Ergonomic Design of Computer Workstation for Elementary Students Studying at Home

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Abstract

The purpose of this study is to understand factors that affect discomfort among elementary students studying at home and construct an ideal computer workstation using the anthropometric measurements gathered from the target respondents. A computer workstation is composed of a chair and a table and is used as a computer terminal for students when attending classes at the comfort of their home. Having a workstation at home is essential for workers and students for work or academic purposes. However, users of computer workstations are commonly affected by Musculoskeletal Disorders (MSD). In this study, the body discomfort of the subjects is measured through an instrument named Corlett's & Bishop's body map questionnaire. The study was conducted requiring information on the profile of the respondents regarding the use of their workstations at home as well as their anthropometric measurements. The statistical analysis used in the study is ANOVA, correlation analysis, and regression analysis. These were used to determine the different types of MSD experienced by respondents on the use of different types of tables and chair and other factors related to their online class at home. Based on the result of the analysis, it was proved that poor sitting posture can significantly affect the discomfort of respondents on their body parts such as lower arm, mid-back, buttocks, lower back, neck, and upper arm. It was also revealed that workstation design factors significantly affect the discomfort of respondents particularly the table height, table width, and seat height. Given these conditions, the researchers proposed an ideal workstation design for elementary students using the anthropometric measurements gathered from the respondents.

Keywords
Workstation, anthropometry, discomfort, Corlett's & Bishop, RULA

1. Introduction
A computer workstation is a high-performance system that is composed of advanced graphics, large storage space, and a Central Processing Unit (CPU) or a powerful processor that can be used in varieties of tasks. A new form of an ergonomic computer workstation is proposed to allow users to sit in several working positions and provide greater comfort for people who spend a long time sitting at their workstations (Workined & Yamaura, 2015). Having a well-adjusted workstation decreases discomfort and stretch pose issues. Additionally, adjusting the work to the specialist essentially decreases weariness and muscle pressure. To set an appropriate pose for the user, it is important to be attentive to the discomfort and pain felt to create an acceptable posture for the user. All the elements of a workstation are interdependent, such as the chair, table, computer, etc. Adjusting one of the components will result in a re-adjustment of another component needed (Maerix, 2016). Ergonomics is widely used in computer workstations to

optimize computer operator performance. Considerations should be given importance while designing a computer workstation, such as accessories needed for proper operation, equipment configuration at the desk, location of furniture in the room, and accessibility to different peripheral equipment. Without a proper computer workstation, the students or workers can lead to Musculoskeletal Disorders (Jafri & Moeed, 2016). Musculoskeletal Disorders (MSDs) are injuries and health issues that can affect the body of a person's movement or musculoskeletal system (muscles, tendons, ligaments, nerves, discs, blood vessels, etc.). MSDs typically occur in uncomfortable positions, powerful movement, and forceful exertions. It usually comes from the back, neck, elbow shoulders, and even wrist or hands. Almost every person experiences MSDs where the body gets worse over time and develops over a week, month, or even a year to adjust the injuries in the body. It may cause different amounts of the pain or factor that affects movements. In our world today, people spend prolonged amounts of time on computers and laptops or some devices. Because of that, many of us received symptoms like numbness, burning sensation and some are itching and even cramping, etc. An uncomfortable workstation is most likely the cause of MSDs, it connects to positions, forms, weight, or mass of the body, discomfort position can harmfully affect the overall health and performance of work. It can lessen the productivity and activeness of the people. The ergonomics design of computer workstations leads to a better understanding of how perfectly design stations are being done to an individual and inspires us from working, giving high performance, efficiency, and qualities of works are being done with satisfactory and calmness (Kumar & Chandrasekaran, 2017). Previous researches that are conducted focused mostly on the design and ergonomics of workstations in the office. Due to the unexpected pandemic, students this time switched to online classes resulting in creating their computer workstation design at home. This research studied the current computer workstation design of elementary students can result in the prevalence of musculoskeletal disorders and injuries studying at home.

1.1 Objectives

The purpose of this study is to identify the common body discomfort of students specifically elementary students studying at home. This study also aims to assess the current workstation design the students use while attending their classes online by analyzing the factors that may affect their discomforts such as table height, width, depth as well as chair height, width, and depth. Other risk factors affecting body discomfort are also considered in the study such as type of table and chair used, age, gender, duration of the study, area of study, time of the study, and their sitting posture while using the computer workstation. Lastly, this study intends to design an ideal workstation for elementary students using the gathered anthropometric measurements.

2. Literature Review

2.1 Ergonomics

Ergonomics is the design of the workplace, gear, machine, tool, environment, product, and system, deliberating the human's physical, physiological, biomechanical, and mental abilities and optimizing the efficiency and productivity of work processes while maintaining workers' protection, health, and well-being. The goal in ergonomics is generally to match the task to the person, not the person to the task (Fernandez, 1995). Typically, ergonomics is known to be related to humans and their work. Ergonomics explores human cognitive, physiological capacities, and psychological and limitations. Experts in the field of ergonomics regularly will plan new workplaces or adjust set up workplaces dependent on the investigations on the human capacities and impediment. The fundamental reason for ergonomics is that activity requests should not surpass workers' capabilities and impediments to guarantee that they would not be uncovered to work stresses that can unfavorably influence security and wellbeing as well as the company's productivity. The purpose of an ergonomics program is therefore to provide a healthy and efficient workplace for the comfort of the worker to fulfill the objectives and the object (Jafri & Moeed, 2016). Progression in computer technology and the risk factor for health due to non-ergonomic designs for computer workstations, it is important to change the current model (Kumar, N. & Kumar, R., 2017). That is likely to contribute to normal hours of work being done at home. Due to less travel, greater work-home balance and less tension owing to the comforts of home, home offices appeal to staff. Home offices would need to include sound ergonomic principles to guarantee the employees' long-term wellbeing. As home offices become a permanent choice for many employees, businesses need to have proper ergonomic accommodation (Davis et al., 2020).

2.2 Workstation Design

Workstation for ergonomics shows a product of comfortability and desire to help the body to feel good at a position. The following factors may affect the situation are the specific workplace, chair, computer (with mouse and keyboard) or laptop, and place and environment (Parkins, 2002). According to Zunjic, et al. (2015) the workstation dealing with ergonomics can sustain the improvement of quality education. Furthermore, one of the primary conditions is protecting the health of the people and especially the students, but, for some reasons, many workstations are not that satisfied that many practices are done. Workstation deals with being productive and willing to do a task. Nevertheless, in an imaginative design of an ergonomically form of a workstation is needed of the people's data of anthropometry with different measurements of the workstation like kinds of postures, work desk, the position of the operation of the controlling comfortability of working areas that aware to avoid musculoskeletal disorder and protect us from injuries of people with their productivity (Mujmule et al., 2020). The reason for this study is to propose a systemized ergonomics design of a designated workstation, which people can do most in a workstation. Most likely, what is an example of a perfect workstation based on an individual? In workstations, using computers or laptops often can cause health issues, such as raising the risk factor of injuries or musculoskeletal disorders in a long period (Davari, 2013). The study shows the anthropometric design of home office computer workstation set up for computer and the acceptable design that could be used and helps the user to reduce discomfort and irritation in a computer workspace.

2.3 Musculoskeletal Disorders (MSDs) and Injuries

Students studying at home that are facing the computer should always maintain a proper posture while sitting during their class. Having a poor posture can lead to musculoskeletal disorders (MSD) or other injuries especially neck pain and low back pain (Grimes & Legg, 2004). MSD is a disorder that affects the physical function of the musculoskeletal system (e.g. tendons, muscles, ligaments, and nerves), and it limits the activities of individuals. Some common musculoskeletal disorders are Carpal tunnel syndrome that causes immobility of the hand and arm. Mechanical back pain syndrome is caused by abnormal stress on the muscles in the spinal column. Tension neck syndrome causes fatigue and stiffness of the neck in the trapezius muscle in the back of the neck and shoulders across the middle of the spinal column. Also, it can cause inflammatory and degenerative diseases such as swelling of the tendons, pain impairment of muscles, nerve compression, and degenerative disorders. Using a computer, students have more physical stress than doing paper-based tasks in school because the sitting posture of the students can be different depending on the computer's location. Based on the result of Grimes and Legg (2004), using a computer for 20 minutes may result in muscle fatigue, headaches, and pain in the neck down to the upper part of the back. To avoid MSD and other injuries, the proper sitting posture of the students should be always observed and maintained. Other than sitting posture: sitting duration, spinal anatomy, anthropometrics, the furniture used in sitting are the other factors that should be considered that may cause MSD and other injuries. Furthermore, the discomfort of the student's posture may lead to MSD and injuries which can destroy the student's focus in learning.

2.4 Anthropometry

In avoiding MSD’s there is a study conducted for our body to avoid disorders that may affect the way we move called anthropometry. Anthropometry can be defined as the assessment of the physical characteristics of the body and these measurements may play a key role as variables in the study of epidemiology and psychology (Tovee, 2012). Such examples of body measurements being examined in anthropometry are height, weight, width, reach, depth, circumference, surface area, and many more. These measurements of our body's dimensions and compositions can describe our current health and can be a way to know many things regarding our behavior such as the ability to reproduce, long-term survival, and physical attractiveness (Goldstein-Fuchs & LaPierre, 2014). Studying Anthropometry and its specific measures has its advantages. Studying can give you an advantage in being fit as it can be a baseline in physical fitness (Casadei & Kiel, 2020). Most anthropometric measures are measured while sitting and looking at our posture. During a pandemic, there is also a possibility that anthropometric measures can also affect the way we study in our study stations, as they can also be used in our workstations. This has a big role in determining the ideal workstation for online studying because this can see how our body should work and how it affects our behavioral patterns. Doing these measurements is easy and not costly for it only needs basic measuring tools such as tape measures, rulers, weighing scales, and skinfold calipers (Lustig & Strauss, 2003). After measuring, these measurements undergo analysis and then tested to various tests like the Rapid Upper Limb Assessment (RULA) which focuses on our upper bodies when we are sitting then given points or ratings on how good the posture of the one being tested along with Corlett's Bishop Discomfort.

2.5 Corlett’s Bishop Discomfort

According to Corlett, E. N. & Bishop, R. P. (1976), many people receive irritating positions which the body cannot handle. In this method, A scale is a subjective symptom survey tool and observes the respondent's different parts of the body's discomforting behavior. These body parts are legs, thighs, buttocks, lower back, lower arms, mid-back, upper arms, upper back, shoulders, and neck. It is scaled from 0 to 10, 0 means no discomfort at all, and 10 means extremely high discomfort. Furthermore, it avoids biases, judgments, and expectations that affect responses, because respondents can rate the amount of pain or discomfort for a specific body part by asking them with direct physical senses. However, the construction of discomfort is not specific. Thus, depending on the investigation of nature, the perceptions of the respondents, and the orders needed, it also incorporates many physical sensations like pain, fatigue, tension, and tingling (Marley & Kumar, 1996).

2.6 Rapid Upper Limb Assessment

The Rapid Upper Limb Assessment (RULA) is created to quickly determine the exposure of workers corresponding to risk based on ergonomic factors that can cause or lead to high ranks of MSD that can affect a human body. The RULA ergonomic assessment tool includes the structure and motion of biological mechanical aspects of our body and our posture that is needed in a job's task or demand on the neck, torso, and upper body (Namwongsa et al., 2018). RULA has its scoring system where it describes how vulnerable to MSDs a job that is being evaluated these numbers ranges from 1 to 6+ where 1 is the safest and protected where there is little to no risk. It was developed by Mc Atamney in 2005 as a way and a method of gathering information for use in ergonomics investigations of workplaces where jobs with upper limb disorders are often reported. Its objectives are to make a rapid assessment of body parts. RULA's variables are composed of anthropometric measures taken by simple tools then listing the measurements then following a 15-step process and assessing using the table given and getting the final rating (Bowden & Maxwell, 2018). This process has been tested and had been under many researches regarding its reliability, RULA showed high-reliability scores and ratings. It was more reliable when the test subjects are eight to twelve years old than with younger children, but RULA is proven useful in determining or creating an ergonomic assessment (Upadhyay, 2019). RULA is a useful tool for the research and can be used in determining the ideal workstation as it works alongside anthropometry to understand the risks and behavior of one person based on the ergonomic principles applied in his study station.

3. Methods

This research considered thirty elementary students from any school studying at home, ranging from 6-12 years old. The participants should be using tables and chairs as their workstations for studying. The participants of the study are asked to take a picture of their normal body position and posture while using the current workstation in studying. In addition, with the assistance of the parents, the researchers asked the participants to answer a survey questionnaire that is administered online to gather data about the factors that affect the discomfort of the participants when using the current workstation in studying. The questionnaire includes the different dimensions of tables and chairs, and a picture of the respondents' workstation along with the students' posture to evaluate using the Rapid Upper Limb Assessment (RULA) presented in Figure 1.

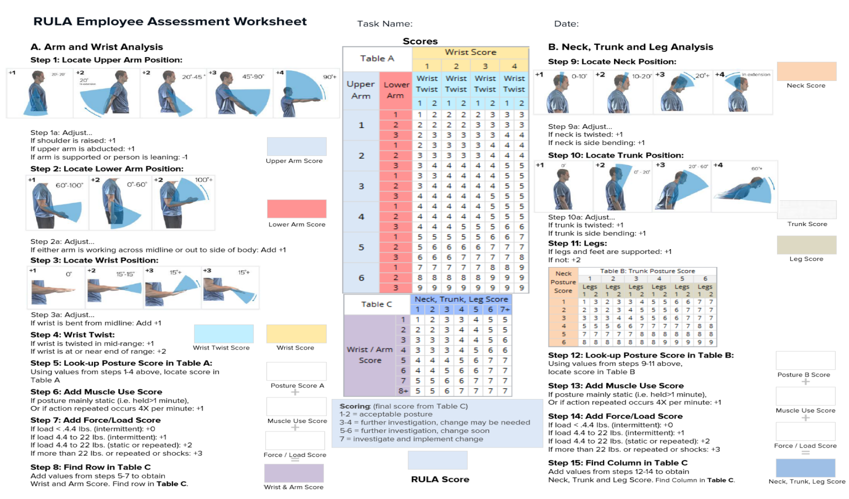


Figure 1. Rapid Upper Limb Assessment Worksheet

After getting the measurements of the table and chair, and the evaluation of the workstation and posture, the next variable to be asked is the discomfort of the respondent in his/her workstation. The discomfort is based on the Corlett and Bishop discomfort scale that follows a rating of 1-5 that scales on how much discomfort the respondent receives with 1 having no discomfort and 5 having the most discomfort. This included the different parts of the body which are mostly affected by discomfort such as the legs, thighs, arms, and more. The detailed discomfort rating is shown in Table 1.

Table 1. Corlett and Bishop Discomfort Scale

Rating	Description
1	Not Uncomfortable
2	Barely Uncomfortable
3	Quite Uncomfortable
4	Very Uncomfortable
5	Extremely Uncomfortable

The data of discomfort gathered from the survey and arranged through a spreadsheet was then inputted to Minitab. This would allow the software to do the Correlation analysis and identify the significant and non-significant factors that affect the comfortability of the elementary students, with the independent variables as the dimensions of the chairs and tables and was matched to the discomfort as the dependent variable. The results gathered from the correlation analysis helped identify the different relations between variables and helped in creating a designing a new workstation by giving the important parts of the chair and table dimensions and room for improvements for each workstation dimension.

The last process for the method is designing the ideal workstation, this was done using the application Sketch-up along with other applications that is used for labeling, improving, and editing more about the workstation created. The principles of anthropometry are also used and followed in creating the ideal workstation whereas the measurement of body parts comes into place as a median is set to be followed as ideal.

4. Data Collection

Multiple Linear Regression is used to analyze where the researcher breakdown the quantitative data sets with multiple variables from the responses of the respondents. The researchers use this method to analyze the correlation of independent variables and to speculate an outcome. The main objective of the researchers using this method is to see how the participant's response to the following study relates to each other and to see how different each response is. The gathered data from multiple linear tests with the researchers' independent variables are used to identify the correlation of the data. The calculation was done using Microsoft Excel and Minitab, a system that visualizes analyzes, and solves data to provide a visual presentation. The program analyzed the data from Excel and provided us with suitable and right interpretations. A total of 32 elementary students participated in the survey, each with their unique profile and study station. Having that results, the researchers isolate in making and creating the 3d model of a standard workstation on elementary students.

5. Result and Discussion

Microsoft Excel and the Minitab application analyzed the collected information, which provides a visual display, analyses, and solves data. Excel data was analyzed via the software to provide us with correct and proper interpretations. The survey included 32 elementary students with various profiles and stations.

Table 2. Correlation Analysis

Independent Variable	Pearson Correlation Value	P-Value
age	0.200	0.272
sitting posture	0.801	0.000
table height	0.365	0.040
table width	0.777	0.000
table depth	0.070	0.702

seat height	-0.749	0.000
seat width	-0.141	0.443
seat Depth	-0.040	0.829

In Table 2, the correlation analysis is shown, this analysis helped the researchers to identify that the RULA, Table height, and seat height are the variables that are significant in affecting the discomfort level of the students who took the survey.

Table 3. Regression Analysis

Factors	Coefficient	P-Value
Constant	8.36	0.177
RULA	5.07	0.001
Table Width	0.109	0.000
Seat Height	-0.1751	0.001
Regression Equation	8.36 + 5.07 RULA +0.109 Table Width - 0.1751 Seat Height	

Shown in Table 3 is the regression analysis formed with the data collected, where it is shown the coefficient of each factor with its equivalent to discomfort and the factor's p-values. The bottom row contains the regression analysis whereas the factors are put into an equation to get discomfort.

Table 4. Female Respondents Anthropometric Measurements

Body Dimension	Mean	S.D	5th%	50th%	95th%
Popliteal Height	42.34	9.20	27.21	42.34	57.47
Buttock-Popliteal Height	42.67	8.57	28.58	42.67	56.77
Sitting Shoulder Height	45.82	6.26	35.32	45.82	56.11
Elbow-Elbow Breadth	42.89	8.25	29.32	42.89	56.46
Hip Breadth	28.37	6.99	16.88	28.37	39.86
Sitting Elbow Height	19.56	4.69	11.84	19.56	27.28
Functional Forward Reach	57.98	9.74	41.96	57.98	74.00
Shoulder Breadth	23.31	5.63	14.05	23.31	32.58

Table 5. Male Respondents Anthropometric Measurements

Body Dimension	Mean	S.D	5th%	50th%	95th%
Popliteal Height	42.30	7.31	30.28	42.30	54.32
Buttock-Popliteal Height	39.50	8.83	24.97	39.50	54.03
Sitting Shoulder Height	45.98	7.38	33.85	45.98	58.12
Elbow-Elbow Breadth	41.30	8.69	27.01	41.30	55.60
Hip Breadth	32.02	6.25	21.74	32.06	42.31
Sitting Elbow Height	22.16	7.31	10.14	22.16	34.17
Functional Forward Reach	56.38	12.44	35.92	56.38	76.85
Shoulder Breadth	25.60	9.16	10.54	25.60	40.66

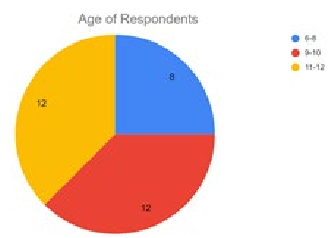
Table 6. Recommended Measurements

Measurement	Body Reference	Percentile	Gender	Recommended
Seat Height	Popliteal height	5th%	Female	27.21 cm
Seat Depth	Buttock popliteal depth	5th%	Male	24.97cm
Seat Width	Hip breadth	95th%	Male	42.31cm
Backrest Height	Sitting shoulder height	5th%	Male	33.85cm
Table Height	Seat height + sitting elbow height	5th%	Male	37.35cm
Table Depth	Functional forward reach	5th%	Male	35.92cm
Table Width	Functional forward reach + shoulder breadth + functional forward reach	5th%	Male	82.38cm

Tables 4-6 above describe the anthropometric measurements of the respondents and the recommended measurement for each dimension of the workstation. These tables also show the range, the mean, and the standard deviation of measurements that the respondents have where it is shown that female respondents have larger anthropometric measurements compared to the male respondents. The data from Table 6 was also used to create the final model of the ideal workstation whereas the maximum and minimum measurements were taken with the corresponding body references to cover a wide range of elementary students.

5.2 Graphical Result

Graphical interpretation of data collected is also generated through the use of applications such as Microsoft Excel and Google Spreadsheets. These allowed the researchers to understand the percentage of the profile of respondents based on the category.



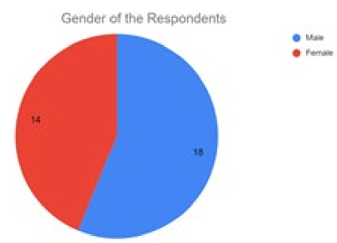


Figure 2. Age of Respondents Chart Figure 3. Gender of Respondents Chart

Figure 2 shows the number of respondents in a pie chart for a certain age group. This graph shows the number of respondents in the age group. Most people are between 11-12 and 9-10 years of age. Figure 3 is a chart showing the number of girls and boys who responded to the survey form. The diagram shows 18 out of 32 respondents are boys and 14 are girls. To identify the difference between divisional discomfort, the data from Figure4 and Figure5 can be used.

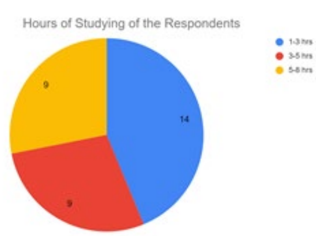


Figure 4. Hours of Studying Chart Figure 5. Place of Studying Chart

The classification of the time study and the number of respondents in the division is shown in Figure 4. This graph shows the duration of the course attended by the students. Most respondents received 1-3 hours, 14 of the 32 answers. The location of the study station of the respondent in their house is shown in Figure 5. The living room has 18 of the 32 answers. These data are also part of the interpretation and can also be explained.

Figure 6. Time of Studying Chart

Figure 7. Grade Level of Respondents Chart

The time of day in which respondents study is shown in Figure 6. 7 of the answers were a full day, consisting of morning and afternoon. 11 people only study in the morning. The grade level of the respondents is also shown in Figure 9. Most of those surveyed are in 6th grade.

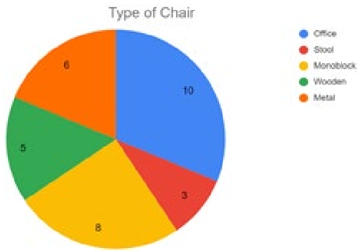


Figure 8. Type of Table Chart

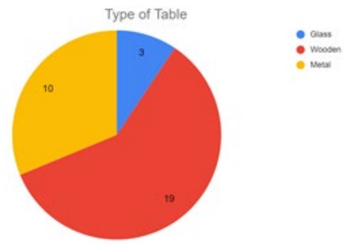


Figure 9. Type of Chair Chart

The table used as a workstation is shown in Figure 8. Glass, wood, and metal are divided into three categories, and the majority of the replies are made under the wood. The chair used by respondents in their studio was presented in the chart in Figure 9. The most type of chair that was used is office chair followed by monobloc, metal wooden and stool.

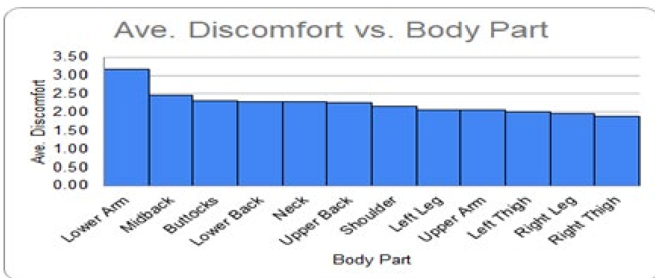


Figure 12. Average Discomfort Score of Parts of the Body

The bar chart in Figure 12 shows an average of 32 answers to discomfort from respondents ranging from 1-5; 1 is less uncomfortable and 5 has extreme discomfort. This shows the most significant to less uncomfortable parts of the body. The bottom arm shows the highest level of discomfort with an average of 3.30, as can be seen from the graph. The right thigh displays an average of 1.90 for the lowest level of malaise. Lower arms support the factor that an uneasy level increases quickly and not in other parts of the body.

5.3 Proposed Improvement

The study covers 30 people who responded to the researchers' ergonomics design. It will deal with a good percentage of body posture, reducing discomfort and maybe reducing the development of MSDs. Body compositions were measured and evaluated using a measuring tape. The study was constructed using Google Forms, which allowed for online discussion.

The study may be able to accommodate more participants who will represent elementary school students, resulting in the most suitable and comfortable design. More participants may aid in the generalization of how ergonomics builds workstations for elementary students who study at home. Additional responders may lead to more data interpretation and the development of more alternatives. The study might also be completed in person; this type of survey might make data processing easier and provide more precise findings when it comes to measuring physical components. With the right instruction, the researchers will also know how to correctly examine and do the data. Finally, the use of appropriate instruments for assessing Anthropometric Measurement to improve the accuracy of design workstations by adapting them to the needs of Grade School students.

6.Conclusion

The researchers discovered that elementary students nowadays are utilizing office chairs, Monoblock chairs, wooden chairs, metal chairs, and stools as their seats based on the findings of the study. They are employing glass tables, wooden tables, and metal tables for tables. Age, gender, duration of study, site or area of study, frequency of study, kind of table, and kind of chair are all risk variables that might contribute to MSD in elementary students. Using their existing workstation, elementary students noticed high discomfort in their lower arm and mild discomfort in their right thigh when studying. The researchers have also identified that study hours have significant differences between the study and the type of chairs have significant differences that can affect the discomfort level in their current study station or workstation. The factors that have a considerable influence and contribute to the pain of Elementary Students include sitting posture, table width, and seat height. Finally, using anthropometric data, the researchers created an ergonomic workstation that matched the body dimensions of the elementary students, and the office chair is the best sort of chair to use in study stations.

Figure 13. Final Model

The final model illustrated in Figure 13 is the result of combining the right specifications with the type of chair and table utilized to create an ideal workspace while minimizing pain.

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Biographies

Christian Horeerat is currently a graduating senior high school student at Mapua University. Mr. Horeerat finished junior high school at Little Shepherd Business and Science High School and received a 1st honor award. His mother is a midwife, a health professional for newborns and his father is a salesman at Silver Horizon Trading Co., Inc. He also has his passion for sports, especially in playing basketball, and received numerous awards in playing basketball either in school programs or within the locality. He has his passion set for being a Civil engineer in the future.

Jhon Lawrence Nueva is currently a graduating senior high school student at Mapua University. Mr. Nueva studied in Paco Catholic School where he finished grade school and junior high school. His dad works as a broker on customs and his mother works as an accountant**.** He also enjoys time with his family and making himself important to every person he will meet. He spends time playing mobile games. For now, moving forward on his college goals and looking forward to a good and successful career life in the future. A goal of being a civil engineer in the future is what he aims for.

Josh Reyes is currently a graduating senior high school student from Mapua University. He finished junior high school at Saint Dominic Academy Pulilan Bulacan which is located in his hometown and he achieved numerous awards such as honors, co-curricular awards, and athletic awards. His father is a retired seaman, and his mother is a bartender that works in cruises. Mr. Reyes creates his path and will take computer science as his first choice in college. He also has his passion for sports, especially tennis, he is an official member of the lawn tennis varsity in his school and is competing in numerous contests. It is in his interest to pursue courses involving computers as it is his passion.

Assoc. Prof. Ma. Janice J. Gumasing is a Professor of the School of Industrial Engineering and Engineering Management at Mapua University. She has earned her B.S. degree in Industrial Engineering and Masters of Engineering degree from Mapua University. She is a Professional Industrial Engineer (PIE) with over 15 years of experience. She is also a professional consultant of Kaizen Management Systems, Inc. She has taught courses in Ergonomics and Human Factors, Cognitive Engineering, Methods Engineering, Occupational Safety and Health, and Lean Manufacturing. She has numerous international research publications in Human Factors and Ergonomics. She has been awarded as Woman in the Academia (WIA) 2019 during the International Conference of Industrial Engineering and Operations Management held in Bangkok, Thailand, Young Researcher Award in 2020 International Conference of Industrial Engineering and Operations Management held in Dubai, UAE, and Outstanding Conference Contributor Award in 2021 International Conference of Industrial Engineering and Operations Management in Singapore.