Abstract— Desk and chair design in elementary schools vary greatly in size and shape, thus any design incompatibility could in turn create discomfort for the students. The purpose of this research is to find a design that would fulfill the needs of the user. The method used in this research is a focus group discussion as well as a scoring concept that applies six different criteria: strength, comfort, ease of maintenance, aesthetics, affordability, and ease of production. The continued scoring process will be conducted with a participatory approach to deciding which design is best. The result of the research shows Concept 1 with a score of 6.712, Concept 2 with a score of 7.863, Concept 3 with a score of 8.385 and Concept 4 with a score of 7.503. Concept 2 and 3 consecutively received the highest scores and through a focus group discussion, it is concluded that further improvements will be conducted based on the user’s suggestion. Concept 3 was applied for the desk and Concept 2 was applied for the seat. Final designs are obtained by the merge of the two concepts discussed in the focus group.

Keyword: Discomfort, Desk and seat, Focus group, Elementary school

I. INTRODUCTION

School furniture varies greatly in size and shape. These differences exist due to the lack of knowledge and understanding when it comes to designing chairs and tables for elementary schools. The massive differences have created a challenge for schools to decide on a comfortable desk design. Another factor to consider in creating a comfortable desk is the matter of Anthropometry. The study of incompatibility between the dimensions of the furniture and the anthropometry has been carried out before [1] [2]. The consequence of a disproportionate design will subsequently affect the students whom will not be able to concentrate in an uncomfortable seat, and prolonged usage might result in injury as well. Furniture which was designed without meeting the necessary ergonomic standards will result in musculoskeletal problems in the long run, whilst also obstructing a student’s ability to study [2] [3]. Previous research explains that less than 20% of students are accepting of the current desk design while the rest felt that either the desk or the chair was too high [4]. Another research shows that about 23.3% had a fitting seat depth, while it was unsuitable for 76.7% of the participants, and 99.6% of the participants had a fitting desk clearance, but 0.4% found it unsuitable [5]. A total of 25.8% of the participants had a fitting desk height while 74.2% of the students found it unsuitable [5]. Therefore, furniture designs must take ergonomic considerations in order to avoid further dissatisfaction in the future. Students are bound to complain if the shape and design of the desk and chair are not to their liking and are disproportionate with the shape of their physiques. Most students would experience difficulty to focus due to the pain in the neck, shoulders and back. Desks should be designed to avoid strain and damage to any part of the body, meanwhile musculoskeletal disorders and back pain problems in adults were partly contributed by having such conditions during their childhood [6]. The design of school furniture is one of the contributing factors to back pain among pupils [7]. In order to avoid musculoskeletal problems, well-designed desks are needed. An ergonomic design is imperative on all aspects, especially when it comes to the needs of children. An ergonomic approach to design would do well to create a suitable working environment for young elementary school students [8][9]. The effort to design ergonomic desks and chairs were undertaken with anthropometric measurements of elementary students in mind [10][11][12][13][14]. The previously mentioned researches were more focused on finding an anthropometrically-fitting design. Various post-studies about
seat and desk design started with model determination, whereas this research focused on the selection of the seat in-demand by users. This study is a preliminary study that serves as the basis in determining the size of the seat and desk dimensions.

II. METHODS

2.1 Research location
The study was conducted in Special Region of Yogyakarta area by doing a survey on the designs of desk and chair, with samples taken from a number of elementary schools in Sleman district.

2.2 Research Samples
Research samples were taken from 20 elementary schools in Special Region of Yogyakarta. Focus group members consist of six groups of each session in five different districts. A typical focus group contains anywhere from 6 to 12 participants and it may be difficult to encourage discussions within small groups, while a group that is too large may be difficult to manage [15]. Survey questions were handed out to representative teachers from those schools.

2.3 Data Collecting
Data collections were conducted by focus group and by handing out survey questions. Focus groups allow one to interview small groups of individual simultaneously, allowing those being interviewed to feel more comfortable speaking openly on any sensitive subject [15]. Focus groups are more rewarding than individual interviews because there is a certain level of camaraderie felt among the subject sharing during focus group interviews [16]. Focus groups are also often used in order to develop a better questionnaire. Therefore, data collection is carried out by focus groups, and followed by questionnaires. Focus groups consist of teachers, ergonomic experts, and carpenters. The focus group will focus on seat models that are more generally used, as well as attributes considered during the selection. Focus group results will serve as a selection of seat options.

The model and seat selection was picked by scoring concept to define variables determined from the focus group. The design chosen would depend on the result of the survey given to those who would be affected the most, and the scores would be given by those who took the survey on the four design choices. The scores range on a scale of 1 to 10, a score of 10 being the highest and most desirable, which would then be further counted based on a scoring weight. The chosen design is the design with the highest scores. Even though the design selection is conducted by picking which design scored the highest, a second focus group will be conducted in order to reach consensus on which design of desk and seat is the most desirable by all the group members, aside from determining changes to improve the design itself.

2.4 Choosing a Design
The chosen design concept from scoring would then be further improved upon with the involvement of incumbent stakeholders whilst at the same time taking into consideration suggestions from the teachers and students. The concept used in this furniture design emphasizes the active participation of the stakeholders for the benefit of the users. This participatory focus group applies well because while actively involving stakeholders in choosing a design in consensus, it also serves to avoid future problems. The participatory concept has been successfully implemented in various fields and has improved the work safety and productivity as well as reduced pain [17][18][19][20].

III. RESULTS AND DISCUSSION

3.1. Seat and desk design proposal
Based on the focus group result, there are four proposed desk and seat designs, shown below in pictures. The four designs were chosen through the scoring concept.

![Concept 1](concept1.png)
![Concept 2](concept2.png)
![Concept 3](concept3.png)
![Concept 4](concept4.png)

Figure 1. Proposed desk and seat design

The proposed designs of seat and desk were based on common designs that are generally used in various elementary schools. There are four concepts taken from the proposed seat and desk designs, namely 1, 2, 3, and 4. Further description of the proposed designs is described in Table 1 below
TABLE 1. DESCRIPTION OF THE PROPOSED DESIGN

<table>
<thead>
<tr>
<th>Proposed Design</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concept 1</td>
<td>Seat and desk are made of wood with the desk and seat connected.</td>
</tr>
<tr>
<td>Concept 2</td>
<td>Seat and desk are made of wood with a convex-surfaced non-full backrest. The desk has a flat anvil.</td>
</tr>
<tr>
<td>Concept 3</td>
<td>Seat and desk are made of wood with full and convex-surfaced backrest. The desk has flat anvil.</td>
</tr>
<tr>
<td>Concept 4</td>
<td>Seat and desks are made of wood with metal frame, and non-full backrest. The desk has a flat anvil.</td>
</tr>
</tbody>
</table>

Based on the focus group discussion, initial decision making on the design incorporated a scoring method with six criteria: strength, comfort to use, ease of maintenance, aesthetics, affordability and ease of production. The proposed seat and desk design was selected using a scoring method. Values of criteria weight respectively are 0.2; 0.3; 0.2; 0.1; 0.1 and 0.1. The comfort to use became the main priority with the agreed weight by the team 0.3. The discomfort in furniture usage usually takes place due to the mismatch between the desk and seat dimensions. The mismatch still happens regardless of the fact that the students have already used the adjustable furniture [21]. Some literature also proves that the mismatch between school furniture and body dimensions causes discomfort in use [1][2][4][22][23]. The criteria of strength and ease of maintenance weighing 0.2 while it was the school’s expectation to meet the lower cost. Meanwhile, other criteria weights are 0.1 each. The scoring result of the design proposal is shown in Table 2, which scoring concept matrix [24].

TABLE 2. ASSESSMENT OF THE SCORING CONCEPT

<table>
<thead>
<tr>
<th>No</th>
<th>Selection criteria</th>
<th>Weight</th>
<th>Concept 1</th>
<th></th>
<th>Concept 2</th>
<th></th>
<th>Concept 3</th>
<th></th>
<th>Concept 4</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Rating</td>
<td>Weighted score</td>
<td>Rating</td>
<td>Weighted score</td>
<td>Rating</td>
<td>Weighted score</td>
<td>Rating</td>
<td>Weighted score</td>
</tr>
<tr>
<td>1</td>
<td>Strength</td>
<td>0.2</td>
<td>8.63</td>
<td>1.726</td>
<td>7.5</td>
<td>1.5</td>
<td>8.63</td>
<td>1.726</td>
<td>8.25</td>
<td>1.65</td>
</tr>
<tr>
<td>2</td>
<td>Comfort to use</td>
<td>0.3</td>
<td>6.68</td>
<td>2.004</td>
<td>7.8</td>
<td>2.34</td>
<td>8.68</td>
<td>2.604</td>
<td>7.38</td>
<td>2.214</td>
</tr>
<tr>
<td>3</td>
<td>Ease of maintenance</td>
<td>0.2</td>
<td>5.83</td>
<td>1.166</td>
<td>8.6</td>
<td>1.72</td>
<td>8.58</td>
<td>1.716</td>
<td>7.43</td>
<td>1.486</td>
</tr>
<tr>
<td>4</td>
<td>Aesthetics</td>
<td>0.1</td>
<td>6.95</td>
<td>0.695</td>
<td>7.2</td>
<td>0.72</td>
<td>7.78</td>
<td>0.778</td>
<td>7.8</td>
<td>0.78</td>
</tr>
<tr>
<td>5</td>
<td>Affordability</td>
<td>0.1</td>
<td>5.63</td>
<td>0.563</td>
<td>7.73</td>
<td>0.773</td>
<td>7.63</td>
<td>0.763</td>
<td>6.58</td>
<td>0.658</td>
</tr>
<tr>
<td>6</td>
<td>Ease of production</td>
<td>0.1</td>
<td>5.58</td>
<td>0.558</td>
<td>8.1</td>
<td>0.81</td>
<td>7.98</td>
<td>0.798</td>
<td>7.15</td>
<td>0.715</td>
</tr>
<tr>
<td></td>
<td>Total score</td>
<td></td>
<td>6.712</td>
<td></td>
<td>7.863</td>
<td>8.385</td>
<td>7.503</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rank</td>
<td></td>
<td></td>
<td>4</td>
<td></td>
<td>2</td>
<td>1</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Based on the scoring result, Concept 3 was selected with a value of 8.385; the highest score compared to the others. The result of the scoring concept was then discussed with the focus group. At this point, the focus group members were the users, ergonomic experts and architects. The objective of this focus group was to discuss of possibilities to combine concepts and fix or improve the concepts. The result of this discussion was that although Concept 3 was selected, some respondents suggested that Concept 3 should be applied for the desk and Concept 2 should be applied for the seat. Therefore, the concept agreed by the participatory team was the combination between Concept 2 for the seat and Concept 3 for the desk.

In addition to the concept combination, the respondents also provided input, among others: (1) The end of the backrest should have been oval shaped and curved for the backrest; (2) The seat surface had slope; (3) the table should provide a flat bed to put stationery; and (4) the footrest was not too high. The revised concept is shown in Figure 2.

The suggestions and insights by the focus group were shown in Figure 2, where the desk’s surface is tilted with slope, and there is a flatbed on top. Whereas the seat is equipped with a tilted surface and oval-shaped backrest. The objectives of such design are:
I. The end of the backrest should be oval-shaped and curved for the backrest thus the students are seated comfortably because the backrest design is in accordance to the surface of their back;

2. The seat surface had slope, thus when the students are seated, their body are not pushed forward;
3. The table should provide a flat bed as a stationery holder;
4. The table surface should be tilted with a slope for comfort, thus their shoulders do not have to be lifted up.

Other than those points above, another suggestion was to increase the distance between the floor and the lower surface of the desk. In order to realize that, the book drawer was shifted 10 cm forward to keep the thigh surface from colliding with the lower surface of the desk.

IV. CONCLUSION

From the conducted research we can conclude that improvements are possible to apply to the designs of desk and chair in schools, based on the methods previously discussed, along with an alternative design chosen from the four suggested designs. The result of the research shows Concept 1 with a score of 6.712, Concept 2 with a score of 7.863, Concept 3 with a score of 8.385 and Concept 4 with a score of 7.503. In the end, the chair design from Concept 2, and the desk design from Concept 3 was chosen. Aside from the combining the two concepts, there were some improvements to be made as well.

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REFERENCES


