, autism benefits most from interventions during the critical developmental period between ages three and seven[3].

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In China, autism is an increasingly significant public health issue. According to the *China Autism Education and Rehabilitation Industry Development Status Report II*, an estimated 10 million people in the country live with autism, including over 2 million children—representing 1% of the population. Alarmingly, the number of diagnosed cases increases by 20% annually[4]. Despite these figures, China's journey into autism research and rehabilitation began relatively late, in the 1990s, leaving the nation lagging behind global advancements by decades[5]. This delay is evident in the limited number of autism-specific research institutions, support organizations, and rehabilitation facilities compared to developed nations[6].

The case studies from Guangzhou, Nanchang, Jiangxi, and Beijing showed that design practices also differ from region to region due to cultural, economic, and social factors. The functional modular and structured spatial layouts as their components are recognized within the study. In addition, it advances such ideas as intelligent interactive walls, natural illumination, and recreation of particular community environments to facilitate children's successful integration into society. In view of this, this research complements the global innovation strategy by proposing an environment for autism rehabilitation that improves on the general treatment results based on the Chinese context best on purpose. It investigates the principles of designing rehabilitation spaces for children with autism in China, focusing on bridging these gaps. Drawing insights from fieldwork in Beijing, Guangzhou, and Nanchang and synthesizing international design theories, this study aspires to develop a framework for creating therapeutic environments that address the unique sensory, functional, and emotional needs of children with autism.

1.1. Research background

1.1.1. Concept of autism

First conceptualized by Dr. Leo Kanner in 1943, autism is characterized by developmental delays in areas such as social interaction, communication, emotional regulation, and cognition[7]. The condition varies in severity, encompassing mild, moderate, and severe categories, each requiring tailored interventions[8,9]. Although its precise etiology remains unclear, autism is widely considered to stem from a combination of genetic and environmental factors. While behavioral therapies and coordinated interventions can significantly improve quality of life, there is no definitive cure[10]. Children with autism face unique challenges, including hypersensitivity to sensory stimuli, rigidity in routines, and difficulties in social interaction. These characteristics underscore the importance of creating environments that accommodate their needs, from calming sensory inputs to predictable and structured routines[11,12].

1.1.2. Autism rehabilitation spaces

Rehabilitation is the process of enabling individuals with disabilities to regain or enhance their physical, cognitive, and social capabilities[13]. For children with autism, rehabilitation encompasses medical, social, educational, and vocational interventions aimed at fostering independence and societal participation. Autism rehabilitation spaces must balance functionality with sensory considerations[14]. Effective designs integrate key elements like circulation, color schemes, acoustics, and materials, ensuring the environment is safe, predictable, and conducive to intervention. Spaces are typically divided into teaching areas, therapeutic zones, living spaces, and outdoor activity areas, each serving distinct yet complementary purposes.

1.1.3. Special spatial needs of children with autism

Children with autism experience the world through a heightened sensory lens, making thoughtful design crucial. Sensory challenges range from hypersensitivity to sounds, lights, and smells to difficulties processing spatial orientation. For example, overly bright lights or overwhelming noises can exacerbate anxiety and impede learning[15,16]. Research suggests that soft, neutral tones, gentle lighting, and tactile-

friendly materials help create calming environments conducive to therapy[17]. Personal narratives from autistic individuals further highlight these sensory needs. A child from Dali, Yunnan, shared their struggles with overwhelming stimuli in public spaces, illustrating the importance of controlled, sensory-friendly environments in rehabilitation centers.

1.1.4. Future directions in autism rehabilitation space design

China's autism research is still in its relatively early stages. However, there have been steady developments in the last several years. The application of intelligent technologies – interactive walls and smart lighting – is considered to be the avenue for future development in the rehabilitation environment[18]. Moreover, natural and pretending people and objects can provide meaningful sensory input and practice in preparing the kids for what they have to face in the street, as well as in everyday life tasks that help them to become independent persons[19]. These developments align with the United Nations Sustainable Development Goals, particularly Goal 4, which seeks to ensure inclusive and equitable quality education, and Goal 10, which aims to reduce inequalities within and among societies[20]. Applying new and liberal design a few shifts, it is possible to eliminate deficiencies and guarantee that children with autism stay dignified and equal in China.

1.2. Problem statement

1.2.1. Challenges in autism rehabilitation in China

China is the most populous country in the world, with 1.42 billion people and around 298 million children, of which more than 2 million have been diagnosed with autism[21]. While the government has stepped up efforts to improve special education and or rehabilitation services, the society is severely lacking in resources meant for children diagnosed with autism. It also makes the job of determining the appropriate service for children attending private facilities all the more difficult due to the variation in the quality of these services, many of which are not equipped or staffed to meet the needs of children. There is a striking lack of knowledge about children with autism who are too old for school or with difficulties in learning and educational services after graduating from the traditional school[22]. Numerous challenges reveal themselves as children grow up in all families, while it becomes clear that rehabilitation centers require vocational training and life skills facilities for disabled people.

1.2.2. Positive spatial design for autism rehabilitation

The research underscores the value of structured, modular, and sensory-friendly spatial designs in autism rehabilitation. By creating predictable environments that cater to children's unique needs, rehabilitation centers can improve intervention outcomes and foster greater independence[15].

1.3. Research purpose and objectives

The ultimate purpose of this research is to propose scientifically grounded, culturally adaptive, and innovative design principles for autism rehabilitation spaces in China. Addressing the sensory, cognitive, and social needs of autistic children through hybrid spatial frameworks that integrate advanced technologies, cultural elements, and modular designs can significantly enhance therapeutic outcomes. These principles aim to bridge gaps in existing practices, push theoretical boundaries, and align with global standards while considering China's unique socio-cultural and economic context.

Specifically, the study seeks to:

1. Investigate novel spatial forms that meet the sensory needs of children with autism, emphasizing hybrid solutions that combine structured and flexible designs.

2. Examine the design of culturally adaptive functional spaces that address the comprehensive sensory needs of children with autism.
3. Explore innovative intelligent design principles, such as adaptive technologies and interactive environments, for autism rehabilitation spaces.
4. Integrate culturally relevant natural environments into the rehabilitation of children with autism.
5. Develop frameworks for simulating various real-life scenarios tailored to the Chinese context, advancing societal integration for children with autism.

1.4. Research questions

1. What innovative spatial forms, integrating both structured and flexible designs, can effectively address the sensory needs of children with autism while pushing theoretical boundaries in rehabilitation design?
2. How can culturally adaptive functional spaces be designed to comprehensively meet the sensory and developmental needs of children with autism in China?
3. What advanced intelligent design features, such as adaptive technologies or interactive environments, can be incorporated into autism rehabilitation spaces to enhance therapeutic outcomes?
4. How can culturally relevant natural environments be integrated into autism rehabilitation spaces to support emotional regulation and therapeutic progress?
5. What frameworks for simulating real-life scenarios, tailored to the Chinese socio-cultural context, can be developed to improve societal integration for children with autism?

1.5. Significance of the research

This study is of substantial importance to designers, policymakers, educators, and families as it addresses critical gaps in autism rehabilitation spaces in China. It directly tackles the challenges faced by a growing population of autistic children and their families, offering innovative spatial principles to improve therapeutic outcomes. By combining theoretical insights with fieldwork and practical applications, this research not only bridges the existing research gap but also aligns with global standards and the United Nations' Sustainable Development Goals (SDGs), particularly in enhancing quality education and reducing inequalities. Moreover, its focus on the unique needs of a vulnerable population highlights its humanitarian significance.

2. Literature review

2.1. Introduction

The design of autism rehabilitation spaces has gained increasing attention in recent years due to the rising prevalence of autism spectrum disorder (ASD) worldwide. This chapter reviews relevant literature to establish the theoretical foundation for understanding the sensory and spatial needs of children with autism.

2.2. Definition of autism

ASD is a developmental disorder of the brain that is manifested by delay in communication, social and play skills, along with limited and recurrent interests and activities[2]. Autism is now more common compared to the past, thus emphasizing the cause and ways to help a child with autism. ASD is generally described as a life-long disorder that has variable degrees of interference. Based on the cognitive and

functional features, autism is categorized into mild, moderate and severe [9]. In fact, while the precise etiology of autism has not to date been pinpointed, it is now generally accepted that the condition is inherited, but that genetic and environmental factors may play interacting roles in the etiology of the condition[8]. The ability to make early intervention leads and improve developmental outcomes is most effective between the ages of three and seven[3].

2.3. Sensory characteristics of autism

Autistic children have distinctive characteristics of sensory processing; therefore, sensory strategies impact children's actions and their interactions with the environment. Some of them have the ability to, or to an altered degree, sense things like light, sound, contact, and odor. These specific sensory characteristics require spaces adapted to their requirements, and we need to identify these needs [16]. The following depicts GiSD: Difficulty in discriminating and interpreting sensory inputs[15]. For instance, while some children with autism may develop a phobia of noise or light or touch sensation, some others may not cry when they get burns or if they are too cold. All these challenges point to the need to embrace concerns of designing rehabilitation spaces to be sensory-friendly to reduce anxiety and improve engagement.

2.4. Sensory integration therapy

While sensory integration therapy has been extensively studied, this research could advance the field by identifying underutilized sensory features, such as integrating dynamic light or scent stimulation systems tailored to local cultural preferences in China. Without these unique contributions, the study risks reiterating well-known principles. For instance, the use of soft-touch fabrics, adjusted light, and gentle color can help a setting that is suitable for therapy[17]. Some of the interventions used for the purpose of sensory integration include the sensory gardens and quiet rooms as well as multi-sensory environments. Both autism-friendly spaces also offer children a way of play and exploration that can be done with an emphasis placed on the sights, sounds, and textures in the environment with little perceived harassment by external stimuli. Sensory-sensitive environments like soft toys, which are actually enhanced by natural light, increased the level of mood regulation and required learning interest in children with autism[23].

2.5. Structured space design

Structured space design is a methodology that organizes spaces into distinct units with clear functions to reduce complexity and enhance predictability. Originating from structured programming principles, this approach was adapted for autism rehabilitation in the TEACCH (Treatment and Education of Autistic and Related Communication-Handicapped Children) program[24]. This method emphasizes routine, visual schedules, and clearly defined activity areas to reduce anxiety and improve adaptability in children with autism. The concept of structured space design extends to architectural layouts, where spaces are divided into functional zones, such as classrooms, therapy rooms, and sensory rooms. Takashi Honma, a Japanese designer, successfully applied these principles in autism-friendly spaces in China, creating environments that promote stability and engagement.

2.6. Modular space design

Modular space design is the concept of subdividing the space into joining units which are flexibly and inter-changeably used for the provision of space[25]. This makes it easier to cater to the needs of children with ASD since every child is unique and requires personalized attention. The modular design concepts have been implemented in the provision of education and healthcare institutions to meet the component requirements of form and functionality[26]. In autism rehabilitation, modularity enables architects to incorporate aspects of the sensory system, such as the sensory gardens, and play regions in a systematic way. This has proven that by

decomposing the difficult environments into workable modules, designers can fashion environments that help heal and stimulate children with autism[27].

2.7. Smart space design

The inclusion of smart technologies into autism rehabilitation spaces is, therefore, a major leap towards advanced therapeutics. Bursts of light, room temperature, 3D projection systems, and a variety of other features can be specifically adapted for children with autism to meet their sensory preferences and, therefore, comfort and attention[28]. Current research examines the use of distinctive interactive touch screens, tablets, and virtual reality interfaces to enhance social relationships and sensory processing. These technologies also help in relaxing patients and, at the same time, practice genuine community and working conditions since most of these technologies are modeled after real life[17].

2.8. Integration of natural elements

Autistic children are known to calm themselves down under nature-based interventions that are proposed to them. Horticultural rooms such as sensory gardens, activity outgrowth, and the use of natural materials in the interior spaces will decrease tension levels and improve nervous well-being[19]. Using features of natural landscapes in rehabilitation zones is based on the biophilic approach, which states human dependence on nature. Sensory gardens are beneficial in enhancing SSP and social interactions in children with autism[15]. In light of these results, the role of infusing nature into the design of treatment space is worthy of greater attention.

2.9. Simulated community environments

Simulated environments that mimic real-life scenarios, such as supermarkets, kitchens, and workplaces, play a crucial role in preparing children with autism for societal integration. These spaces allow children to practice essential life skills in a controlled, supportive setting, reducing their anxiety and enhancing their confidence[24].

2.10. Literature gap

While there are strides toward identifying the sensory and spatial requirements of children with autism, thorny issues include the application of specialty technologies and the incorporation of modular design. Also, the integration of smart technologies in the rehabilitation environment is still relatively new, and there is scarce evidence on the consequences arising from such interventions' sustained usage. To fill these gaps, this study develops a framework for the design of the autism rehabilitation space.

3. Research methodology

3.1. Introduction

This chapter outlines the research design and methods employed to explore the design and functionality of autism rehabilitation spaces in China. Using a qualitative case study approach, the study investigates the sensory, functional, and cultural dimensions of rehabilitation centers in four regions: Guangzhou, Nanchang, Jiangxi, and Beijing**.**

3.2. Research design: Case study approach

A case study approach was selected for this research because of its ability to provide a detailed exploration of complex real-world phenomena[29]. This approach enabled the study to examine the role of spatial design characteristics on the treatment outcomes of autistic children and their caregivers. To support this research, four geographical areas, namely Guangzhou, Nanchang, Jiangxi, and Beijing, were chosen to reveal culturally, economically, and socially different approaches to rehabilitation. The choice of the case

study technique was effective in exploring sensory, functional, and cultural needs and making sure the results were practical and not speculative. To some extent, the inclusion of such regions allowed for the definition of more general concepts that could be applicable to the design of rehabilitation on a national level.

3.3. Data collection

3.3.1. Participant observations

Participant observations were performed in four rehabilitation centers, with 100 observation hours. These concerned child engagement with space in terms of routes, lighting, color schemes, and choice of material for therapy rooms, sensory gardens, and shared utility spaces. Research methods also documented the interaction between children and their setting, thus offering insight into how architectural space organizes sensory experience and influences rehabilitation. These interactions were recorded through detailed field notes as the researcher focused on the similarities and differences between instances that nurtured or hindered therapeutic outcomes.

3.3.2. Semi-structured interviews

Semi-structured interviews were conducted with 30 participants, including architects, therapists, educators, and families of children attending the centers. This method allowed for an in-depth exploration of participants' experiences and perspectives while providing flexibility to probe emerging themes. The interview questions focused on specific design features, cultural influences, intelligent technologies, natural elements, and simulated environments.

3.4. Data analysis

The collected data were analyzed using thematic analysis to identify recurring patterns and key themes. This process began with familiarization, where observation notes and interview transcripts were reviewed multiple times to identify initial ideas. Coding was then applied to significant data points, such as "sensory-friendly design," "cultural adaptability," and "intelligent technologies," which were grouped into broader themes reflecting the study's objectives. These themes were refined and organized into overarching categories that informed the study's conclusions.

3.5. Ethical considerations

The principles of ethical considerations were followed throughout the process so as to respect and uphold the rights of participants and their dignity. Informed consent was obtained from all the participants after fully explaining the purpose of the study, the procedures that were to be followed, and measures that had been put in place to ensure the privacy of the participants. Cohort participants remain anonymous following guidelines that involved data coding and the exclusion of any sensitive information from observation notes and transcripts. Participant observations were unobtrusive to reduce the disruption of therapy sessions, and interviews with the participants were arranged at a feasible time convenient within the therapy schedules.

3.6. Limitations

The study acknowledges several limitations. First, while the inclusion of four regions enhances diversity, the findings may not fully represent the breadth of autism rehabilitation practices across China. Second, the sample size of 30 participants, though diverse, may not capture all stakeholder perspectives. Third, the time constraints of the fieldwork restricted opportunities for longitudinal observations, which could have provided deeper insights into the long-term impacts of spatial design on therapy outcomes. Finally, as with any qualitative research, the interpretation of data may be influenced by researcher subjectivity, though efforts were made to mitigate this through reflexivity and peer review.

4. Results

4.1. Introduction

This chapter presents the findings derived from 30 participants, grouped into five key themes: (1) hybrid spaces combining structured and flexible elements; (2) integration of cultural elements in rehabilitation spaces; (3) intelligent design features and their impact on therapy outcomes; (4) incorporation of natural elements to support sensory needs and emotional regulation; and (5) simulated community environments for societal integration.

4.2. Hybrid spaces combining structured and flexible elements

Participants frequently emphasized the balance between structured layouts for predictability and flexibility for individualized therapy needs. Therapists particularly appreciated the role of modular designs in tailoring the environment.

"We need structured spaces so the children feel secure, but also the flexibility to adapt these spaces when their moods or needs shift." (Participant 5, Therapist, Beijing)

In Guangzhou, therapists and architects demonstrated the use of movable partitions to create sensory corners, adapting spaces to accommodate varying levels of sensory sensitivity.

"The use of adjustable partitions and modular furniture allows us to convert rooms for different therapies, making it easier to customize the environment for each child." (Participant 12, Architect, Nanchang)

Parents also highlighted how flexibility in room designs positively influenced their children's focus and engagement during therapy.

"When the therapy room was adjusted with fewer distractions, my child became more focused. Having movable furniture is really helpful for sessions." (Participant 7, Parent, Guangzhou)

These observations align with the critical need for hybrid spaces that provide a balance between stability and adaptability.

4.3. Integration of cultural elements in rehabilitation spaces

The inclusion of cultural elements within rehabilitation centers emerged as an essential factor in creating a sense of familiarity and comfort for children and families. Therapists and architects reflected on the benefits of incorporating local designs.

"Incorporating traditional Jiangxi patterns and local materials into the therapy rooms made families feel more comfortable and connected to the environment." (Participant 18, Therapist, Jiangxi)

Participants from Guangzhou noted that cultural symbols, colors, and patterns helped establish an inclusive environment.

"We use cultural symbols and designs in Guangzhou because it helps both children and parents feel that the space is part of their community." (Participant 23, Architect, Guangzhou)

Parents emphasized how cultural familiarity contributed to a calming atmosphere.

"The use of traditional Chinese colors and patterns in the rooms makes the environment feel warm and welcoming." (Participant 9, Parent, Jiangxi)

Cultural sensitivity in design thus enhances both therapeutic experiences and family involvement.

4.4. Intelligent design features and their impact on therapy outcomes

Intelligent design features, such as adaptive lighting, interactive walls, and smart technologies, were highlighted for their role in improving therapy outcomes. Therapists appreciated the adaptability of these technologies in managing sensory inputs.

"Smart lighting that changes intensity helps us regulate the sensory environment based on the child's mood and activity." (Participant 4, Therapist, Beijing)

Interactive walls equipped with touch panels were particularly effective in engaging children during therapy sessions.

"Interactive walls with touch panels allow children to engage with visual and tactile activities during therapy, which has been very effective." (Participant 15, Educator, Guangzhou)

However, some participants also identified challenges in implementing and maintaining these technologies in resource-limited settings.

"While smart systems like interactive walls are effective, maintaining them can be challenging, especially in centers with limited resources." (Participant 11, Therapist, Jiangxi)

Parents also shared their observations on how these features benefited their children.

"My child responds well to the adaptive lights, and the interactive wall helps him engage during sessions." (Participant 2, Parent, Beijing)

Such features enhance therapy outcomes but require thoughtful implementation and consistent maintenance to ensure their effectiveness.

4.5. Incorporation of natural elements to support sensory needs and emotional regulation

Natural elements, such as sensory gardens, water features, and natural lighting, were consistently identified as therapeutic assets. Therapists described how these features supported children's sensory needs and emotional well-being.

"Our sensory garden includes textured pathways and a small pond. Many children find it calming and enjoy exploring the space during breaks." (Participant 8, Therapist, Guangzhou)

Architects discussed the intentional use of natural light in therapy rooms to create a soothing atmosphere.

"Natural light in the therapy rooms has a noticeable impact on children's mood and helps them stay focused during activities." (Participant 10, Architect, Beijing)

Parents also shared how exposure to natural elements improved their children's engagement in therapy.

"My son calms down whenever he spends time in the outdoor sensory garden. The water fountain is his favorite spot." (Participant 16, Parent, Jiangxi)

The integration of natural elements into rehabilitation spaces offers substantial benefits for sensory processing and emotional regulation.

4.6. Simulated community environments for societal integration

Participants emphasized the value of simulated environments in preparing children for real-world scenarios. These spaces, such as mock supermarkets and kitchens, provided children with opportunities to practice essential life skills in a controlled environment.

"In our simulated kitchen, children learn basic skills like cooking and setting the table. This builds their confidence for home activities." (Participant 20, Therapist, Guangzhou)

Educators noted how mock supermarkets enabled children to practice social interactions and decision-making.

"The mock supermarket helps children practice shopping. It's a controlled environment where they can rehearse social interactions and decision-making." (Participant 29, Educator, Beijing)

Parents echoed these observations, describing how simulated environments helped their children gain confidence and independence.

"My daughter practiced crossing the mock zebra crossing in the center, which helped her prepare for actual road safety." (Participant 24, Parent, Nanchang)

Simulated environments thus play a crucial role in equipping children with the skills necessary for societal integration.

5. Discussion and conclusion

5.1. Introduction

This chapter contextualizes the key findings in relation to the study's objectives, themes, and participant responses while grounding them in existing literature. The discussion focuses on how hybrid spaces, cultural integration, smart technologies, natural elements, and simulated environments can inform autism rehabilitation design in China. Additionally, the chapter addresses policy implications, limitations, and future research opportunities.

5.2. Key findings and interpretations

5.2.1. Hybrid spaces: Balancing structure and flexibility

The research reveals that hybrid spaces, which combine structured and flexible design elements, are essential in autism rehabilitation centers. Structured designs, such as fixed therapy zones, provide predictability that reduces anxiety and fosters security in children with sensory sensitivities. Movable partitioning and variable furniture items within the facility enable the therapists to fit the environment to the baby's evolving requirements[30]. For instance, therapists patented how some divisions were placed to make children-friendly corners during their learning sessions and noted an improvement in the child's concentration as well as decreased stimulation. Furthermore, the architects of Nanchang mentioned that due to the employment of modular furniture, it became convenient to rearrange the therapy sections for group or individual assignments. Such conclusions can also be aligned with the theory of adaptable systems for those who argue that flexibility enhances structure, wherein flexibility works hand in hand with structure in relation to an organized set of routines in space, making it dynamic to meet diverse needs[31].

5.2.2. Cultural integration in rehabilitation spaces

Cultural integration in rehabilitation spaces plays a vital role in creating environments that resonate with the children and their families[32]. Respondents in Jiangxi also highlighted how therapy room designs with the incorporation of Chinese traditional patterns and local materials made children feel at home which was helpful emotionally. For instance, one therapist narrated how warm earth colors matched the regional trends while creating a relaxing atmosphere during sessions. Interviews conducted among Guangzhou-based therapists and parents revealed that cultural artifacts, such as paintings depicting local buildings, contributed to the creation of inclusive environments. This supports the existing literature regarding culturally sensitive

architecture in support of autistic children[33], stating that such elements are not merely ornamental but functional.

5.2.3. Intelligent design features and sensory regulation

Intelligent design features, such as adaptive lighting, interactive walls, and smart sensory tools, emerged as key innovations for sensory regulation and therapy engagement. In centers across Beijing and Guangzhou, adaptive lighting systems enabled the therapists to change the brightness and color strength for each child depending on their sensitivity, either to make the environment visibly soothing or invigorating, as necessary. For example, one educator mentioned how the use of low lighting helped a particular child with sensitivities to calm himself during therapy. Other engaging features, such as touch screens, puzzles, and pictures on the walls, continued to interest children by presenting them with information that was suitable for therapy. However, according to participants' reports, in developing provinces such as Jiangxi, they found it challenging to sustain these technologies indicating that there is a discrepancy between idea and implementation. These support the dual importance of innovation and resource allocation in making intelligent design features sustainable and effective[34].

5.2.4. Natural elements for sensory and emotional support

The incorporation of natural elements, such as sensory gardens, natural lighting, and water features, was consistently recognized for its positive impact on children's sensory and emotional well-being. For example, the therapists working in Guangzhou noted that children quietened down when playing with textured pathways and water features that were incorporated into sensory gardens to deliver calming sensory stimuli. Likewise, when discussing with architects in Beijing about designing therapy rooms they pointed out that large windows and skylights were intentionally provided in order to bring natural lighting inside. This approach is consistent with biophilic design, which has been identified as a crucial precondition for human health [35]. The respondents also claimed that their children were less distracted and anxious when they included outdoor sessions in their daily schedule, which supports the use of natural environments[36].

5.2.5. Simulated community environments for skill development

Simulated environments, such as mock supermarkets, kitchens, and road crossings, were highlighted as essential tools for preparing children with autism for real-world scenarios. These spaces provided a controlled environment where children could practice life skills, such as shopping, cooking, and navigating pedestrian crossings. In Guangzhou, therapists shared how a simulated kitchen helped children learn essential home activities like preparing simple meals, which boosted their independence. Educators in Beijing similarly described how a mock supermarket allowed children to rehearse social interactions and decision-making in a safe setting. This observation aligns with the emphasis on structured teaching in the TEACCH program[37], which advocates for the use of realistic scenarios to build confidence and social skills. Parents frequently mentioned how these simulated experiences increased their children's preparedness for daily life, highlighting the value of practical, hands-on learning environments.

5.3. Implications for policy and practice

The implications of the current study for autism rehabilitation policy and practice are discussed, indicating its importance in China. The participants especially emphasized the need for varied standardization policies across private rehabilitation centers because differences in resources and specialists in delivery services were compounded. Technological features of inhabited localities indicate the possibility of wide-scale innovations in case they were involved in state-sponsored programs. In addition, notes on the cultural and regional versatility of rehabilitation spaces suggest that they require – context-specific policies.

China's rehabilitation sector needs to address gaps between policymakers, designers, and the community to create convergence and conform to global best practices.

5.4. Conclusion

This study aimed to investigate the design of autism rehabilitation spaces in China, the sensory architectural features, the applicability of space, and the use of natural and virtual environments. The case study approach used in the study meant that the findings underscored the importance of flexible design features that meet sensory and cognitive and, hence social challenger's requirements of children with an ASD. Environmental features for example brightness, color choice as well as noise levels came out clearly to be crucial when it comes to managing anxiety and improving the results of therapy. Hence, functional spatial integration such as modularity and zoning were crucial in designing environments that could enable the dictionary of predictable and efficient therapeutic learning environments. Furthermore, natural and simulated experiences exhibited a great deal of promise for promoting enterprise and socialization of children for play and other community activities. However, the study also underscored regional disparities in resources and practices, necessitating standardized guidelines that accommodate cultural and geographic diversity.

Conflict of interest

The authors declare no conflict of interest.

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