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Innovative Research on Highly Interactive Chinese Contemporary Design Education Spaces

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Abstract: The transformation of instructional philosophy in design education has given rise to new interactive characteristics in the teaching models and learning approaches within design majors, subsequently posing new demands on teaching spaces tailored to modern design educational needs. This study, focusing on the design education system within the context of contemporary interdisciplinary attributes, derives spatial design solutions that effectively enhance teaching interaction and stimulate students' creative thinking. The article first outlines the developmental trajectory of design education in China, elucidating its evolution from "art" to "technique" and ultimately to "thinking." Secondly, it integrates literature to demonstrate the pressing need for high interaction in current design educational processes. Finally, it analyzes the accessibility of interaction dimensions among "space-teacher-student" based on the existing types of teaching spaces in China, and maps out the interaction pathways. By summarizing and categorizing issues such as low interaction levels between teachers and students (T-S) and among students themselves (S-S), as well as weak accessibility in interaction pathways, this study proposes corresponding design strategies. These strategies encompass balancing the "physical" and "psychological" interaction radii between teachers and students, enhancing the accessibility of student collaboration and interaction, transcending the four-dimensional sensory perception of space for interaction, and integrating technological diversity into interaction. By implementing these strategies, this research aims to refine the design practice of innovative teaching spaces under a highly interactive model in design education, fundamentally propelling the traditional design education system towards a more integrated and interdisciplinary future.

Keywords: Chinese Contemporary Design Education, Highly Interactive, Innovative Teaching Spaces Design.

1. Research Background

Analysis of the Impact of Teaching Spaces on Teaching Interactivity: Renowned Chinese educational psychologist Lin Chongde proposed in his cognitive structure model the significant influence of teaching environments on education and cognitive development. Lin pointed out that innovative education requires constructivism, which emphasizes that students should construct

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knowledge through interaction with the environment or others. Teaching environments are crucial for stimulating students' innovative abilities [1]. American environmental psychologist Robert Sommer noted in his 1977 article that teaching spaces are not homogeneous, single-dimensional cubes but interconnected and diverse microenvironments[2]. He emphasized the importance of the relationship between teaching space design and behavior, and advocated for using environmental awareness to promote learning initiative and interactivity. American architect and educator Henry Sanoff argued that merely improving the quality of teaching content is insufficient; attention must also be given to the physical teaching environment to enhance learning interactivity[3]. Scholar Douglas Amedeo classified teaching spaces into five types: Shallow Rectangle, Deep Rectangle, T-shaped, L-shaped, and Cross-shaped. He analyzed how these layouts affect exploratory behaviors, learning interactions, and cooperative behaviors between teachers and students, aiming to identify spatial layouts that enhance interactivity [4]. Australian educational psychologist Kevin Wheldall examined the impact of seating density, gender-based seating arrangements, and the independence and combination of seats on teacher-student interactivity in teaching spaces [5]. These studies collectively demonstrate that the different forms of teaching spaces are key factors influencing the interactive relationships between teachers and students.

Analysis of the Characteristics of Teaching Spaces in Design Education: The primary distinction between design education and other disciplines lies in its lack of a unified educational model; diversification and innovation are the ultimate directions for the development of design education. Design education must be tailored to local conditions, established according to national circumstances, and developed in response to market demands. It is constantly adapting to changes in market and societal needs [6]. Therefore, the construction of the design education system not only changes with national circumstances but also requires specific teaching environments due to the unique attributes of design education. Compared to traditional disciplines, the teaching space environment in design education must evolve with the continuously changing educational framework, gradually adapting to the latest design teaching models, course content, and curriculum structures, resulting in diverse forms of teaching spaces.

2. Evolution of Teaching Spaces and Teaching Pathways in the Transformation of Chinese Design Education

2.1. Evolution of Design Education and Teaching Spaces

Chinese design education has transitioned from pattern education in the early 20th century, through the arts and crafts period in the mid-20th century, to the art and design period at the end of the 20th century, and has now reached the current stage of interdisciplinary integration in design disciplines [7]. The structure and organizational form of teaching spaces have changed to varying degrees, profoundly affecting the interaction paths between teachers' teaching outputs and students' learning receptions, thereby fundamentally altering the traditional teaching modes of design education. **Pattern Education Period:** During this period, the focus was on aesthetic education. New-style schools primarily taught crafts, drawing, and manual drawing subjects. Early pattern education emphasized foundational skills, with a core focus on exploring "variations" in drawing from life. At that time, the Central Academy of Arts and Crafts had a high proportion of life drawing courses in its foundational teaching, and other courses were also heavily drawing-related. This led to a homogeneous teaching environment centered on drawing, with teaching spaces mainly dedicated to drawing and painting [8]. **Arts and Crafts Period:** Driven by the return of numerous craftsmen, the establishment of art schools, the prevalence of utilitarianism, and a society focused on industrial production, Chinese design education gradually shifted from pattern education to arts and crafts education. The goals of arts and crafts education were more specific and practical, marking a

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transition from "art" to "technique." In addition to drawing studios, more workshops for skill learning were added to the teaching spaces. **Art and Design Period:** The early 20th-century modernist movement, technological revolutions, global aesthetic trends, and changes in art academia transformed Chinese design education from a single-line arts and crafts education to an educational system encompassing various disciplines such as product design, visual communication design, textile and fashion design, and environmental art design. The teaching scope became broader, and the content more diverse. Correspondingly, teaching spaces also made breakthroughs with technological advancements, becoming more inclusive and multifunctional. **Modern Design Period:** In the process of constructing the art and design system, design education integrated knowledge from peripheral disciplines, continuously expanding and merging based on the original framework. This ongoing stimulation has led the design discipline towards maturity and system perfection, forming new design specialties, design ideas, design methods, and design theories. This reflects the evolution of modern design education from "art" to "technique" and finally to "thinking" education. Additionally, with the development of smart classrooms, traditional design education spaces are gradually evolving into intelligent teaching spaces, incorporating more technological equipment and offering greater flexibility.

2.2. Analysis of the Evolution of Teaching Pathways in Design Education

During the Pattern Education Period and the Arts and Crafts Period, design education relied heavily on unilateral output and technical guidance from teachers. The apprenticeship teaching model resulted in a relatively rigid and traditional spatial structure, with a single teaching pathway. In the Art and Design Period, the expansion of design disciplines led to a diversification of design teaching content, and teaching pathways shifted from traditional one-way instruction to interactive teacher-student models. With the emergence of modern interdisciplinary education, design teaching has evolved from theoretical indoctrination and technical guidance to stimulating and colliding ideas. The interactive teaching model has also transformed from teacher-student interaction to multidimensional interactions, including interdisciplinary interaction, technological interaction, and media interaction.

3. Current Trends and Issues in the Development of Teaching Spaces for Design Education

3.1. Exploration of the Development of Future Teaching Spaces in Design Education

Contemporary design education has evolved from the aesthetic training of pattern design, through the emphasis on manual skills during the arts and crafts period, to the flourishing development of specialized fields in the art and design period. It has become increasingly evident that merely "learning" design is insufficient to meet the depth required by modern design. Instead, there is a need to shift from "learning" design to an educational model focused on "innovative" design. The aesthetic theories, technical support, and professional foundations encompassed within "design" are not confined to a single discipline but are the result of interdisciplinary integration. This integration has introduced new challenges in design education, leading to a transitional period of exploring new concepts and methods. The existing framework of design education struggles to keep pace with the rapidly advancing design industry and the swiftly expanding design fields. To address these challenges, contemporary design education has gradually developed a new core educational concept: the cultivation and development of innovative design thinking [9]. Consequently, the future model of teaching spaces in design education will not cater to independent disciplines but will be increasingly based on the modularization of functions and the comprehensive utilization of space enabled by intelligent technologies. These spaces will not only facilitate the absorption of theoretical knowledge by students but will also be adaptable to transform into spaces for the practical application of professional skills.

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3.2. Analysis of Current Issues in Teaching Spaces for Design Education in China

Issues Inherent in Contemporary Design Education: Due to the historical context of rapid socio-economic development and transformation in which Chinese design education has developed, it remains in its nascent stage and has yet to achieve true maturity and stability [10]. One of the most typical problems in current design education is the phenomenon of "design ants" [11]. This issue arises fundamentally because the constructed framework of design education cannot keep pace with the rapidly increasing enrollment numbers. Moreover, design education has not entirely escaped the essence of "Western education imitation" and has yet to develop a comprehensive service system and research strategies tailored to cultivating innovative design talent suited to China's unique context. Consequently, other influential factors beyond education itself are often overlooked. **Insufficient Research on Design Teaching Spaces to Support Current Educational Needs and Solutions:** Currently, there is a near absence of exploration and research on design teaching spaces in China. The evolution of teaching spaces across different periods has, on one hand, catered to the reform needs of the design education content system of those times. On the other hand, it has often simply integrated and introduced new technologies and smart classroom concepts from conventional teaching spaces directly into design education. The research on teaching spaces has transitioned from traditional teaching spaces to technical teaching spaces, internet teaching spaces, and now smart teaching spaces. However, there has been a lack of research that progressively analyzes what types of spaces are most suitable for design education based on the evolution of these spaces. This has led to a convergence of design education spaces with universal education spaces, while modern design education requires that its spaces meet various conditions, including professional operations, theoretical learning, teacher-student interaction, multimedia interaction, and student-student interaction. Therefore, research on contemporary design education teaching spaces is both crucial and necessary.

4. The Impact of High Interaction Frequency on Contemporary Design Education

4.1. The Impact of Enhanced Interaction Dimensions on Thinking

Introduction of Interactive Teaching: In 1984, educational psychologist Annemarie Sullivan Palincsar introduced the concept of reciprocal teaching, based on scaffolding theory. This method holds significant educational value, emphasizing the creation of information exchange scenarios between teachers and students. Unlike scaffolding theory, reciprocal teaching further promotes and enhances students' comprehension of text learning. It is particularly useful for breaking down complex theoretical knowledge through interactive modes such as examples and mutual questioning between teachers and students[12]. **Upgrading of Interaction Methods:** In the late 1970s, interactive teaching began to employ more "teacher-student dialogue" methods, encouraging teachers to use specific interactive techniques to enhance students' cognitive strategies. Initially, this approach was mainly applied to teaching mathematical problems (Schoenfeld), physical problems (Larkin & Reif), and writing problems (Englert & Raphael), with teachers predominantly guiding the interactions. Over time, this evolved into a mode where interactions occurred not only between teachers and students but also among students themselves. These interactions were characterized by the creation and generation of problem points, with the pace of questioning and feedback driving the learning process . **Breakthrough in Interaction Dimensions:** In the 1990s, educational psychologist Howard Gardner introduced the Multiple Intelligence Theory [13]. This theory, in some ways, echoes the ancient Chinese concept of the "Six Arts," which focused on societal needs, whereas the Multiple Intelligence Theory centers on the individual's potential[14]. Gardner’s theory aims to help teachers develop each dimension of student interaction, thereby fostering students' inherent potential. This

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approach significantly aids in the advanced development of logical thinking, critical thinking, and creative thinking. With technological advancements, the smart classroom emerged as a transformation of the traditional classroom into an intelligent one. The primary intention behind integrating technological devices in teaching was to enhance student engagement and interaction throughout the learning process[15]. This includes fostering positive interactions among people, between people and technology, people and resources, people and the environment, technology and technology, technology and resources, resources and the environment, technology and the environment, resources and resources, environment and environment. The development of these dimensions in teaching spaces has led to significant breakthroughs, potentially facilitating the realization of Multiple Intelligence Theory within these spaces and stimulating the creation of more multidimensional interaction models in contemporary education.

4.2. The Impact of Interaction Frequency on Cognitive Development

Theories such as cognitive development, social interaction, and constructivism all emphasize the effective impact of teaching interaction frequency on the formation of students' cognitive processes. Frequent interactions between teachers and students enable students to better construct knowledge structures, enhance cognitive abilities, and promote cognitive development. Cognitive development theory highlights that students construct knowledge through interactions and experiences with others, suggesting that increased interaction frequency provides more opportunities for students to engage in the knowledge construction process, thus promoting cognitive development. Social interaction theory posits that learning is a social process; increased interaction frequency among teachers can enhance teaching cohesion and diversify teaching models[16]. Similarly, increased interaction frequency among students fosters communication and cooperation, allowing them to acquire new cognitive and thinking methods, thereby promoting cognitive development. Constructivist theory emphasizes that learners construct knowledge through active participation. Increased interaction frequency offers more opportunities for students to engage actively in the teaching process, thus facilitating their cognitive development. **The High Interaction Nature of Design Education:** While most educational disciplines advocate for more interactive methods to enhance teacher enthusiasm and student engagement, John Sweller's cognitive load theory suggests that excessive or ineffective teaching interactions can have adverse effects on students. Unlike scientific disciplines that rely on simplified simulations, abstract analysis, task decomposition, and linear progression to solve problems, design education is characterized by non-linearity. It involves teachers and students continuously redefining and constructing thoughts based on scenarios, objects, materials, and other factors. This innovative thinking process relies on constantly "posing problems" and "solving problems," with regular "reflective dialogues" ultimately yielding results. Contemporary design education emphasizes cultivating design thinking, which involves divergent, agile, interactive, and iterative thinking processes to solve innovative and creative problems. In fostering design thinking, whether through empathy exploration, design definition, proposal generation, prototype production, or final product testing, continual inspiration and interaction are essential to spark innovative ideas from multiple perspectives. Thus, high-frequency interaction is a fundamental attribute in design thinking within design education[17]. **The Need for High Interaction in Contemporary Chinese Design Education:** There are two primary drivers for the high interaction demand in contemporary Chinese design education. Firstly, the need arises from the inherent "lack of communication" in the Chinese educational system. In Western thought, dialogue and experimentation are seen as drivers for problem-solving and are key elements of Western educational models. However, in many Asian regions, critical dialogue is viewed as disruptive to classroom harmony, leading to classroom silence. Secondly, the need stems from the transformation of China's design education system[18]. The transition from the period of arts and crafts to the era of art design marks a shift from one-way to two-

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way teaching forms, transforming the teacher-student relationship into a genuine “dialogue” model. In this context, interactive teaching better facilitates the transmission and generation of design ideas. However, most undergraduate design students in China transition directly from a high school drawing training system to a university design education system, creating a significant gap. The abrupt shift in teaching models makes it difficult for students to adapt; prolonged reliance on dependent learning in high school hinders their ability to engage actively in learning. They struggle to move from “passive input” to “active output” . Given the intrinsic characteristics of design education, there is an urgent need for students to develop more subjective initiative under the guidance of teachers and other factors. Therefore, design education requires an effective, efficient, and diverse interactive teaching system.

5. Analysis of Interaction in the Spatial Layout of Contemporary Chinese Design Education

The interactivity analysis of design education spaces hinges on the intricate interplay among three key dimensions: teachers, students, and spatial media. These components mutually influence, constrain, and are interdependent, fostering a multifaceted dynamic within the educational milieu. By scrutinizing the dimensions of interaction, behavioral trajectories, and the ease of interaction within the instructional space, one can synthesize the prevalent interaction patterns, distinctive features, and hindrances within contemporary design education settings. Such analysis paves the way for more precise and impactful design innovations and practices aimed at overcoming these challenges.

The design education spaces prevalent in China can be broadly classified into six categories: A, B, C, D, E, and F(Fig1-6), all the orange blocks symbolize media technology embedded within the space, encompassing multimedia among others; the vibrant yellow blocks signify the arrangement of student areas during class sessions; the green dashed lines illustrate the extent of accessibility for teacher-student engagements; and the blue dashed lines delineate the routes of teachers' interaction patterns.

5.1. Analysis of Type A Teaching Spaces

Type A teaching spaces are the conventional model for most design schools in China, primarily relying on teacher-led instruction from the front of the classroom and the projection of content through screen devices. As shown in Figure 1, due to the spatial limitations of the student seating areas, the interaction radius between each student, the teacher, and the teaching content varies. Students seated in the back rows are particularly prone to losing out on interactive engagement. Additionally, the interaction between students is relatively low. Although the teacher can interact with students by moving along the sides of the seating arrangement, the interaction efficiency is low, and the paths available for interaction are limited.

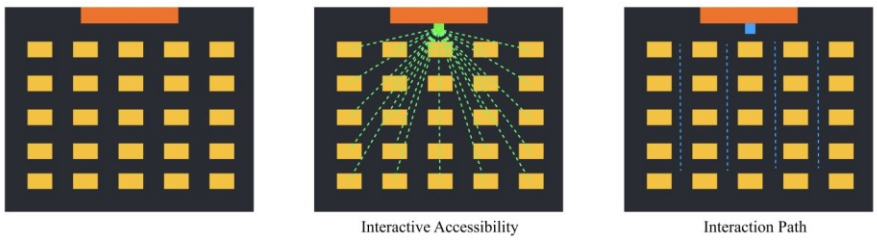

Figure 1: Analysis of Type A Teaching Space Layout

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5.2. Analysis of Type B Teaching Spaces

Type B teaching spaces(Fig.2) aim to address the issue of excessive interaction radius by arranging the student seating more compactly and adding multimedia projection equipment in the middle of the space. This allows students in the back rows to interact more effectively with the displayed content. However, in Type B spaces, the paths for teacher interaction are restricted, and the introduction of multiple screens, while reducing the interaction radius between the back-row students and the teaching content, tends to fragment or even weaken the sense of interaction between the teacher and the students.

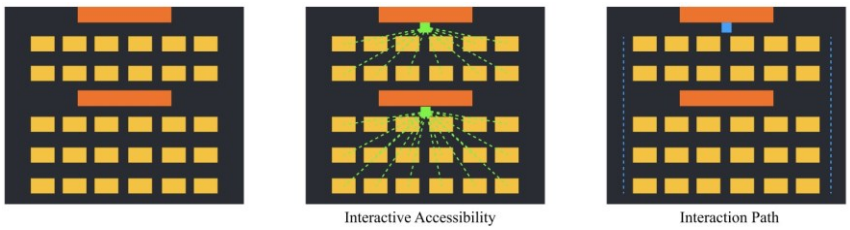

Figure 2: Analysis of Type B Teaching Space Layout

5.3. Analysis of Type C Teaching Spaces

Type C teaching spaces(Fig.3) are an upgrade from Type B, maintaining the dual-screen setup but extending the student seating area horizontally to avoid the segmented teaching experience of front and back rows. The screens are placed on either side, allowing the teacher to form a natural T-shaped interaction path, enhancing the potential for teacher-student interaction compared to Type B spaces. However, Type C spaces also create a sense of lateral separation, which reduces the interaction between students.

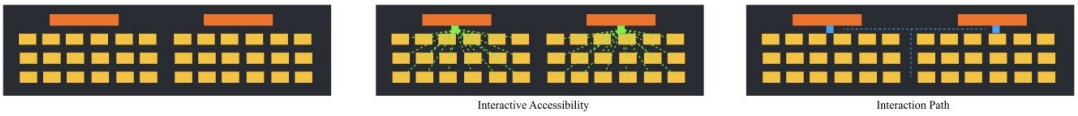

Figure 3: Analysis of Type C Teaching Space Layout

5.4. Analysis of Type D Teaching Spaces

Type D teaching spaces(Fig.4) are also a common form in China, where students are arranged in a horseshoe shape. Although the interaction radius between students, the teacher, and the content displayed on the podium varies depending on seating arrangements, similar to traditional teaching spaces, the unique open area allows the teacher's movement path to be unrestricted. This enables the teacher to interact easily with students within the U-shaped structure during the teaching process. However, the issue with Type D spaces is that the U-shaped configuration is not conducive to group discussions, hindering student-to-student interaction.

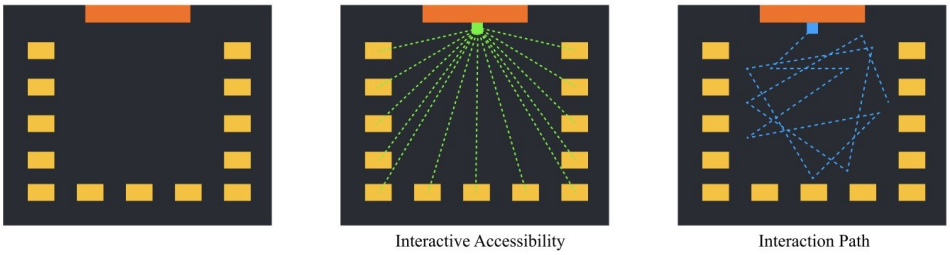

Figure 4: Analysis of Type D Teaching Space Layout

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5.5. Analysis of Type E Teaching Spaces

Type E teaching spaces(Fig.5) represent a new model in educational environments, aligning with a design education system led by design thinking. In these spaces, students are grouped, and the movable tables and chairs can be rearranged into different configurations at any time. In Type E spaces, interactions primarily occur within groups, and the teacher's interaction path is relatively straightforward. However, the main issue remains that the traditional screen is still positioned at the front of the space, which continues to impose limitations on the interaction radius between students and the teaching content.

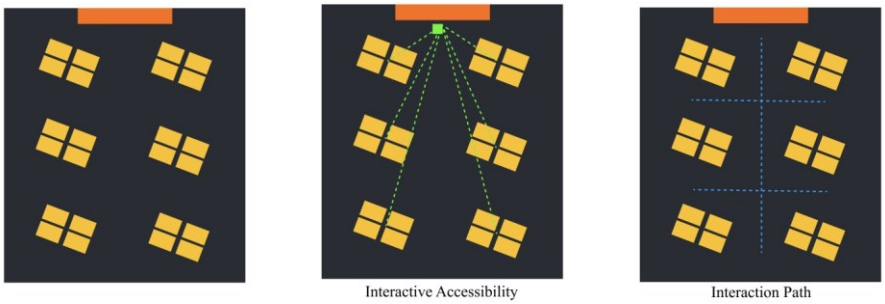

Figure 5: Analysis of Type E Teaching Space Layout

5.6. Analysis of Type F Teaching Spaces

Type F teaching spaces(Fig.6) are an extension of Type E spaces, breaking away from the traditional front-centered display of teaching content. Instead, after grouping the student areas, each group is equipped with its own display screen, decentralizing the teacher-centered layout. This arrangement equalizes the interaction radius and enhances interaction accessibility. Additionally, the open area in the middle ensures flexibility in the teacher's interaction path.

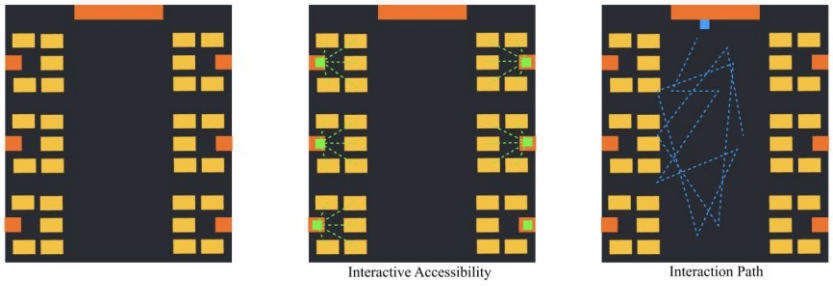

Figure 6: Analysis of Type F Teaching Space Layout

In summary, the analysis reveals that design education spaces in China have undergone a transformation, shifting from the unilateral interaction characteristic of traditional teaching environments to a multidimensional interaction model that caters to the tripartite dimensions of students, teachers, and space. To further explore spatial planning that more effectively supports design thinking and innovative coursework models, it will be imperative to integrate an array of technological tools and robust theoretical support.

6. High-Interactive Design Teaching Space: Innovation and Practice

To design a highly interactive teaching space for design education, one must first focus on the core principles of the current design education system, which emphasizes the need for interaction across the three dimensions within the space. Next, efforts should be made to enhance and diversify the

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development of multiple intelligences in both students and teachers, thereby increasing the frequency and intensity of these interactions. Finally, the design must also improve the experiential quality of interaction by leveraging new media technologies to enhance the perceptual impact of spatial interactions. There are four practical approaches to achieve this.

6.1. Balancing Physical and Psychological Interaction Radii Between Teachers and Students

Despite continuous updates, adjustments, and improvements in educational spaces for design in China, the uneven interaction radii between teachers and students have persisted throughout. This inequality contributes to a dual passivity in the psychological and physical experiences of some students. Although teachers' movement paths vary within the space, the dominant area is consistently placed at the front of the teaching space, which fails to activate interaction among spatially unequal participants. As shown in Figure 7, placing the traditional lectern at the center of the teaching space, and employing a dual-screen structure with split-screen reception mode, equalizes the interaction radius between teachers and every student in the space. This layout eliminates differences in seating proximity, allowing students to experience not only a sense of equitable communication in the psychological realm but also actively engage in multi-sensory interaction from auditory and visual perspectives in the physical realm. Consequently, this enhances immersive interaction, audiovisual engagement, and language interaction within the space.

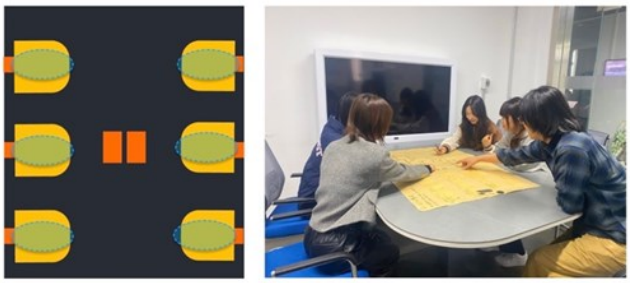

Figure 7: Innovative Practices of Teacher-Student Interaction Radius in Educational Spaces

6.2. Enhancing Student Cooperative Interaction Accessibility

During the transformation of design education spaces in China, from Type A to Type F, consideration has been given to the accessibility elements of teacher-student interactions. However, in the process of design thinking, aside from guidance from teachers' theories and cases, there is a greater reliance on stimulating interactions among students. While Type F spaces partly address the weak accessibility of student interactions seen in Type D spaces, the use of individual desks, even if they are movable, tends to reduce the enthusiasm for student communication to some extent. As shown in Figure 8, designing desks as a unified whole not only facilitates the placement of students' learning devices such as computers but also enhances cooperative interaction processes in design teaching, such as mind mapping.

Figure 8: Innovative Practices in Student Interaction Radius within Educational Spaces

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6.3. Advancing Spatial Perception through Four-Dimensional Interaction

The theory of transparency in modern architecture posits that enhanced spatial experiences can be achieved through the utilization of transparent building materials, interpenetrating spaces, and the ubiquitous presence of air, light, and movement. Presently, domestic educational spaces often adopt a closed-off teaching environment, imposing certain limitations on the space, particularly when fixed seating arrangements restrict students situated at the back from fully engaging in interactive experiences. By applying the theory of transparency, where one side of the teaching space is designed as a fully glassed-in area and the other side features a wall for artwork displays, the original three-dimensional interactivity within the space is seamlessly expanded. As illustrated in Figure 9, this design not only subtly stimulates a sense of cohesion within the teaching space as supervisors pass by, but also actively prompts intellectual interaction through the artwork displayed on the corridor walls, fostering effective logical and self-reflection exchanges.

Figure 9: Transparency Configuration in Educational Spaces

6.4. Integrating Technological Interaction for Multifaceted Learning

The integration of multimedia technologies within educational spaces has significantly enriched the diversity of interactions between classrooms and students, fostering an effective human-computer interface for both instructional output and input. Beyond the pedagogical richness imparted by multimedia, the incorporation of additional technologies further unlocks multidimensional interactive possibilities. For instance, the installation of in-class recording devices enables the comprehensive evaluation of the quality and frequency of teaching interactions. The seamless integration of wireless classroom feedback systems promptly captures students' responses to lesson content, fostering an efficient feedback loop that stimulates active teaching engagement. Furthermore, the development of post-class educational applications ensures the continuity of interactive dimensions, extending learning beyond the traditional classroom setting.

7. Conclusion

The integration of multimedia technologies within educational spaces has significantly enriched the diversity of interactions between classrooms and students, fostering an effective human-computer interface for both instructional output and input. Beyond the pedagogical richness imparted by multimedia, the incorporation of additional technologies further unlocks multidimensional interactive possibilities. For instance, the installation of in-class recording devices enables the comprehensive evaluation of the quality and frequency of teaching interactions. The seamless integration of wireless classroom feedback systems promptly captures students' responses to lesson content, fostering an efficient feedback loop that stimulates active teaching engagement. Furthermore, the development of

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