Analysis Anthropometry Comfort of Table and Chairs in the Elementary School Class

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Abstract. This study aims to calculate the level of anthropometric compatibility of elementary school students with the design of learning furniture that they use in school. This research uses a descriptive method. The data analyzed included the dimensions of the table and chairs as well as the Anthropometry data of grade 1, grade 4 and grade 6 elementary school students. Research sites include Inpres Tanah Miring I Elementary School, Inpres Tanah Miring IV Elementary School, and Inpres Tanah Miring VII Elementary School. The results showed that the dimensions of the desk had a height of a work table is 77 cm, a width is 50 cm, and a length is 120 cm. The dimensions of the chair has a height of 43 cm, width of the back is 39 cm, seat width is 40 and seat length is 120 cm. The difference between the standard size and the size of the survey results in the spotlight is the difference in height over the work table for elementary school grade 1 is 13.5 cm, grade 4 is 7.5 cm and for grade 6 is 1.5 cm and table height for grade 1 is 21 cm, grade 4 is 16.5 cm, and for grade 6 is 10 cm.

Keywords: anthropometry, elementary school, learning facilities

1. Introduction

The interior is the inside of a building or room, the order of furniture or decoration inside the interior of a building. When interpreted, interior design is the initial idea intended for a room or a plan from the inside of a building so that the room has a value of life / aesthetics [1]. Interior finishing has a greater influence on children than overall building design, because the growth of a person is influenced by the physical environment [2]. The physical environment is in the form of physical condition of the dwelling (building) and space (interior) along with all the furniture [3]. If the classroom becomes very comfortable to move in it, it can affect the formation and development of children's behavior. Children need a place where they can grow and develop freely, and expressing feelings such as the development of creativity. The demand continues to grow and develop every day, from new games that can be found in the world of children themselves [4],[5].

There are several principles that need to be considered by the teacher in managing the physical environment of the classroom according to Loisell [6], [7] namely:
a. Visibility

Visibility means the placement and arrangement of items in the classroom does not interfere with students' views.

b. Accessibility (easily achieved)

Spatial planning must be able to make it easier for students to reach or retrieve the items needed during the learning process. Accessibility can also include circulation. Circulation is the direction and guidance of the road that occurs in space. Circulation is achieved by laying down doors, floor games, and ceiling games [8]. According to the standard circulation of 45% circulation and physical comfort (body movement), this circulation is good for the room used for two occupants.

c. Space flexibility (Dexterity)

Space flexibility is where a space can be used for several activities of different characters and can be changed in the arrangement of space without changing the structure of the building. There are 3 concepts of flexibility, namely expansionability, convertibility and versatility.

d. Convenience

Comfort here relates to room temperature, light, sound and class density.

e. Beauty

The principle of beauty is related to efforts to organize classrooms that are fun and conducive to learning activities. A beautiful and pleasant classroom can have a positive effect on students' attitudes and behavior towards the learning activities carried out.

Effective learning can start from the classroom climate that can create an exciting learning atmosphere, for this reason, it is necessary to pay attention to the arrangement / arrangement of classrooms and their contents. The classroom environment needs to be well organized so as to enable active interaction between students and teachers, and between students. Space management in the world of education is very important for the learning process in schools. The main purpose of structuring classrooms is to direct student activities and prevent the emergence of unexpected student behavior through the arrangement of seats, furniture, displays, and other items.

Seating arrangement is an effort made by the teacher in managing the classroom, it is hoped that effective classroom management will determine the learning outcomes achieved. With a good seating arrangement, it is expected to create conditions for learning that are conducive, and also fun for students. This is consistent with Winzer's opinion [10] that the proper arrangement of the classroom environment influences the level of student involvement and participation in the learning process. Furthermore, it is known that seating affects student comfort in learning.

Educational infrastructure is one of the main elements in the world of education. Therefore, the completeness of educational infrastructure in schools needs to be considered for the progress of the school. In addition to the arrangement of educational infrastructure facilities also need to be considered for convenience in the teaching and learning process. Facilities are all physical and non-physical forms that are directly used to support the educational process, especially the teaching and learning process, such as buildings, classrooms, tables, chairs, and teaching equipment and media. Infrastructure or facilities are all things that indirectly support the course of the process of education or teaching such as the yard, garden, park, and road to school. Infrastructure or facilities are also referred to as hidden curriculums and will turn into educational facilities if used directly for teaching and learning. Classroom furniture is an important physical facility because many student learning activities are spent in the classroom such as reading, drawing, writing and other activities. Schools must provide class furniture that can meet the needs of students because if used class furniture that has poor design in the long term can have a negative impact on student health.

In the interior of the school furniture is very determining students in accessing activities in the classroom. Therefore furniture must be adjusted to the height of students. However, because in one high class the students are different then it must be made a standard that is common to all students.
The standard that is often used as a standard for measuring school furniture on an international scale is the ISO (International Organization of Standardization) standard. But not all countries use these standards. The following data is about ISO furniture and chairs [11].

### Table 1. Student table size data by age

| Until age | high range (cm) | base table height (cm) | the height on the work table (cm) |
|-----------|-----------------|------------------------|----------------------------------|
| 15        | 167.5           | 76.0                   | 91.5                             |
| 12        | 148.5           | 68.5                   | 79.5                             |
| 9         | 132.0           | 63.5                   | 69.5                             |
| 7         | 120.0           | 58.5                   | 63.5                             |
| 5         | 109.0           | 48.5                   | 57.0                             |

| Until age | work table width (cm) | table height (cm) | table length (cm) |
|-----------|-----------------------|-------------------|-------------------|
| 15        | 46.0                  | 55.0              | 76.0              |
| 12        | 42.0                  | 59.0              | 71.0              |
| 9         | 38.0                  | 52.5              | 61.0              |
| 7         | 35.5                  | 48.0              | 61.0              |
| 5         | 33.0                  | 44.5              | 53.5              |

Based on the above table it can be explained that the height of the range for elementary school children 120 - 148.5 cm, the height of the base table 58.8 - 68.5 cm, the height of the work table 63.5 - 79.5 cm, the width of the work table 35.5 - 42 cm, table height 48 - 55 cm, table length 61 - 71 cm. So it concluded that the size of the table for elementary school children is the height of the table 48.5 - 68.5 cm, the width of the table 33-42 cm, the length of the table 53.5 - 71 cm [8].

### Table 2. Data on student seat sizes by age

| Age | high chair (cm) | hip space (cm) | hip support height (cm) |
|-----|-----------------|----------------|------------------------|
| 15  | 40.5            | 15.0           | 17.5                   |
| 12  | 37.0            | 14.5           | 16.0                   |
| 9   | 32.5            | 13.5           | 14.0                   |
| 7   | 29.0            | 13.0           | 13.0                   |
| 5   | 26.5            | 12.0           | 12.5                   |

| Age | back width (cm) | seat width (cm) | seat length (cm) |
|-----|-----------------|-----------------|-----------------|
| 15  | 44.5            | 38.0            | 37.0            |
| 12  | 42.0            | 37.0            | 34.0            |
| 9   | 35.5            | 33.0            | 30.0            |
| 7   | 33.0            | 30.5            | 27.5            |
| 5   | 30.5            | 28.0            | 25.0            |

Seats are facilities or items needed by students in the learning process, especially in the learning process in class. If the seat is good, not too low, not too big, according to the student's situation,
students will feel comfortable and can study quietly. The shapes and sizes of seats used vary according to the needs of students.

Some principles that must be considered by the teacher in managing the physical environment of the classroom according to Loisell [10] are as follows:

a. Visibility, which means the placement or arrangement of items in the classroom does not interfere with students' views so that they can freely view the teacher, objects, or activities that are taking place. Likewise the teacher must be able to look at all students during the learning process.

b. Accessibility (easily achieved), meaning that the arrangement of classrooms must make it easier for students to reach and retrieve the items needed during the learning process. In addition, the distance between seats must be enough for students to pass so students can move easily and not disturb other students who are working.

c. Flexibility, which means that items in the classroom should be easy to organize and move according to the demands of learning activities to be carried out by students and teachers.

d. Convenience, what is meant here is comfort with respect to room temperature, light, sound and class density, both for students and for teachers themselves.

e. The beauty, regarding the teacher's efforts to arrange classrooms that are fun and conducive to learning activities. Classrooms are beautiful and pleasant, positively influencing the attitudes and behavior of students towards the learning activities carried out.

The chair design in the class does not fully refer to anthropometric measurements. School desks and chairs are usually made in bulk, one type of one size for all. Function of a chair traditionally as a seat and learning activity may already meet the requirements, but as a comfortable, safe, and stress-free place for a relatively long period of time can not be ascertained [8]. This study aims to calculate the level of anthropometry suitability of elementary school students with the design of learning furniture that they use in school so that the anthropometric suitability level of elementary school students is known. In addition, this study will analyze the effect of furniture size on circulation in the classroom.

2. Methodology

This research uses a descriptive method. Data analyzed included: dimensions of tables and chairs, grade 1, grade 4 and grade 6 elementary anthropometry data (anthropometric measurements of the body adjusted to the needs of elementary school students' learning desks and chairs, among others; Body Weight, Height, Shoulder Width, Sitting Shoulder Height, Sitting Elbow Height, Arm Length, Sitting Knee Height, Sitting Height and Sitting Hip Height). Data were analyzed to determine the dimensions of the tables and chairs based on the size of the observations compared to the standard size and the average data of the anthropometric size of elementary school students. The research sites included the Inpres Tanah Miring I Elementary School, Inpres Tanah Miring IV Elementary and Inpres Tanah Miring VII Elementary School.

3. Results and Discussion

3.1. Condition of Tables and Chairs for elementary school students

The class room has a size of 800 cm x 700 cm, for each class has a number of different students for class 1 has a number of 16 tables and 16 chairs, for class 4 has 20 tables and 20 seats while for class 6 has 20 tables and 20 chairs. For each class consists of 4 rows of benches the distance between rows between 55 - 60 cm for the middle row of 70 cm, rarely between tables and chairs for learning 20 cm. Each learning table and chair contains 2 students, while the distance between the front desk and the blackboard for class 1 is about 300 cm, while class 4 and class 6 are 193 cm.
Figure 1. Plan of class 1, class 4 and class 6

Elementary student study tables and chairs are used by 2 students for 1 study table and chairs, with the size of a table; height 77 cm, width 50 cm, stepping height 15 cm from the floor, the height of the work table 69 cm and the length of the table 122 cm. While the size of the chair is 43 cm high, the chair width is 40 cm, the back height is 39 cm and the chair length is 122 cm.

Figure 2. Dimensions of tables and chairs

Attributed between the standard size of the table with the size of the survey results, there is a difference in size, this difference in size will certainly result in unfavorable but there is also no problem, among others; for grade 1 elementary school students with a height of 13.5 cm with a difference that is quite high students will find it difficult to read and write (seen in photos of learning activities, there are some students who are standing up to write or read, picture 3), for the width of the table work difference of 14.5 cm this difference is good because the area of the work table (activity) will be more extensive, the difference in height of the desk 21 cm with this difference elementary school students find it difficult to look forward (look at the board) and for the length is not problematic because the chair is long enough for 2 students. Whereas for grade 4 elementary school the height of the work table is 7.5 cm by default the difference is quite high, for the width of the work table the difference is 12 cm from the standard size for the age of 9 years which is 38 cm, for the height of the desk the size of 16.5 cm, for the length of the table . For grade 6 elementary school, the difference in height is 1.5 cm on the work table, the width of the work table is 8 cm, the height is 10 cm. Data on the difference in standard size and the size of the results of serving for the table can be seen in Table 3.
Table 3. Data of table dimensional based on observation standards and results

| Grade | Age (year) | top height of work table (cm) |  |  |  |
|-------|------------|-------------------------------|---|---|---|
|       |            | standard | observation | difference |
| 1     | 7          | 63,5     | 77,0         | 13,5        |
| 4     | 9          | 69,5     | 77,0         | 7,5         |
| 6     | 12         | 75,5     | 77,0         | 1,5         |

| Grade | Age (year) | Workbench width (cm) |  |  |  |
|-------|------------|----------------------|---|---|---|
|       |            | standard | observation | difference |
| 1     | 7          | 35,5     | 50,0         | 14,5        |
| 4     | 9          | 38,0     | 50,0         | 12,0        |
| 6     | 12         | 42,0     | 50,0         | 8,0         |

| Grade | Age (year) | Table height (cm) |  |  |  |
|-------|------------|--------------------|---|---|---|
|       |            | standard | observation | difference |
| 1     | 7          | 48,0     | 69,0         | 21,0        |
| 4     | 9          | 52,5     | 69,0         | 16,5        |
| 6     | 12         | 59,0     | 69,0         | 10,0        |

| Grade | Age (year) | Table length (cm) |  |  |
|-------|------------|------------------|---|
|       |            | standard | observation |
| 1     | 7          | 61.0     | 120.0        |
| 4     | 9          | 61.0     | 120.0        |
| 6     | 12         | 71.0     | 120.0        |

Table 4. Data of chair dimensional based on observation standards and results

| Grade | Age (year) | height of seat (cm) |  |  |  |
|-------|------------|---------------------|---|---|---|
|       |            | standard | observation | difference |
| 1     | 7          | 29,0     | 43,0         | 14,0        |
| 4     | 9          | 32,5     | 43,0         | 10,5        |
| 6     | 12         | 37,0     | 43,0         | 6,0         |

| Grade | Age (year) | backrest width (cm) |  |  |  |
|-------|------------|---------------------|---|---|---|
|       |            | standard | observation | difference |
| 1     | 7          | 33,0     | 39,0         | 6,0         |
| 4     | 9          | 35,5     | 39,0         | 3,5         |
| 6     | 12         | 42,0     | 39,0         | -3,0        |

| Grade | Age (year) | seat width (cm) |  |  |  |
|-------|------------|-----------------|---|---|---|
|       |            | standard | observation | difference |
| 1     | 7          | 30,5     | 40,0         | 9,5         |
| 4     | 9          | 33,0     | 40,0         | 7,0         |
| 6     | 12         | 37,0     | 40,0         | 3,0         |

| Grade | Age (year) | seat length (cm) |  |  |  |
|-------|------------|-----------------|---|---|---|
|       |            | Standard for 1 person | Observation for 1 person |
| 1     | 7          | 27,5,0   | 120,0        |
| 4     | 9          | 30,0     | 120,0        |
| 6     | 12         | 34,0     | 120,0        |
For the dimensions of tables and chairs for grade 4 and grade 6 the same size, it can be seen from the average height of class 4 comfortable using the existing tables and chairs, both for reading and writing activities. Also, the legs are not hanging and the back of the chair can be used optimally. While for grade 6 for reading activities it is felt quite comfortable while for writing activities is rather troublesome (having to look down), for that the height of class 6 table needs to be added a little.

3.2. Anthropometry Data for Elementary Students

From the measurements for grade 1 elementary school the average anthropometric measurements include; with a body weight of 23 kg, height 117 cm, shoulder width 24.4 cm, shoulder height sitting 79.8 cm, elbow sitting height 67.6 cm, arm length 49 cm, knee height sitting 37.3 cm, sitting height 99.8 cm and sitting hip height 57.9 cm. For grade 4 the average anthropometric measurements are; height 133.4 cm, body weight 31 kg, shoulder width 27.9 cm, shoulder height sitting 83.3 cm, sitting elbow height 69.4 cm, arm length 53.6 cm, knee height sitting 40.5 cm, sitting height 105.2 cm and sitting hip height 59.1 cm and for grade 6 the average anthropometric measurements include height 145.3 cm, body weight 40.9 kg, shoulder width 31 cm, shoulder height 88.8 cm, height sitting elbows 74.5 cm, arm length 61.4 cm, knee height sitting 43.3 cm, sitting height 110.9 cm and sitting height hip 62.2 cm. Anthropometry data for elementary school, grade 4 and grade 6 students can be seen in table 5.
Table 5. Anthropometry Data for Elementary School Students

| Grade | Weight (kg) | Height (cm) | Shoulder width (cm) |
|-------|-------------|-------------|---------------------|
| 1     | 23.1        | 117.1       | 28.2                |
| 4     | 31.0        | 133.4       | 29.1                |
| 6     | 40.9        | 145.3       | 31.0                |

| Grade | Seated shoulder height (cm) | Elbow Height Sit (cm) | Sleeve Length (cm) |
|-------|-----------------------------|-----------------------|-------------------|
| 1     | 79.8                        | 67.6                  | 48.8              |
| 4     | 83.3                        | 69.4                  | 53.6              |
| 6     | 88.8                        | 74.5                  | 61.4              |

| Grade | Knee Height Sit (cm) | Sitting Height (cm) | Sitting Hip Height (cm) |
|-------|----------------------|--------------------|------------------------|
| 1     | 37.3                 | 99.8               | 57.9                   |
| 4     | 40.5                 | 105.2              | 59.1                   |
| 6     | 43.3                 | 110.9              | 62.2                   |

Figure 5. Anthropometry data for elementary students

4. Conclusion

Conclusion (and implications, recommendations, or suggestions, if any) can be in the form of finding generalization based on the research problems. Suggestions can be in the form of input/proposition for future researchers, or implicative recommendations from the research findings on theory, practice and probably policy.
Analysis of the influence of learning desks and chairs on the anthropometric comfort of elementary school students can be concluded as follows:

1. Dimensions of the table with a height of work table 77 cm, table width 50 cm, table height 69 cm and table length 120 cm. while the dimensions of the chair with a chair height of 43 cm, width of the back 39 cm, chair width 40 and chair length 120 cm. for the difference in size between the standard size and disturbing survey results are the difference in height over the work table for grade 1 is 13.5 cm, grade 4 is 7.5 cm and for grade 6 is 1.5 cm and table height for grade 1 is 21 cm, grade 4 is 16.5 cm and for grade 6 is 10 cm. while for the width of the work table and the length of the table is not a problem.

2. Chair dimensions with a chair height of 43 cm, width of the back 39, seat width of 40 cm and length of 120 cm. for the difference in size between the standard size and the results of the survey the height of class 1 is 14 cm, for class 4 is 10 cm and class 6 is 6 cm while for the width of the back, the width of the chair and the length of the chair is better because the size is larger than the standard size.

The dimensions of the learning desk and chair should be adjusted to the age of the students, not made the same from grade 1 to grade 6 elementary school. For a small space, it is better not to be forced to include excessive study tables and chairs, let alone the distance of the study tables and chairs so close to the blackboard. For elementary school children in Indonesia Certainly different, including based on ethnicity, racial and the place where they live.

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