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Ergonomic Optimization Design Research of Campus Seating

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Abstract **Original Research Article**

Campus seating is a core piece of furniture that covers all scenarios, including teaching, self-study, and relaxation. Its design directly affects the physical and mental health as well as learning efficiency of students and faculty. Addressing common shortcomings in current campus chairs—such as mismatched dimensions, body mechanics-unfriendly shapes, and musculoskeletal fatigue caused by prolonged use—this study takes human factors engineering as its theoretical foundation, relying on anthropometric data and principles of sitting biomechanics to analyze chair usage and human factors issues across three typical campus settings: classrooms, libraries, and public areas. It proposes an optimized design framework comprising four key aspects: standardized functional dimensions, biomechanically informed form and structure, scenario-based functional design, and growth-adaptive adjustment mechanisms. Using library reading chairs in universities as a case study, the design was implemented and evaluated through both subjective assessments and objective experiments to verify comfort and health benefits. Results show that incorporating ergonomic features such as curved desktops, adjustable lumbar support, and pressure-distributing seat surfaces significantly reduces neck and lower back strain during prolonged sitting, improves pressure distribution across the body, and increases overall comfort by over 40%. This research provides both theoretical guidance and practical pathways for enhancing the human-centered and health-oriented design of campus furniture.

Keywords: campus seating, human factors engineering, sitting posture health, furniture design, pressure distribution, anthropometry.

I. Introduction

With the advancement of educational modernization in China, the quality of campus spaces has evolved from merely meeting functional needs to optimizing user experience. Seating furniture is among the most frequently used and most directly contact with students and teachers on campuses, distributed across various settings such as regular classrooms, auditoriums, libraries, study rooms, public corridors, and dining halls. The design quality of seats significantly affects users' physical health and behavioral efficiency. Relevant surveys indicate that Chinese students typically spend more than eight hours per day in a seated position, while high school students and those preparing for college entrance exams may sit for 10 to 12 hours daily. Prolonged exposure to poorly designed seating environments can lead to excessive strain on the cervical and lumbar spine and buttocks, resulting in issues such as myopia, scoliosis, and lower back muscle fatigue. It also reduces focus during study, thereby negatively impacting teaching effectiveness [1].

Ergonomics is an interdisciplinary field focused on the optimal integration of "people, machines, and environments," aiming to align product design with human physiological and psychological characteristics to achieve safe, healthy, efficient, and comfortable experiences [2]. Through methods such as anthropometric measurements, sitting biomechanical analysis, and pressure distribution testing, ergonomics provides scientific foundations for seat dimensions, shapes, and structural design, which have been successfully applied in office chairs, automotive seats, and aircraft seating [3].

In contrast, current campus seating designs in China have traditionally prioritized cost control, durability, and space utilization, often overlooking students' physical characteristics and health needs. Most schools use standardized, one-size-fits-all desks and chairs that fail to accommodate significant variations in student height and body type. Seat shapes are mostly simplified and flat, offering insufficient support for the spine and muscles. Additionally, these seats offer limited functionality and cannot meet diverse learning behaviors [4]. Although some scholars have conducted research on classroom furniture for primary and secondary schools and university library seating, no comprehensive design system covering all campus scenarios has yet been established, and the applicability and scalability of existing designs remain limited.

Therefore, this paper takes campus-wide seating as its research subject, integrating data from anthropometry, sitting biomechanics, and user surveys to thoroughly analyze the ergonomic shortcomings of current campus seating. It proposes a holistic optimization design approach and validates it through practical implementation and results. The goal is to develop a scalable, ergonomically sound campus seating design solution, promoting healthier upgrades and transformations of campus learning environments.

II. Theoretical Foundation of Human Factors Design for Campus Seating

2.1 Core Design Principles of Human Factors Engineering

The application of ergonomics in seat design essentially involves adjusting the physical parameters of seats to match human physiological structures and behavioral characteristics, enabling users to achieve a natural sitting posture with minimal muscle load, optimal spinal alignment, and even pressure distribution. This ultimately increases comfortable sitting duration and reduces health risks associated with prolonged use. The three fundamental principles followed are:

First is the percentile adaptation principle [5]. Product dimensions should be determined based on anthropometric data of the target population, selecting an appropriate range of percentiles so that the majority of users fall within this range. For campus seating, the 5th percentile female body dimensions are typically used as the lower limit, and the 95th percentile male body dimensions as the upper limit, ensuring that over 90% of students experience satisfactory comfort [6].

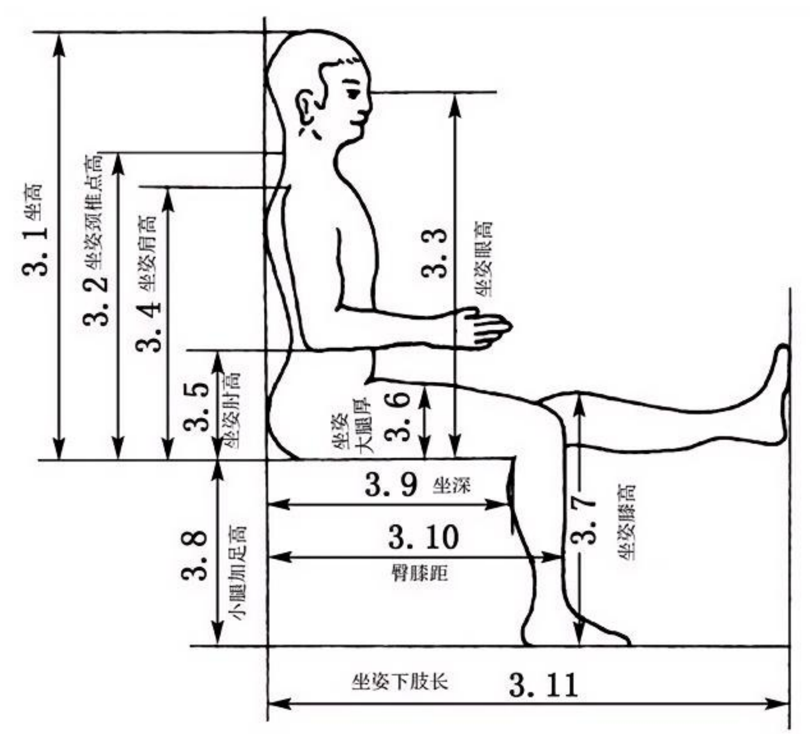

Figure 1 Schematic of seated human body measurement parameters

The second principle is the biomechanical friendliness principle [7]. When standing naturally, the human spine forms an "S"-shaped physiological curve, and the pressure on the intervertebral discs is evenly distributed. However, when sitting, the pelvis tilts backward, causing the lumbar spine to straighten, which can increase disc pressure to 1.4 or even 1.8 times that of standing—making it a major contributor to lower back fatigue and injury. A well-designed chair should use parameters such as backrest support and seat tilt to guide the spine toward its natural physiological curvature, improve pressure distribution, and prevent excessive stress on any particular tissue.

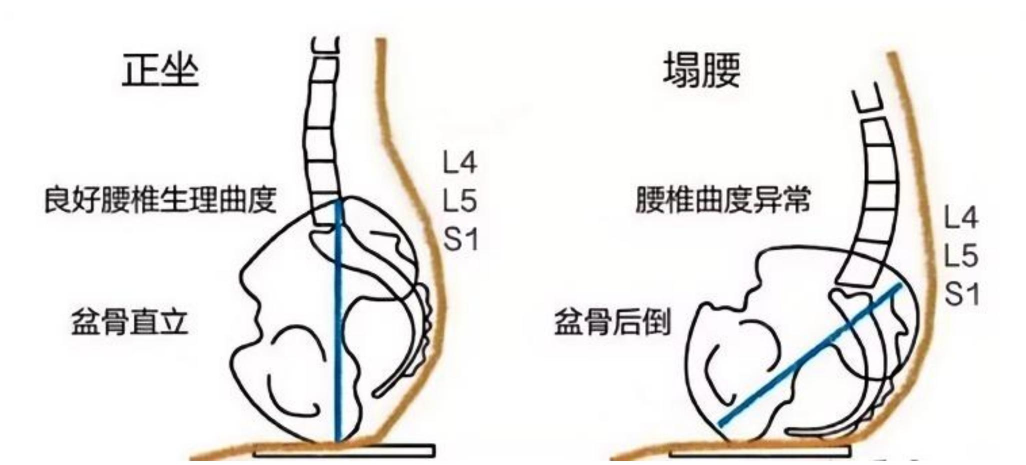

Figure 2 illustrates changes in spinal physiological curvature and lumbar pressure under different sitting postures.

The third principle is the principle of dynamic comfort [8]. When users sit for extended periods, they often need to make minor bodily adjustments to relieve fatigue, as there is no absolutely fixed "standard sitting posture." Therefore, chair design should not only aim for maximum comfort in a single posture but also provide ample space for bodily movement. Adjustable structures should be employed to accommodate various sitting postures and task scenarios, effectively combining static support with dynamic adjustment.

2.2 Campus Seat Scene Classification and Differences in Human Factor Needs

Due to the diversity of campus scenarios, the human factor needs for campus seating also vary. Campus seats can be classified from three aspects: single-use duration, main activities, and usage purposes. Their characteristics and needs are shown in Table 1.

Table 1 Typical Usage Scenarios and Human Factor Needs Characteristics of Campus Seats

Scenario Type	Typical Locations	Single Use Duration	Core Behavioral Characteristics	Core Ergonomic Demands
Teaching & Lecturing	Ordinary classrooms, lecture theaters, laboratories	45–90 minutes	Alternating between looking up to listen and bowing to take notes, with frequent posture changes	Sufficient spinal support, reasonable viewing distance, ample leg space, convenient access
Self-study & Reading	Libraries, self-study rooms, exam-prep classrooms	2–6 hours	Long-time reading, writing, electronic device operation, with relatively fixed posture	Uniform body pressure distribution, proper lumbar support, functional tabletop, high adjustability
Public Rest	Corridors, canteens, campus squares, waiting areas	5–30 minutes	Short rest, communication, waiting, frequent sitting and standing	Easy seating, easy cleaning, wear resistance, moderate back support

Among them, seats in teaching and self-study scenarios have the most prominent ergonomic problems and the highest health risks due to long use time and fixed body posture, which are the main research objects of this paper [9]. Although public rest seats are used for a short time, as supporting facilities of campus space, their comfort directly affects the overall spatial experience quality of the campus.

III. Current Ergonomic Status and Problem Analysis of Campus Seats

3.1 Research Data Sources

To systematically understand the problems in the use of campus seats, this paper integrates field measurement data and user survey results from domestic universities, focusing on classrooms and libraries in colleges and universities, with a total sample size of more than 500. The data comes from actual measurements and questionnaire surveys at Southwest Petroleum University, Kunming H Middle School, South China University of Technology, and other institutions, with good population and regional representativeness.

3.2 Analysis of Core Ergonomic Problems

3.2.1 Insufficient Matching Between Functional Dimensions and Human Body Dimensions

Size mismatch is the most common basic problem of campus seats, which directly forces users to adopt bad sitting postures to adapt to furniture. At present, desks and chairs in most colleges and universities adopt fixed-size design with a single specification, which cannot meet the needs of students with large height differences.

According to field measurement data of fixed desks and chairs in university classrooms, the tabletop height of most colleges and universities is about 790 mm, the seat height is about 440 mm, and the height difference between desk and chair is about 350 mm. According to Human Dimensions of Chinese Adults (GB/T 10000-1988), for people aged 18–25, the 5th percentile of male popliteal height is 383 mm, and the 95th percentile is 448 mm, while the corresponding values for females are 342 mm and 405 mm; the 5th percentile of male sitting elbow height is 228 mm, and the 95th percentile is 298 mm, while the corresponding values for females are 216 mm and 279 mm .

Fixed-size seats cannot fit users at both ends of the size range. When the seat is too high, short students will have their feet suspended, their calves compressed by sagging, and their bodies tilted backward, resulting in lack of lumbar support. When the tabletop is too high, users need to shrug their shoulders and raise their elbows to write, keeping shoulder muscles in a tense state. When the tabletop is too low, users have to lean forward significantly, increasing the burden on the cervical and lumbar spine [10].

Table 2 Matching analysis between existing campus desk/chair sizes and human body dimensions

Parameter	Measured Average	Reasonable Ergonomic Range	Core Matching Problems
Tabletop Height	790mm	700–760mm	Generally too high, forcing shoulder shrugging or forward leaning
Seat Height	440mm	380–440mm	Too high for female and short male students, causing suspended feet
Tabletop Depth	400–470mm	500–600mm	Relatively narrow, insufficient book storage space, too close a viewing distance
Seat Depth	440mm	380–420mm	Relatively deep; popliteal fossa easily compressed by seat front edge
Under-table clearance	580mm	≥620mm	Insufficient, knees easily hit the front seat backrest

Questionnaire results show that more than half of students think the height of desks and chairs is inappropriate, and 44% of students think the leg space under the table is insufficient. More than 70% of students report symptoms such as shoulder and neck soreness, waist discomfort, and buttock numbness after long-term use.

3.2.2 Morphological Design Inconsistent with Biomechanical Principles

At present, most campus seats have overly simple morphological designs, adopting flat seat surfaces and straight backrests, which lack matching with human physiological curves and cannot provide good support [11].

Figure 3 Comparison of spinal pressure between bad sitting posture and good sitting posture

Most seat backrests only provide basic leaning functions without special lumbar support structures. When sitting for a long time, the waist is in a suspended state, back muscles have to keep contracting to maintain posture, and lumbar intervertebral discs remain under high pressure for a long time. According to biomechanical research, in an upright sitting posture without lumbar support, the pressure on lumbar intervertebral discs is about 40% of that when standing; when leaning forward, the pressure rises to 1.8 times that of standing. Long-term maintenance of such posture will greatly increase the risk of lumbar muscle strain and lumbar disc herniation [12].

The hard flat seat surface concentrates body weight on the two ischial tuberosities, resulting in excessive local peak pressure, which blocks blood circulation in the buttocks and back of thighs, causing numbness and swelling after prolonged sitting. Most seat front edges are right-angled, which compresses blood vessels and nerves at the popliteal fossa, aggravating lower limb fatigue and swelling [13].

3.2.3 Weak Adaptability of Functional Design to Usage Scenarios

Different learning scenarios have significantly different functional requirements for desks and chairs, but most current campus seats have homogeneous and single functions, which cannot adapt to diverse usage needs.

Taking library reading desks and chairs as an example, traditional rectangular straight-edge tabletops cannot adapt to different activities such as reading, writing, and electronic device use. Users need to lean forward to get a proper viewing angle when reading, and their elbows lack effective support when writing. Frequent posture adjustments increase muscle burden. Most desks and chairs lack supporting functions such as storage space and charging interfaces, which cannot meet the electronic and multi-task learning habits of contemporary students.

In addition, most campus seats have no adjustment function and cannot change parameters according to users' height, body shape, and task type, resulting in great comfort differences of the same seat for different users, and cannot relieve sedentary fatigue by changing sitting posture. According to a KANO model-based survey, "adjustability" and "size adjustment" have become the most fundamental and high-level demands of students for reading desks and chairs, and are also key breakthroughs to improve student satisfaction [14].

3.2.4 Ergonomic Deficiency of Public Rest Seats

Public rest seats on campus often prioritize durability, landscape effect, and maintenance cost, while seriously neglecting ergonomic comfort. Common problems include too high or too low seat surface, an unreasonable backrest angle, and lack of armrest support, which can only meet very short-term seating needs and cannot achieve effective rest and relaxation [15]. Meanwhile, some all-metal seats have large temperature differences in winter and summer with poor tactile experience; the flat and smooth seat surface causes easy sliding when leaning, further reducing comfort.

IV. Ergonomic Optimization Design Strategies for Campus Seats

4.1 Standardized Design of Functional Dimensions Based on Human Body Dimensions

Size adaptation is the foundation of seat ergonomic design. It is necessary to establish a hierarchical and classified size standard system for different scenarios and target populations to ensure accurate matching between core parameters and human body dimensions.

4.1.1 Percentile Selection Principle for Size Design

For scenarios with small age span and concentrated height (primary and secondary school classrooms), 2 to 3 fixed size models can be set according to the anthropometric standards of corresponding age groups, covering students from the 5th to 95th percentile, such as low-height and high-height desk-chair sets. For scenarios with complex user groups and large height span (university libraries, public areas), adjustable structures should be prioritized to expand the size adaptation range and realize multi-purpose use of one seat [16].

Core parameters are determined according to the following rules:

Seat height: Taking foot contact with the ground as the baseline, the 5th percentile of the target population's popliteal height is the lower limit, and the 95th percentile is the upper limit, to avoid knee hyperextension for tall users.

Seat depth: Based on the requirement of no compression on the popliteal fossa, take the 50th percentile minus 60 mm to reserve buffer space.

Tabletop height: Determined by sitting elbow height, ensuring vertical upper arms when forearms are naturally placed on the tabletop, with minimum muscle load.

Under-table clearance: Meet the 95th percentile of sitting knee height and thigh thickness, to ensure sufficient space for leg movement and posture change.

4.1.2 Recommended Core Parameters of Campus Seats for Universities

Based on Chinese adult anthropometric standards and ergonomic design corrections, the recommended parameters of seats for core campus scenarios are shown in Table 3.

Table 3 Recommended core ergonomic parameters for campus seats in universities

Category	Parameter	Recommended Value / Adjustment Range	Design Basis
Seat Parameters	Seat Height	380–440mm (adjustable)	5th–95th percentile of popliteal height for 18-25 year olds + shoe correction
	Seat Width	≥480mm	95th percentile of sitting hip width + clothing correction + activity margin
	Seat Depth	380–420mm	50th percentile of sitting depth - 60 mm popliteal fossa reserve
	Effective Backrest Height	≥380mm (above seat surface)	Supports to lower scapula edge, covering lumbar and lower thoracic spine
	Backrest Width	≥420mm	Corrected by 95th percentile shoulder width
	Seat Tilt Angle	3–5°(lower front, higher back)	Prevents body sliding, improves backrest fit
	Backrest Tilt Angle	95°-105°	Shares upper body weight, reduces lumbar pressure
Tabletop Parameters	Tabletop Height	700–760mm (adjustable)	Seat height + sitting elbow height + posture correction
	Single-seat Table Width	≥600mm	Normal forearm working range requirement
	Tabletop Depth	≥500mm	Healthy viewing distance protection + book storage space demand
	Under-table clearance	≥620mm	95th percentile sitting knee height + activity margin

4.2 Biomechanics-Compliant Morphological Optimization Design

4.2.1 Curved Support Design of Backrest

The backrest should conform to the natural physiological curvature of the human spine, and adopt an "S"-shaped continuous curve to strengthen lumbar support.

Figure 4 Design principle of S-shaped bionic curved backrest support

A raised lumbar support structure is set at the position corresponding to the 3rd and 4th lumbar vertebrae, with a protrusion thickness of 10mm~15mm, which can effectively support the lumbar spine, maintain lumbar physiological lordosis, and greatly reduce intervertebral disc pressure. The backrest is integrally concave curved, increasing the back contact area and distributing pressure evenly on both sides of the spine.

Backrest height is adjusted according to scenarios: long-term self-study chairs adopt high backrests (above the lower scapula edge) to reduce muscle tension; classroom teaching seats adopt medium backrests, which ensure lumbar support without interfering with head and shoulder movements in class.

4.2.2 Pressure-Distributing Morphological Design of Seat Surface

The seat surface is curved, thick at the back and thin at the front, with a concave middle. The area corresponding to the ischial tuberosities is slightly recessed to increase contact area and reduce local peak pressure. The front edge adopts a waterfall-shaped design with a circular arc transition, which smoothly reduces edge compression on blood vessels and nerves at the popliteal fossa and ensures unobstructed lower limb blood circulation.

The seat cushion has a two-layer structure: "soft outside, rigid inside." The bottom layer is made of hard load-bearing material to ensure stability and durability; the surface layer is a 20~30mm thick elastic cushion, which distributes pressure and provides support, preventing excessive sinking of the buttocks and insufficient lumbar support. The surface material should preferably be breathable and wear-resistant textile fabric to improve long-term contact comfort.

4.3 Scenario-Based Functional Adaptation Design

4.3.1 Teaching Scenario: Compound Adaptation for Lecturing and Writing

Classroom desks and chairs should adapt to the two common postures of students in class. The tabletop angle is adjustable from 0° to 12°: a 10° to 12° tilt can reduce neck curvature and relieve cervical pressure during writing; a flat tabletop is suitable for listening to lectures, ensuring stable placement of school supplies.

Desks and chairs are arranged in a staggered layout, with chairs placed behind the front desks, so that front-row students do not block the sight of back-row students, and the longitudinal passage space is enlarged, facilitating students' access while maintaining classroom order.

4.3.2 Library Scenario: Functional Integration for Diverse Learning Behaviors

Library reading desks and chairs should adapt to reading, writing, electronic device use, and other activities. The tabletop is arc-edged and concave, with a concave depth of about 70 mm and width of about 420 mm, which fits the human chest contour, reduces trunk forward tilt angle, and relieves lumbar burden. Relevant experiments show that, compared with traditional straight-edge tabletops, arc-edged tabletops reduce trunk bending angle by about 2°, and improve waist comfort by about 20% after prolonged sitting [16].

The tabletop is equipped with hidden individual power sockets for charging mobile devices; open partitions under the table are provided for storing schoolbags and homework; the seat is equipped with height-adjustable armrests to provide arm support and reduce shoulder and back pressure.

4.3.3 Public Rest Scenario: Balanced Design of Comfort and Durability

Public rest seats are mainly for short-term use, with a seat height of 380~400mm for easy sitting and standing, and a backrest tilt angle of 100~110. Moderate armrests are provided, which not only provide support but also serve as seat dividers to enhance personal space perception.

Materials with low thermal conductivity and good environmental performance, such as solid wood and eco-friendly wood-plastic composites, are preferred to improve tactile experience under extreme winter and summer temperatures. The surface is treated with wear-resistant and waterproof coating to reduce maintenance costs and extend service life.

4.4 Adjustable and Growth-Oriented Design

Considering the characteristics of rapid physical development and large individual differences among students, campus seats should emphasize adjustability to achieve "one seat for multiple uses" and "adaptable to growth."

Basic adjustment includes seat height and tabletop height adjustment. Primary and secondary schools are suitable for gear-type adjustment structures with 3–5 height levels, which can adjust sizes with students' height growth and extend product service life. Universities can adopt gas struts or hand-crank stepless adjustment for precise adaptation, suitable for students of different heights.

Advanced adjustment realizes adaptation to different sitting postures and work needs through changes in seat depth, backrest tilt, and tabletop tilt. For long-term self-study chairs, sit-stand alternating function can be added, with table height adjustment range covering standing work height, so that students can change posture regularly to reduce sedentary hazards.

V. Design Practice and Verification: A Case Study of Reading Seats in University Libraries

5.1 Design Positioning and Scheme Conception

Taking the university library self-study scenario as the research object, targeting the characteristics of long daily self-study time, diverse task types, and frequent electronic device use, and combining the optimization design strategies proposed above, this paper carries out integrated optimization design of reading desks and chairs. The design aims to improve sedentary comfort, reduce musculoskeletal fatigue, adapt to various learning tasks, ensure good durability, and coordinate with library space.

5.2 Detailed Scheme Design

5.2.1 Seat System Design

The seat adopts a combination of mesh backrest and high-density latex cushion to ensure breathability and improve comfort. The backrest is an S-shaped curved structure with an up-down adjustable elastic lumbar support to adapt to the lumbar position of users of different heights. The seat surface has a waterfall-shaped front edge with a 4-tilt to prevent body sliding; the backrest tilt has two gears, 95°and 105.

Dimension parameters: seat height adjustment range 380–450mm, seat width 480mm, seat depth 400mm, total backrest height 500mm (above seat surface), armrest height 220–260mm (adjustable). The seat bottom is equipped with silent rollers and a positioning mechanism, balancing mobility and stability.

Figure 5: Schematic diagram of adjustable lumbar support mechanical structure

5.2.2 Tabletop System Design

The tabletop is arc-shaped and concave, with a concave depth of 72mm and width of 420mm, which fits the human trunk curve and reduces trunk forward tilt. The tabletop is divided into left and right operation areas, accounting for 70% and 30% of the area, respectively. The upper operation area has a tilt angle of 0–12, and the lower area has a tilt angle of 60–90.

The tabletop height is electrically adjustable from 540–760mm, adapting to both sitting and standing learning postures for sit-stand alternation. Hidden centralized Type-C and USB charging ports are arranged on the tabletop, and drawer-type storage is provided under the table to keep the desktop tidy. All panels are light-colored eco-friendly boards, with a simple and elegant style, matching the quiet reading atmosphere of the library.

5.3 Ergonomic Effect Verification of the Design Scheme

The ergonomic performance of the scheme is verified by combining objective physiological index testing and subjective evaluation. Twelve college students (6 males and 6 females, height 155 cm～185 cm) were invited as subjects, and two sets of seats were compared after 2 hours of standardized learning tasks.

5.3.1 Objective Index Test Results

The body pressure distribution test system was used to measure the pressure values of the seat surface and backrest. The results show that compared with traditional seats, the optimized scheme reduces peak seat pressure by about 28% and average pressure by about 17%, with more uniform pressure distribution; the waist contact area increases by about 40%, with significantly improved lumbar support effect, which can effectively disperse spinal load.

Posture capture analysis shows that when using the optimized scheme, the average trunk bending angle of subjects is 5.2°, much smaller than 8.7° of traditional desks and chairs; the neck bending angle is reduced by about 12°, the proportion of healthy sitting time is increased by 32%, and the incidence of bad sitting posture is significantly reduced.

5.3.2 Subjective Comfort Evaluation

The Likert 5-point scale was used for subjective comfort evaluation, covering four parts: waist, buttocks, neck, and thighs (1 = very uncomfortable, 5 = very comfortable). The results are shown in Table 4. The comfort scores of all parts of the optimized scheme are higher than those of traditional desks and chairs, with a comprehensive comfort score of 4.12, an increase of 43.6% compared with traditional desks and chairs. Among them, waist comfort improves the most, confirming the ergonomic improvement effect.

Table 4 Comparison of subjective comfort scores before and after optimization

Evaluation Part	Traditional Desks & Chairs	Optimized Scheme	Score Improvement
Waist	2.42	4.25	75.6%
Neck	2.75	3.92	42.5%
Buttocks	3.00	4.08	36.0%
Thighs	2.83	3.83	35.3%
Comprehensive Score	2.87	4.12	43.6%

VI. Conclusion and Prospect

6.1 Research Conclusions

Taking ergonomics as the core theory, aiming at the current design status and health pain points of multi-scenario campus seats, this paper systematically constructs an ergonomic optimization design system for campus seats, and verifies the effectiveness of the scheme through design practice. The main conclusions are as follows:

First, current campus seats in China generally have problems such as size mismatch, non-biomechanical shape design, and weak scenario adaptation, which are inducing factors of musculoskeletal fatigue for students after prolonged sitting, and ergonomic upgrading is urgently needed.

Second, the ergonomic design of campus seats should establish a hierarchical adaptive size system, select core parameters according to the physical characteristics of the target population, and improve spinal support and body pressure distribution through morphological designs such as S-shaped backrests and pressure-distributing seat surfaces, so as to reduce sedentary hazards from the physiological level.

Third, the ergonomic demands of seats vary greatly across different campus scenarios. It is necessary to design scenario-based functions according to use duration and behavioral characteristics, and adopt adjustable structures to extend product life cycle and improve practicability and growth adaptability.

Fourth, for university library reading seats, humanized designs such as arc-edged tabletops, adjustable lumbar supports, and tiltable tabletops can effectively improve seat comfort and health, relieve sedentary discomfort, and have good promotion value.

6.2 Limitations and Prospects

The size parameters of this study are mainly based on the adult population aged 18–25, and the detailed sizes for primary and secondary school students need to be further refined according to the anthropometric data of corresponding age groups. Meanwhile, the sample size in the verification stage is small, and future research can expand the sample size and carry out long-term tracking of health effects.

In the future, intelligent sensing technology can be integrated into campus seat ergonomic design. Built-in pressure sensors and posture recognition modules can realize functions such as sitting posture monitoring, sedentary reminder, and automatic parameter matching, transforming from passive adaptation to the human body to active health intervention, and bringing more possibilities for the intelligent and healthy development of campus learning spaces.

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