

Ergonomic Design of Desk and Chair for Primary School Students in Taiwan

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Abstract: The objective of this study presents an ergonomic application of anthropometric database which was established by National Science Council and National Tsing Hua University in Taiwan, in used of designing high school, primary school and primary students' desks and chairs. The project has been proceed for three years, each stage are focused on different age students. The range of growth change in school is variety. The traditional desk and chairs are not able to fit all students in different body figure. How to achieve the requirement of students for different body situation is the major consideration in this study. The procedures adopted for the assessment included the current school furniture survey, a design analysis and a subjective comfort evaluation. Then, the result of study focuses on the application of an anthropometric survey of school in Taiwan. Finally, bases on the anthropometric database, the anthropometric consideration of school furniture are suggested for designing primary school desks and chairs in Taiwan. The design approach proposed a series of desks and chairs adjustable in ergonomic issues. In design consideration, the production cost, ease of management and installation is important factors to undertake in this project.

Keywords: *anthropometric, anthropometric database, school students, design approach , primary school desk and chair*

1. Introduction

This paper presents a study on the ergonomic application of anthropometric database in used of designing primary school students' desks and chairs. Nowadays the establishment of anthropometric database was taken in Taiwan and effective. The department of Industrial Engineering and management , National Tsing Hua university, established the "The anthropometric database from primary school to high school students" which was supported by National Science Council. Since the school students anthropometric databse has been established, the anthropometric database will be completely in Taiwan. And it will be useful reference for environmental safety and design regulation establishment. However, how to apply anthropometric database in used of product design is another important objective. "Ergonomic design of desk and chair for primary school students" is the sub-plan of "The Establishment of Elementary and Primary school Students Anthropometric Databases of Taiwan Population ". The objective of this study focuses on the application of an anthropometric database of Taiwanese people, in use of designing primary school teaching equipment. The procedures adopted for the assessment included the current school furniture survey, a design analysis and a subjective comfort evaluation. Then, the results of this study focuses on the application of an anthropometric survey of primary school in Taiwan, Finally, bases on the anthropometric database, the anthropometric considerations of school furniture are suggested for designing

primary school furniture in Taiwan.

2. Method

2.1 Current Primary school students' desk and chair

Ministry of Education in Taiwan has consulted with Department of Biomedical Engineering, National Taiwan University. To design the ideal school desk and chair for school student. (Tab1, Fig1, Fig2) In considering Human Factor issue, identified 10 type of different desk surface height and 5 type of different seat surface height school desk and chair. It was completely consideration to fit students in different body figure range. However, from the manufacture and capitalization point of view, to produce 15 type of different desk and chair, it requires 15 type of production process. From school managing point of view, to store different type of desk and chair in order to provide variety body range of students is necessity. Also it is required to organize different type of desks and chairs to suit different body figure student in every new school year. Therefore, how to undertake ergonomic requirement, saving production cost, desk and chair management in school and students needs is the most important issue in this study.

Table 1. Ideal school chairs for school students' size.

| Type | 115 | 130 | 145 | 160 | 175 |
|-------------------------|-----------|-----------|-----------|-----------|-----------|
| Range of student height | 106-120.9 | 121-135.9 | 136-150.9 | 151-165.9 | 166-180.9 |
| Seat surface width | 30 | 34 | 36 | 38 | 40 |



Fig1 current school desk and chair



Fig2 students in class

2.2 Ergonomic Dimension

R.T Lin has studied the subjective preference assessment, and related research about ideal dimension which was taken in Taiwan and foreign countries. Suggest and establish the dimension model for school students' desks and chairs for Taiwanese school students. [1] Normally it was divided in three categories. "Extremely design" which is considering the application for extremely figure, such as fat, thin, tall and short people. "Average people and adjustable design" is for ordinary people, actually average people is not existed. Therefore "Average people design" is constrained for people whom are not suitable for extremely design and adjustable design. In considering the ergonomic dimension of primary school students' desks and chairs for Taiwanese primary school students. This research has followed the model, applied the anthropometric database in used of primary school students' desk and chair ergonomic design as Fig3 and Tab2. Fig3 and Tab2 show the ideal ergonomic dimension for primary school students apply by "Average design", for example like seat depth, "Extremely design" for example like seat width, and "Adjustable design" for example like seat and desk surface height.

2.3 Design development

This design project simulates a class in normal distribution situation. School desk and chair have to undertake students' physical and psychological need. A class included different body figure range student. Students require different type of desks and chairs to fit their body figure. Students are full of energy in growing

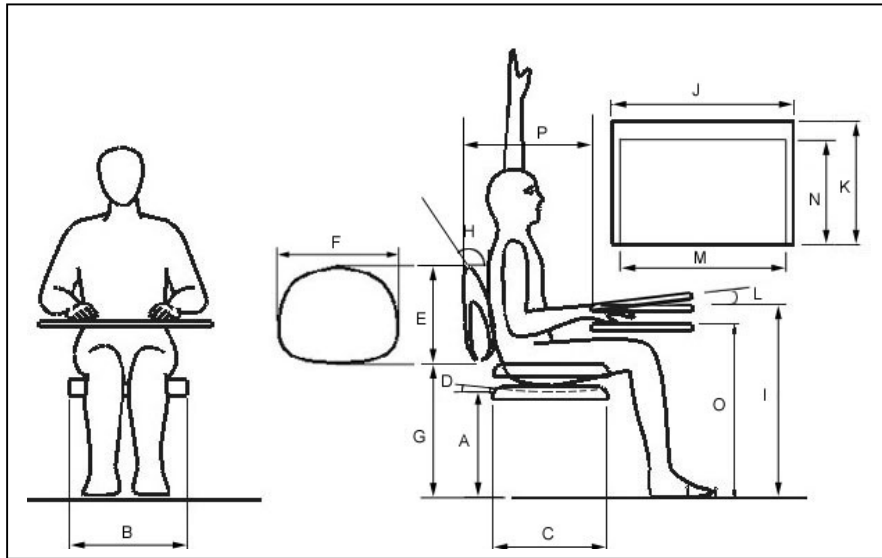


Fig3 ideal ergonomic dimension for primary school students

Table2 Ergonomic suggestion for ideal desk and chair design

| 代號 | item | 5 % | 50 % | 95 % | Design |
|----|---------------------|------------|------------|------------|-------------------|
| A | Seat surface height | 28.8 cm | 35.2 cm | 40.4cm | Adjustable design |
| | Adjustable range | 27-33 cm | 33-39 cm | 39-45cm | |
| B | Seat surface width | 38cm | 38cm | 38cm | Extremely design |
| C | Seat surface depth | 37cm | 37cm | 37cm | Average design |
| D | Seat surface angel | 3- 5° | 3 - 5° | 3 - 5° | Average design |
| E | Back support length | 30cm | 30cm | 30cm | Average design |
| F | Back support width | 40cm | 40cm | 40cm | Extremely design |
| G | Back support angel | 100 - 105° | 100 - 105° | 100 - 105° | Average design |
| H | Desk surface height | 58cm | 64cm | 70cm | Adjustable design |
| | Adjustable range | 56-62cm | 62-68cm | 68-74cm | |
| I | Desk width | 65cm | 65cm | 65cm | Average design |
| J | Desk Depth | 50cm | 50cm | 50cm | Average design |
| K | Desk angel | 0~10° | 0~10° | 0~10° | Average design |
| L | Drawer width | 55cm | 55cm | 55cm | Average design |

up age, school desk and chair have afforded students' unusual using way. Applying more storage space for students' staff. The comfortable using interface is for whole class day. Considering the production process to simply production procedure and to reduce production cost. School is easy to organize their desk and chair in a school even in each classroom. Undertaking the suitable material to reduce wood material consumption. Above issues are design strategies in design development. Some of design idea sketch as follow: (Fig4, Fig5, Fig6, Fig7)

3. Discussion

The ideal primary school student desk and surface height, seat surface height, suggesting to establish on "adjustable design". based on (Fig1 and Tab1). How to design the adjustable way to achieve capital issue and suitable for different body figure's students. The design features are as follow:

3.1 To suit for different body figure student

With the adjusting items, the students can adjust the suitable desk and seat surface height from the adjustable

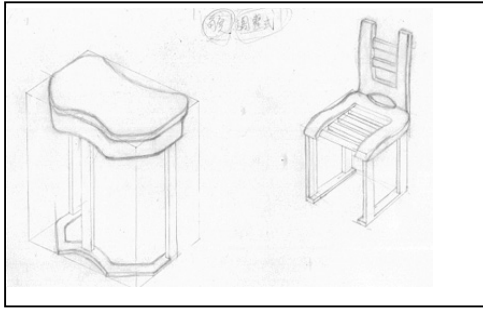


Fig4 Idea sketch1

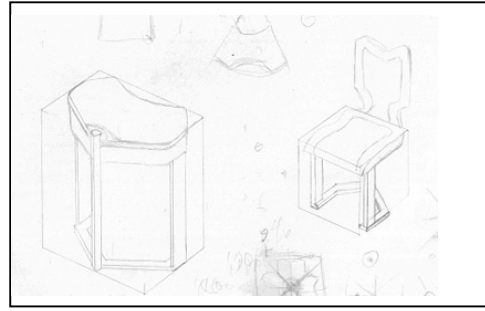


Fig5 Idea sketch2

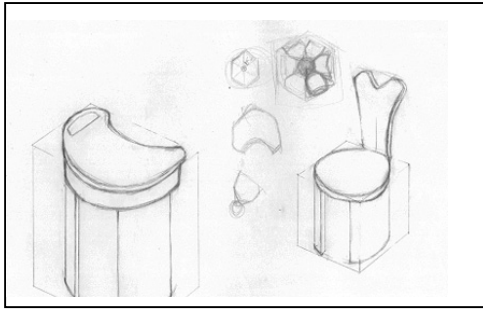


Fig6 Idea sketch3

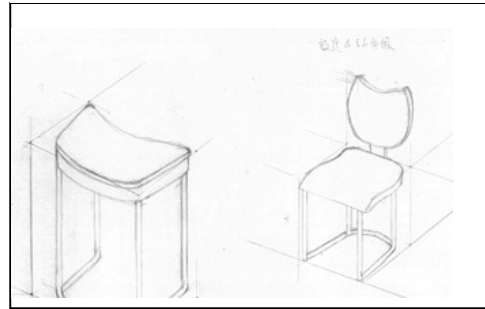


Fig7 Idea sketch4

items.(Fig8, Fig9) Students can adjust dynamic dimension suitable for different body figure. For the desk and chair, the adjustable dimensions are both for seat and desk surface height (Fig8, Fig9, Fig10). To consider the adjustable range for primary school students, their body dimension are between in wide range. How to establish a reasonable adjustable range for different range students, we suggest the adjustable item should based on Fig3 and Tab2. Different body figure student can adjust suitable desk and chair for themselves

3.2 To consider teaching activities

The desk and chairs can combine together in order to undertake variety primary school teaching activities. And the combination way is flexible to achieve different group teaching process or team working activities as. Fig11. The cabinets are necessity for students to storage for their stuff in primary school as Fig12. In design consideration, the cabinets should adopt with teaching activities not only for storage purpose. Therefore, the cabinets are designed to become serious of teaching equipment and easy to combine with desks and chair as Fig13.

3.3 To consider production issue

The desk and chair system will vary only in the adjusting items. With the design, only adjusting item will make it possible to meet the requirement of all students. In production process, a unique adjusting item of desk surface, seat surface, made by plastic injection, a set of steel pipe, can simply production process reduce production cost.

3.4 Convenience for management

For the adjusting items. School does not have to spare different type of desks and chairs. It is also convenience for school to purchase desk and chair, to organize desk and chair in each classroom.

3.5 Material consideration

In economic consideration, the frame is made by plastic. It achieves strong and durable character. Desk and chair



Fig8 adjusting item



Fig9 adjusting way



Fig10 adjusting desk and chair

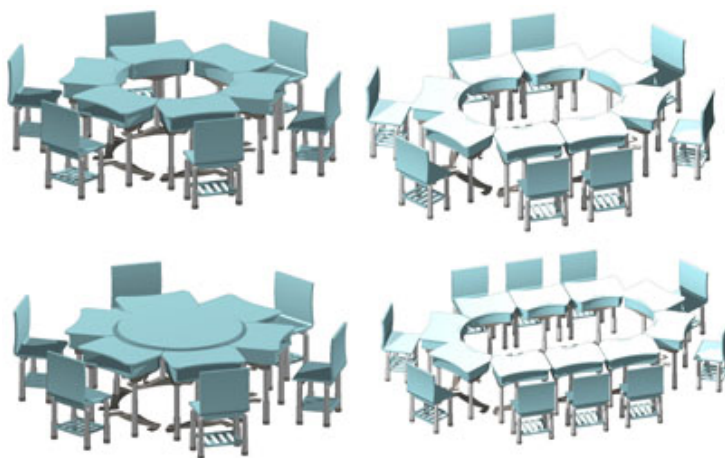


Fig11 flexible combination of desks and chairs



Fig12 flexible combination of cabinets



Fig13 flexible combination of desks, chairs and cabinets

made by plastic as well. Also achieve strong and durable character. The plastic parts are easy to maintain and clean, the material will reduce wood consumption.

4. Conclusion

This study is using industrial tool to consider ergonomic demand, to undertake the capital issue in order to establish the design regulation to suitable for different body figure's primary school students. The achievement of this project are using ergonomic tool to achieve suitable desk and chair for student, and the using product design method to undertake the production issue, convenience management for school and material consideration. The structure of adjustable item has been applied for pattern. The evaluation stage is holding on next stage in order to exam the design achievement. This study can be reference of how to use anthropometric database and ergonomic in product design.

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