Research on Methods for Improving Student Experience in Classroom Chairs Based on Human Factors in Chair Design

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Abstract: Classroom furniture design is an important factor affecting students' psychological, physiological, and knowledge absorption. This paper focuses on the influence of chairs on students, especially children's mental health, and analysis the human factors in chair design, aiming to improve the learning experience and mental health. By examining ergonomic factors, psychological needs, and student feedback, the potential impact of chairs on student mental health is analyzed, and improvements are suggested. This paper reviews the relevant literature, using field surveys and interviews with five students to study the impact of different chair designs on students' mental health. The results show that reasonable chair design promotes students' positive emotions, concentration, and comfort, while improper design may lead to anxiety and physical discomfort. Considering many factors, this paper proposes suggestions for optimizing chair design to promote students' mental health, including comfort, support, and aesthetic design. After improvement, we can provide a better learning environment for students and promote their mental health and academic achievement.

1. Introduction

The focus of academics and society is the influence of chairs on students, especially children's mental health. In recent days, chairs have become necessary tools in assisting us to study, rest, and eat. Within university contexts, seating furniture, including classroom chairs, is one of the most necessary pieces of furniture to provide students with a comfortable learning environment. The design of the chair affects the physical comfort of the students and also affects the psychological state and knowledge absorption of the students. As our understanding of student mental health has grown, people have become more aware of chair design's impact on student psychology. The comfortable and ergonomic chair can enhance students' learning enthusiasm and concentration, which is conducive to the healthy development of psychology. On the contrary, unreasonable chair design may lead to students' physical discomfort and anxiety, potentially threatening their mental health. We take children's mental health as the starting point and analyze the human factors in chair design, including pressure distribution, anthropometric analysis, deficiencies, and user feedback. Students' user feedback will be detailedly analyzed and elaborated on with the aim of creating an appropriate learning environment for students' mental health. Therefore, this study aims to focus on the impact of chairs on student mental health and to provide students with a more mentally healthy learning environment by improving chair design. Optimizing the design of the chair and enhancing the student's learning experience will help promote the overall development of the student's mental health.

2. Literature Review

Classroom chair design affects not only students' physical comfort but also affects students' psychological state and knowledge absorption ability. Related research has tested and explored this issue.

Based on anthropometric measurements of 10-14-year-olds, Parcells, Stommel, and Hubbard found that there is "a substantial degree of mismatch between the students' bodily dimensions and the

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classroom furniture available to them" [1]. They found that fewer than 20% of students have appropriate furniture, which is especially problematic for female students.

In a quantitative cross-sectional study, Harvey and Kenyon surveyed college students about five popular types of classroom chairs, seeking to elicit student perceptions of three key dimensions: Comfort and Space, Learning Engagement, and Interactivity. They found that students preferred modern mobile chairs, suggesting the need to "(re)consider the purposes and roles of seating styles within the 21st-century classrooms, with seating selection based on principles of universal design" [2].

In addition, research conducted at the University of Bangladesh examined whether its classroom furniture was manufactured for ergonomic factors or not. The researchers analyzed and compared the classroom chair dimensions with students' anthropometric data, exploring the potential mismatch between the two. The research reached the conclusion that the seat height of both desk-and-chair and side-mounted-desktop-chair was high, while the desk height of the desk-and-chair was high, and that of the side-mounted desktop chair was low for the students [3].

However, the studies mentioned above were based on anthropometric measurements or large-scale questionnaires. They did not aim to elicit students' in-depth perceptions or experiences of their chairs through interviews as the present study does. Additionally, the current study focuses on Asian students' perceptions of classroom chairs and how students of different heights experience these chairs.

The purpose of the study is to explore students' views on chairs through interviews from the perspective of the influence of chairs on students' psychological, physiological, and knowledge absorption and to provide in-depth understanding and suggestions for optimizing the design of classroom chairs.

3. Research Methods

The research aims to interview Asian students to consider their feelings about the comfort of chairs and possible improvements from the impact of chairs on students, especially children's mental health. The following will elaborate on the limitations of the participant recruitment, interview process, data analysis, and research.

Figure 1 Picture of the classroom chair of one West Coast University

To ensure the results are representative and reliable, we recruited five Asian students from one West Coast University who regularly use classroom chairs. The students were recruited through the researcher's network but were purposely selected to represent a diversity of heights and body sizes.

The participants' heights are 155cm, 160cm, 165cm, 183cm, and 185cm. Their corresponding body sizes are slim, average, overweight, and average. Three of the participants were female, and two were male. All were Asian. They ranged in age from 19-21 and represented different STEM majors at the university and thus had experience with the same type of chair. Figure 1 shows the picture of the classroom chair of one West Coast University.

Interviews were conducted over the phone to facilitate the participants to express their views freely in a familiar environment. We prepared an interview guide in advance, mainly covering the students' feelings and experiences with the comfort of classroom chairs. Specific issues include how soft or firm the seat is, how back support, seat height, and width affect the student. In addition, we asked students about their views on the coordination of seats and desktops, as well as the evaluation of chair materials and appearance design. For the students who put forward suggestions, we have an in-depth understanding of their hope to develop specific improvement measures and suggestions. All the interviews were recorded to ensure the accuracy and reliability of the data [4].

After the interview, the researchers detailed analyzed and sorted out the recorded content. The student's feelings and experiences of the comfort of the chairs were obtained by classifying the interview content. In the data analysis process, we examine the differences in students' perceptions of chairs with different heights and body types and further explore the possible influencing factors.

There are some limitations to be explained. First, the sample size is small, with only five participants, which may only partially represent some of the students in the university. Second, the participants are all Asian students and their cultural background and physical characteristics may differ from those of students in other regions. Therefore, caution should be exercised when generalizing the findings. Finally, participants' subjective awareness and recall bias may affect the interview in this study.

In summary, this study aims to gain an in-depth understanding of Asian students' feelings and experiences of classroom chairs, as well as suggestions for improvements in the design of classroom chairs. We hope to provide valuable references and suggestions for optimizing the design of classroom chairs to improve students ' learning experiences and children's mental health. However, we are aware of the limitations of the research. Future investigation can expand the sample size and consider differences in other cultural and physical characteristics to obtain more comprehensive and accurate research results.

4. Investigation Results

Through interviews and data analysis of five Asian students, we have gained an in-depth understanding of their feelings about classroom chairs, as well as opinions about improvements in chair design. Here are the key takeaways from the survey:

Firstly, sitting experience and long-term use:

In the study, we asked participants how they felt when using classroom chairs at different times [5]. Most students say the chair is comfortable in the short term (about 50 minutes), but in the long term (90 minutes duration), some students say they are distracted, especially without proper support. It shows that the chair's design needs to consider long-term use to meet the needs of students and reduce the interference of discomfort with learning [6].

Secondly, the impact of visual design and appearance:

Students have different opinions about the visual design and appearance of classroom chairs. Some students believe that chairs don't need to be particularly flashy as long as they fit into the classroom environment. However, some students find that the chair's appearance influences the learning experience. Some students suggest improving the appearance of chairs and using materials such as soft leather to make them prettier and possibly more comfortable. Therefore, the design of classroom chairs should balance functionality and aesthetics to provide a pleasant learning environment.

Thirdly, the importance of the height adjustment function:

We found that interviewees generally attach importance to the height adjustment function of classroom chairs. Adjustable chair height can assist students in adjusting their seats according to their height and ensure that their feet can sit entirely on the ground to get support and comfort. However,

some students reported occasional problems with height adjustment, causing the chair to sink and affecting comfort. Therefore, improving the stability and flexibility of the height adjustment function is an important measure to improve sitting comfort [7].

Fourthly, the seat and backrest cushions need improvements:

In the feedback, some students mentioned that they wanted to improve the seats and cushions on the back. Using softer and more comfortable cushions can reduce the discomfort caused by longtime sitting posture and improve learning efficiency. In addition, optimizing the materials and fillers on the seat and backrest to adapt to the body's characteristics and needs is also a meaningful way to improve comfort.

Fifthly, desktop design and function improvement:

Some students find the desktops too small to put objects or write on. Furthermore, for side-mounted desktop chairs, students mentioned the problem that the desktop is too high or too low. Improving the desktop design to make it more in line with the needs of students as well as improve practicality and comfort.

Through interviews and data analysis, we have an in-depth understanding of the impact of classroom chairs on students' psychological, physiological, and knowledge absorption. Comfort, visual design, height adjustment function, seat and backrest cushions, and desktop design and function are important factors affecting the student experience. Therefore, in the chair design process, we should be human-centered and fully consider students' physical characteristics and needs to provide more comfortable and practical chairs. According to the above, this paper proposes the following design modification scheme.

From the psychological point of view, the visual design of chairs should be in line with students' aesthetic preferences and personality characteristics, so designers can use different colors, patterns, and shapes to enhance students' emotional identity and sense of belonging [8].

From a physiological point of view, the chair's comfort and support should meet the student's height and postural needs. By adjusting the height, angle, and elasticity, it can adapt to different student preferences [9].

From the perspective of knowledge absorption, the desktop design and function of chairs should align with students' learning habits and goals; a foldable and rotatable desktop is available in different learning modes and scenarios [10].

To sum up, this study provides a valuable reference for optimizing classroom chairs, which is expected to improve student's learning experience and promote children's mental health. However, the sample size is small, and future research can further expand the sample size to consider the needs of students from different cultures and regions to obtain more comprehensive and accurate results [11].

5. Discussion

Based on our interviews and data analysis with five Asian students, the design of classroom chairs significantly impacted the student experience and learning. First, comfort experience and long-term use are issues of common concern in chair design. Students generally believe chairs are comfortable for short-term use, but lack of proper support leads to distraction and discomfort when used for a long time. Therefore, optimizing chair design, considering students' sitting conditions, and providing support and comfort are crucial to improving students' learning experiences.

Second, students also have different views on classroom chairs' visual design and appearance [12]. Some students think that the chair's appearance does not need to be too fancy as long as it conforms to the classroom environment; others believe that appearance has a specific impact on the learning experience. Thus, in the design of classroom chairs, we must balance functionality and aesthetics, provide designs that meet students' aesthetic preferences, and create a pleasant environment.

Moreover, the height adjustment function is an issue that students general concern about. They believe the height adjustment function is vital to adjust the seat for better support and comfort.

However, students occasionally reported that the chair sank due to height adjustment, making them feel uncomfortable. Therefore, improving the stability and flexibility of the height adjustment

function is the key to improving the chair's comfort.

Seats and cushions on the back are also one of the issues proposed by students. Using softer and more comfortable cushions can reduce the discomfort caused by longtime sitting posture and improve learning efficiency. In addition, optimizing the materials and fillers on the seat and backrest to adapt to the body's characteristics and needs is also a practical way.

Finally, some students feel the small desk area is insufficient for activities such as placing study materials or writing. For side-mounted desktops, students mentioned problems with the desktop being too high or too low. We must improve the desktop's design to meet the student's needs and increase its practicality and convenience.

To sum up, the design of classroom chairs has an essential impact on students' learning. Comfort, visual design, height adjustment function, seat and backrest cushions, and desktop design are all hot topics. Considering the students' psychological, physiological condition and knowledge absorption and optimizing the chairs, we can create a more suitable environment for learning, improve students' learning efficiency and promote the development of mental health. Furthermore, it is a good idea to expand the sample size. Considering the needs of students from different cultures and regions, researchers can further explore the relationship between chair design and students' learning effects and mental health to provide a more scientific basis for optimizing classroom chairs.

The influence of the shape and design of chairs on students' psychological, physiological, and knowledge absorption is summarized as follows.

For psychology, the comfortable chair design can improve students' learning enthusiasm and engagement, reduce pressure, and thus promote students' academic performance. Sitting in comfortable chairs makes them feel relaxed and happy, which is conducive to their emotion.

From a physiological point of view, improper sitting posture for a long period of time can cause problems and pressure on the spine, which adversely affects the physical health of students. Therefore, the designers need to consider students' physical characteristics and needs, provide good support, reduce discomfort, and ensure students' health.

For knowledge absorption, a comfortable chair design helps students focus and improve learning efficiency and knowledge absorption. Students can better focus on learning content in a comfortable chair, which is conducive to the digestion and absorption of knowledge.

Based on the three aspects discussed above, this paper puts forward the following suggestions.

First, considering the appearance and material of the chair, choose soft leather and other materials to improve the texture of the chair and increase the comfort of the students. At the same time, the shape of the chair should also conform to the environment and create a pleasant learning atmosphere [13]. Second, thickening the seat and backrest cushion to provide better support and comfort and reduce the discomfort caused by students' sitting posture. At the same time, it is necessary to ensure the height adjustment function, and prevent the chair from sinking with the use and affecting the learning experience. In addition, consideration should be given to providing tables and chairs of various heights to match students of different heights [14]. Third, optimize the desktop design, and provide enough workspace to meet the needs of students. For side-mounted desktop chairs, adjust the desktop height to make it in line with the physical characteristics of students [15].

To sum up, improving the design of classroom chairs and considering the needs of students' psychological, physiological, and knowledge absorption will improve their learning experience and performance. In addition, it is suggested that future research further investigate the relationship between classroom chair design and learning effects and mental health to provide a scientific basis for creating appropriate classroom environments.

References

[1] Parcells C, Stommel M, Hubbard R P. Mismatch of classroom furniture and student body dimensions: empirical findings and health implications[J]. Journal of adolescent health, 1999, 24(4): 265-273.

[2] Harvey E J, Kenyon M C. Classroom seating considerations for 21st century students and

faculty[J]. Journal of Learning Spaces, 2013, 2(1).

[3] Parvez M S, Tasnim N, Talapatra S, et al. Are library furniture dimensions appropriate for anthropometric measurements of university students? [J]. Journal of Industrial and Production Engineering, 2022, 39(5): 365-380.

[4] Dray J, Bowman J, Campbell E, et al. Systematic review of universal resilience-focused interventions targeting child and adolescent mental health in the school setting[J]. Journal of the American Academy of Child & Adolescent Psychiatry, 2017, 56(10): 813-824.

[5] Schulte-Körne G. Mental health problems in a school setting in children and adolescents[J]. Deutsches Ärzteblatt International, 2016, 113(11): 183.

[6] Zemp R, Taylor W R, Lorenzetti S. Are pressure measurements effective in the assessment of office chair comfort/discomfort? A review[J]. Applied Ergonomics, 2015, 48: 273-282.

[7] Ansari S, Nikpay A, Varmazyar S. Design and development of an ergonomic chair for students in educational settings[J]. Health scope, 2018, 7(4).

[8] Moes N C C M. Analysis of sitting discomfort, a review[M]//Contemporary ergonomics 2005. Taylor & Francis, 2023: 200-204.

[9] Shen Z, Wan X, Jin Y, et al. SeatPlus: A Smart Health Chair Supporting Active Sitting Posture Correction[C]//International Conference on Human-Computer Interaction. Cham: Springer International Publishing, 2021: 531-547.

[10] Huang M, Gibson I, Yang R. Smart chair for monitoring of sitting behavior[J]. KnE Engineering, 2017: 274-280.

[11] Hassanain M A, Iftikhar A. Framework model for post-occupancy evaluation of school facilities[J]. Structural Survey, 2015, 33(4/5): 322-336.

[12] Lewinski P. Effects of classrooms' architecture on academic performance in view of telic versus paratelic motivation: a review[J]. Frontiers in psychology, 2015, 6: 746.

[13] Guo L X, Dong R C, Zhang M. Effect of lumbar support on seating comfort predicted by a whole human body-seat model[J]. International Journal of Industrial Ergonomics, 2016, 53: 319-327.

[14] Casas S A S, Patiño S M S, Camargo L D M. Association between the sitting posture and back pain in college students[J]. Revista de la Universidad Industrial de Santander. Salud, 2016, 48(4): 446-454.

[15] Narenthiran O P, Torero J, Woodrow M. Inclusive Design of Workspaces: Mixed Methods Approach to Understanding Users[J]. Sustainability, 2022, 14(6): 3337.