ANTHROPOMETRICS AND ERGONOMICS DESIGN FURNITURE STUDIES IN THE LABORATORY OF ARTS EDUCATION

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Abstract

This study examines the level of comfort furniture in Arts Education Laboratory. The study was conducted to determine the relationship of furniture convenience with student achievement. This research is a qualitative descriptive study using anthropometrics and ergonomics theory approach. How anthropometrics and ergonomics dimensions vary between students is the main problems in this study. The findings of the study states that the ergonomics and anthropometrics dimension among students has a value of X (mean) under 395-490 mm Standard International (recommendation: Dreyfuss , 1959, Nurmianto , Eko.1991). With a standard deviation of 1.96, the 2.5 percentile and 97.5 percentile are still in the normal range 34.7-45.7 cm (Data Table 4.7 and Table 4.8: Force student-dimensional anthropometrics 2012-2013). Furniture Design in Arts Education Studio has not considered the use of body dimension for the students using it. Therefore students might experience discomfort while doing lab work using the existing furniture (2.5 percentile), and hence the furniture should be adjustable. Center of gravity or moment of gravity during lab hours of students sitting and resting on the buttocks of normal working area is in the range of 34.7-45.7 cm. While students standing on the feet resting with angular motion and freedom of movement (SBB) is in the range 72.5-89.8 (Data Table 4.2 - Table 4.5: Data Ergonomics Student Force from 2012 to 2013) in accordance with the recommendation CG Drury in the 'Journal of Applied Ergonomics' Vol.13, p.135 which is still the comfortable level. Furniture discomfort in Arts Education Studio has no significant effect on student achievement. It might be influential in the event of injury to the wrist (tenosynovitis), or incidents that are categorized as epycondylitis, peritendinitis and carpal tunnel syndrome, which will affect student's work caused by muscle pain, thereby reducing student achievement.

Keywords: anthropometric, ergonomic, furniture, laboratory.

Preliminary

Supriyanto (2010, P.124) in a study entitled "Factors Affecting the Ability of Constructive Drawing in Students in Arts Education Program" mentioned that one of the factors that affect a student's ability to draw constructive is the completeness and condition of facilities and infrastructure. Data from the study's findings stated that 29 % of the 102 students expressed there are very few facilities and infrastructure, 19 % said enough, and the remaining 52 % stated mediocre. This finding does not necessarily show students receive the infrastructure as it is. Some of the attributes that determine the infrastructure variables are: completeness, comfort (ergonomic), size (anthropometry), functions, feasibility, etc. Ergonomic and anthropometric attributes are important aspects of the facilities and infrastructure that affect the achievement of students in practicum courses. Students working in the studio (laboratory) work for more than 4 hours. It is likely similar in almost all studios such as painting studio, sculpture studio, graphic studio, craft studio (ceramics, batik, wood craft) and visual communication design studio.

The discussion of the ergonomic aspects cannot be separated from the discussion of anthropometric measurement of the size of the wearer's body. Ergonomics studies are related to its user's satisfaction, which can be in the form of comfort or health viewed from the science of anatomy, physiology, psychology, health, and work safety.

The purpose of this study is: To know the dimensions of the furniture product's user's body (dimensions of the student body) and attitude/position sitting, standing position (center of gravity, angular motion) while doing lab work, including the legs, arms, sight and reach.

This research is a descriptive qualitative study, that is used to measure three things: (1) the existence and distribution of a wide range of behaviors or characteristics that occurs naturally, (2) the occurrence of natural events, and (3) the relationships between the characteristics, behaviors, events, or phenomena of concern and also the magnitude of these relationships (Alwasilah, 2002:151). In regards to the scope and limitations of the study, this study is classified as a macro study that discuss anthropometric and ergonomics aspects. The micro aspects of the research findings are discussed with the purpose of reviewing them in a limited study that supports the above macro aspects. The method used in the discussion is a rapid assessment method that examines a problem which leads to a conclusion acquired by observations and analysis. This study uses the approach of anthropometry and ergonomics theory, because it consists of several areas of study in the areas of ergonomics and anthropometry of students who works in the Arts Education studio/laboratory. With the unit of analysis per region, then information from several areas will be incorporated into the analysis to formulate the conclusions of the study, hence this research is a multiple case study (Yin, Robert K.1987: 56). The subject of this study is factors affecting the comfort of the studio work of students. The factors in question can be viewed from the standpoint of anatomy, physiology, and work

safety which is summarized as anthropometric (human beings factors) and ergonomics (safety).

Literature

The term ergonomics is derived from the Latin word *ergon* meaning work and *nomos* which is the laws of nature. Ergonomics can be defined as the study of human aspects in the working environment that are also viewed in anatomy, physiology, psychology, engineering, management and design. Ergonomics is also related to optimization, efficiency, health, safety, and human comfort in the workplace, home or outside home. In ergonomics, a knowledge regarding the interaction between human, working facilities, and environment to adjust the working atmosphere is required. Ergonomics is also known as the "Human Factors". Ergonomics are also used by various experts and professionals in their fields, such as anatomy, architecture, product design, physics, physiotherapy, psychology, and in the industrial engineering (Nurmianto, Eko; P47). Thus the science of ergonomics is a science of human's quest to improve comfort in the work environment by using the method of approach of analyzing the physical relationship between humans and their facilities. The benefit of applying ergonomics is to study the comfort while working.

The application of ergonomics in general is activity in designing or redesigning. This can include hardwares such as working equipments (tools), work benches, platforms, seats, working tool handles (workholders), control systems, props, passageways, doors, windows, etc. (Kurniawan, Djoeliana, 2003. p : 26). Still in regard to the above issue is the discussion in the design of the working environment, because if the hardware system changes, the work environment might also change.

Ergonomics also play an important role in improving work safety and health factors. To be ergonomic, basic knowledge of the functions and muscular skeletal system is required. Kinesiology (human movement mechanics) and biomechanics (applied mechanics techniques used to analyze human skeletal muscle system) are associated with ergonomics. These sciences will provide the basic knowledge to address the problem of human posture and movement in his workplace and space. In addition, a vital knowledge in the scientific application of ergonomics is anthropometrics (calibration of the human body). In this case there is fusion and application of anthropometric data and statistics, which is also the main prerequisite. . Ergonomic aspects in a work facility design process are important factors in supporting the improvement of production services, especially in terms of the space and accommodation facilities design. The necessity to include ergonomic factors in public facilities design is due to the fact that the discussion is associated with the role anthropometry of the user's body and the application of the anthropometric data.

To create an accommodation facility that is comfortable and safe for its users, it is necessary to approach it from the study of anatomy, physiology, psychology, health and work safety, and also planning and management. In order to obtain an optimal design of a space and accommodation facilities then one should consider factors such

as the length of the dimensions of the human body, both in static and dynamic positions.

Another point to be observed is the weight and center of mass (center of gravity) of a segment/part of the body, body shape, the distance to the circular movement (angular motion) of the hands and feet, etc.

According to Stefenson (1998), anthropometric is a collection of numeric data related to the physical characteristics of the human body size, shape, and strength used for the application in handling design issues.

Anthropometric research is usually conducted in association with the military from the civil society. It is reasonable for several reasons. First, it is related to the procurement of military equipment, uniform entity, fighter pilots, etc. Second, related to the conducting government institutions and third, the commission that conducted a study made by the government.

The main disadvantage of anthropometric studies for the military is that it is determined by sex and age of the wearer, whereas it can be done by measuring the dimensions of height and weight. The research report was used as a standard in military clothes production before the World War in the United States , so it cannot be used as a public standard.

In the next development, anthropometric studies was also conducted by civil society, such as which have been conducted by the U.S. Department of Health (by. Dr. Howard W. Stoudt), Education and Welfare by Jean Robert with no less than 7500 samples civilians aged between 18 years to 79 years. Anthropometric research variables also experienced growth except for gender, ethnicity/nation, age group and also clothes (uniform), woman's pregnancy factor, and physical defects of the human body.

A good example of the development of anthropometry in this era is the same facilities provided for people with disabilities and those with the normal physical terms. Ergonomically, each have equal rights in the use of services in the public service facilities, for example a special pathways for wheelchairs, special space in the lavatory, a special line for in and out of offices, campuses, hotels, restaurants, supermarkets, etc.

The size of the human body is taken into consideration in the design of the interior, because of it there is a real impact. The two effects are dimension structural type and the functional dimension type. Structural dimensions refers to static dimensions including measurement of the head , torso , and shoulders in a normal position. While the functional dimension refers to the dynamic dimensions, including the reach at work or physical movement associated with the work. Designing a product using static anthropometric data can be seen using the example in the manufacture of a door, which can use the following formula;

$= X + (2{,}325\ SD)$

$= 1740 + (2.325 \times 70)$

$= 1903$ mm

These results are acquired from the standard (non- ergonomic) calculation, where static anthropometric data should be added. Static anthropometric dimensions are defined as static footwear, hats and dynamic clearance (dynamic slack) because human height will increase when walking or running, known as a dynamic effect. So, the total height of the door that must be made is: Door height = 1903 + height + boots height + hat height + dynamic clearance (1903 +30 +50 +50 = 2033mm. This is the designing of a product that is comfortable.

Designing a product using data dynamic anthropometric data can be seen from an example in making a rack (shelf). In this product the anthropometrical consideration is the maximum reach of the human hand to the front. Therefore the calculation of the design is to measure the shoulder height of the user, which is generally added with dimensions of 7.5 cm to tiptoe. Shoulder height dimension will describe the shelf height that will provide maximum reach.

The dimensions of the human body that are commonly used in the design of a product can be illustrated in Table 2.1: Anthropometric Indonesian society Adults with interpolation and the British Society of Hong Kong. (Page Appendix Table)
It is a big mistake to apply an average anthropometric dimension in the design of a product, because the use of average anthropometric dimensions of a product would not be beneficial to other users, since the anthropometric dimensions between users varies. This is unless the average dimension also includes a standard deviation and percentile.

Guidelines for using the most appropriate average anthropometric dimensions ought to consider the corresponding standard deviation in the design to be performed, the average dimension of the appropriate population, the corresponding percentile values as the basis of design, and appropriate grouping of gender.

In using the data in a static anthropometry chair design work for example, working chair will be used by men and women in the working population, so the main demand would be a simple adjustable chair. What is the range of dimensions of the work chair? For the requirements of most major office chair, the sole of the foot should be located on the surface of the floor, and the seat height should be adjustable in some way so that there will be no pressure on the lower part of the thigh.

Corresponding dimensions are knee high fold (popliteal height). The user population includes women so that the appropriate range is 32.5-49.0 cm. Sole height is also a consideration in women, although there are women who prefer not to wear shoes while working. So we get the range of 325-490 mm dimension. While Dreyfuss (The Measure of a Man) recommends a range of 15-18 inch or 381-457 mm (Figure 2.5: Standard Design Work Chair) on the image attachment page.

Discussion

Distribution of Arts Education Curriculum are grouped into four areas (See appendix, Table 1: Distribution of Department of Arts Education Curriculum Year 2012-2013): General Courses (*Mata Kuliah Umum*) with course code of *KU 100* to *400* with 12 credits. Meanwhile Field Experience Program Course is coded *RK 400*

and weighs 4 credits. Basic Education Course (*MKDK*) is coded *KD 300-KD 305* with 12 credits. Subjects theory besides those coded *KD* are grouped to the practicum courses (core subjects Programs) which is *RK 111 - RK162* with credit weights 16 credits, which could also be offered to other courses for majors or other majors Practicum courses coded *RK 211 - RK 497* with a weight of 94 of credits. For the Bachelor undergraduate program must complete a minimum of 138 credits. (Data acquired from Arts Education Curriculum Document 2013).

The discussion in this study is related to the study of anthropometric and ergonomics furniture design in lab course category. This is reasonable because the student participants who did standard practice is used to standard dynamic dimensional measurements, where the lab motion (angular motion) is conducted with cyclic movement of the feet, hands, vision, and shoulders. Students who attend theory-based classes, only experience static or silence, and they do not do a lot of movement. Therefore both have a different standard of measurements. Distribution of the curriculum is arranged based on the competency target for undergraduate students, with the learning and assessment systems arranged in Courses Syllabus (*Syllabus Perkuliahan* and *Satuan Acara Perkuliahan* (SAP)).

Presented is the result of student ergonomics in Class A and B batch 2012/2013 using the standard dimensions, which is hand and shoulder movement using the term elbow free movement and elbow not free to move. The data in question is as follows:

Ergonomic data are divided into two areas, which is Horizontal and Vertical work area. Horizontal work area is a benchmark to judge the normal movement, which is the movement of the rotating forearm that rests on a horizontal plane. This plane could be a work desk surface with working conditions by sitting (See Table 2: Dimensions of Student Ergonomics Force from 2012 to 2013). Horizontal work area assessment standards are used to analyze the design of an office chair height or seat depth, which is measured by the size of the user's ergonomic measurements. Also, maximum working area can be achieved by measuring student's ergonomics, that is measuring student with arms outstretched to measure the spin axis around the shoulder. This measurement needs to be done to analyze the convenience of work table in the studio based on ergonomic standards, including analyzing the space for students in terms of freedom of movement in doing studio work. Vertical work area is used to design work desk by analyzing student's elbow motion when students are doing lab work in the studio. Is student's elbow free to move while they work? Research data presented in Table 4.1 until Table 4.4 are the data of students' ergonomics that have been classified in group based on sex. Information on the movement of the arm in horizontal dimension (angular motion) will be used to analyze the design of the desk or the horizontal work field and vertical movement of the arm will be used to analyze the work chair and furniture objects vertically.

Things assessed on Anthropometric Data are student's body dimensions factors that are related to the use of furniture in the laboratory/studio, including the long dimension of the body in both static and dynamic positions. The observation

also include the weight and center of mass (center of gravity) of a body part, body shape, and the distance to the circular movement (angular motion) of the hands and feet. The dimensions of the student body are grouped into two types: structural and functional dimension. Structural dimension is also called static dimension, which include measurements over the head, torso and limbs. Functional dimension is also known as dynamic dimension, which includes measurements while students are working in a practicum or a movement that occurs in the context of work. Ten major dimensions are used as a benchmark for measuring anthropometric dimensions, they are: height, sitting height, weight, length of the buttocks to the front of the knees the buttocks to the popliteal part, the range between the elbow to the hip in a sitting position, knee height (front and the back), and thigh height. Furthermore, the student anthropometric dimensions data are presented in the form of Normal Curve and Table 4.6: Anthropometric data of students (see Appendix).

Result

The chair which is used by male and female students certainly has a different range of dimensions among them. In the design of the work chair, footwear (shoes) is also calculated, considering while barefooted during work the feet will hang and create pressure on the lower thigh. Therefore the seat should be easy to adjust (adjustable). What is the dimension of a comfortable work chair according to ergonomic standards? A comfortable chair is as high as the knee (popliteal height) or in accordance with the dimensions of the column 13 of Table 4.7 men and column 13 in table 4.8 women, namely high-dimensional folding of the knee. Given that chair users consists of men and women so it must use the appropriate range for both, which is between the range of 30.48 (Table 4.8 column 13) - 41.8 cm (Table 4.8 column 13). Meanwhile, according to the Australian Standard on 'Ergonomics in Factory and Office Work' the recommended range is between 34.0 cm - 48.0 cm. Dreyfuss in the book 'The Measure of a Man' recommended the range of 38.1 cm - 45.7 cm and there is a lumbar support in the sitting position. This recommendation emphasizes the provision of the backrest, which can be adjusted to support the lumbar region or lower region of the spine. This is intended to reduce the tendency toward spinal kyphosis, where the spine bends to the back. Therefore, the selection of the chair size (height, width, and depth of the seat) must be based on user student's anthropometric data.

The height of a work chair is distinguished in two ways:

a. Lower chairs that is used to work together with stool or table (desk and tables)
b. Higher chairs that are used to work together with a bench or machine, or with a workshop table that allows working while standing.

The purpose of low chair design is to let the leg rest directly on the floor and avoid pressure on the bottom side of the thigh. In this case the moment of gravity lies in the prominent bone on the buttocks (Figure 2.7 and Figure 2.8: Posterior Sit), while the overall weight of a heavy foot will be supported by the leg. The minimum weight of the foot will be supported by lower thigh, considering compression in the

area given below this will cause tingling. Therefore anthropometric data is the main basis in designing high seat/chair that is as high as the knee indentations (column 13, Table 4.7) in accordance with the recommendation of CG Drury and BG Coury in 'A methodology for chair evaluation, the (Journal of Applied Ergonomics, 1982, Vol. 13 P 135).

High chair is designed to work while standing and working on a high stool. High stool is designed based on the user's elbow height. High chair height can be adjusted to support the upper body so that your elbows are a few centimeters high above the work. Anthropometric data size is the vertical distance from the point of elbow bend to the surface to sit horizontally. To anticipate the occurrence of leg fatigue due to the load at the bottom of the foot, it will be moved to the inside of the groin. So it is necessary to design a foot rest on a bench or on a chair leg which is adjustable. In designing a work chair, it should be based on the type of work, resulting posture, the force required, and integrated visual views with tables or benches that are used to work.

Similarly, the basic design of the garage workbench or table also corresponds to Table 4.7 based on the elbow height on column 8 and column 12 which is the knee height in a sitting position. Based on the results of the study, the male elbow height while sitting (column 8, Table 4.7) is 68.13 cm while the lower range is (column 8, Table 4.8) which is 56.96. Thus table height dimension is in the range between 56.96 - 68.13, in accordance with the user student's ergonomic data with added footwear height between 2.60 cm-4.6 cm. So the comfortable workbench to work ergonomically in students are between 59.56-72.73. The width of a table using student ergonomic data based on anthropometric data in Table 4.7 column 18 (the distance from the elbow to the fingertips) plus 20 columns of data (arm length) is 47.7 +20.3 = 68.7 above range. While the lower range is the data in Table 4.8 in column 18 (the distance from the fingertips to the elbow) plus column 20 (arm length) is 41.7 +15.5 = 62.6 cm. The length of the table can use anthropometric data of students that have been presented in Table 4.7 and Table 4.8. The length dimension of the table that is ergonomically comfortable can be referred to the data in Table 4.7 in column 22, which is the distance of the left fingertips to the right fingertips. How long the dimension of a table that is ergonomically comfortable can be seen in Table 4.7 and Table 4.8 column 22, which is the distance of the left fingertips to the right fingertips, and is in the range of 160.4 to 164.7. Therefore workbench dimensions (workshop) that is ergonomically comfortable should be: upper range table length 164.7, width 68.7, and height 72.73. While the bottom range table length 160.4 cm, width 62.6 cm, and height 56.96 cm. The data is the analysis of the dimensions of the table is convenient for Arts Education student practicum according to calculations from the data findings after measuring the male students and female students. The recommendation of Panero, Julius and Zelnik, and Martin in his book 'Human Dimension and Interior Space': the length 152.4 cm - 182.9cm, width 76.2-91.4 cm, height 73.7cm - 76.2cm.

Analysis on the office chair and work table is an example of the analysis that has been done to the overall types of furniture that are present in the laboratory/studio in Arts Education Department. Overall, the analysis of the furniture is the same, by using the percentiles of the largest and small percentile after the Mean (X) and Standard Deviation (SD) of known ergonomics students dimensions.

To ergonomically analyze a good and comfortable Etsel height we can refer to Table 4.2 vertical work area, which is Elbow-Free Move (SBB) and also consider students' anthropometric dimensions Table 4.6 Column 3 which is visual height. Therefore an Etsel that is both ergonomic and anthropometric is to have a height of between 212.98 upper percentile and 186.02 lower percentile. Besides determining Etsel height, 212.98 or 186.02 position can also determine observer's comfortable distance to the works being exhibited. The data of the horizontal working area is therefore used to analyze the horizontal field such as the table width, total room space, total space motion, the seat width, cupboard depth and length, width and length of the corridor, etc. While the vertical working area is the data that will be used to analyze object height such as work table height, chair height, stool height, cabinet height, ceiling height, etc.

Referring to the rules of the science of ergonomics, it has not been implemented fully in the process of designing a piece of furniture that will used by students in practicum courses. The reality is that finished products are brought regardless of the anthropometric dimensions of the user students. Finished products are just aiming for profit as much as possible in making furniture. While the design process and functional characteristics of human users (students) are less considered by the manufacturers, such as capacity of the senses, response time, and the optimal position of the hand and foot muscles to work.

From the table it is known that average value (mean) and standard deviation (SD) is 1.96. While the 95 percentile of the body size and the 5th percentile indicates a small body. To accommodate 95% of the population the 2.5 and 97.5 percentile range limits can be applied.

N (X.бX) 95 %

2.5 % 2.5 %

-1.96 +1.96 X б б

For example, analyzing the depth of the dryer rack (dry shelf) at Graphic Studio students work while standing. In calculating the depth of the shelf, it is better to select 5 percent of the population that can reach all the shelves. The smallest percentile 1 % should not be used to avoid the consequences of high shelf because there is only one tall student.

To analyze the level of comfort of drying rack, anthropometric data in Table 4.6 can be used. According to Table 4.6: Anthropometric Data Male Student Column 7 and Column 12 (using shoulder height dimension in a standing position) with a small percentile 2.5, then the convenient shelf height is 144.13 cm so that all population can reach the shelf depth. If the 95 % percentile is used as a design standard, then 151.97 is obtained for the shelf height. Between 144-152 cm, every

student can still reach the depth of the rack. But the shelf cupboard that is available is 170 cm long, 120 cm wide with a depth of 45 cm. From the shelf that is high, not all students can reach the height of the rack. Only 2.5 percentile of students can reach the high shelf. The rest of the students must use the stepping stool or tiptoed to be able to reach the base.

The dimensions of the fancy furniture available in studio of Arts Education mostly use 50^{th} percentile, or average dimensions. As a result, the amount of furniture cannot accommodate all of the users. Furniture is supposed to be used comfortably by all the dimensions of the student body. It would be better if in designing the furniture, the installation can be set or changed (the built -in adjustment), that can be adjusted to the student user. Furniture such as office chair or shelves which can be installed differently is a product that can be applied to the system's built-in adjustment. It is a big mistake if the average anthropometric dimensions of students is used as in the standard design of used furniture (chair or desk), because the use of anthropometric dimensions of the average student does not benefit the other and ince the anthropometric dimensions of the students varies. Guidelines for using the most appropriate in the average Anthropometric dimensions ought to consider standard deviation, the average (mean), gender groups, and has a corresponding percentile values.

Applying static anthropometry in designing a work chair can be taken as an example. Working chair will be used by male and female population; hence the first consideration is that the chair should be adjustable. What is the dimensional range of the chair? The main prerequisite for a working chair is that the sole should be positioned on the floor, and the seat height should be adjustable to prevent pressure on the bottom of the thigh.

The dimension that fits is popliteal height. Female population range is 32.5-49.0 cm. footwear height will be the main support in female, although there are some female that prefer to not wear shoes while working. Therefore the range is 32.5-49.0 cm. Dreyfuss (*The Measure of Man*) recommended the range 15-18 inches or 381-457 mm.

Human body size is taken into consideration in designing furniture, for it may result in two effects, namely structural dimension and functional dimension. Structural dimention refers to static dimension, including measurements of the head, torso, and shoulders in normal position. Functional dimension refers to dynamic dimension, which include reach while working or physical movement that is related to the work.

If anthropometric dimensions are not considered in designing a furniture, it may result in several unwanted effects, such as *algias* or muscle pain due to leaning forward position. Or it may result in vertebral syndrome in students with heavy loads. Osteo articular deviations might also occur, such as scoliosis in students with kyphosis (hunchback). Muscle and tendon pain might also happen, such as achilles damage, extensor tendons in carving artist, or tenosynovitis in sculpture artists.

Incidents such as tenosynovitis or injury of the wrist are categorized epicondylitis, peritendinitis, and carpal tunnel syndrome. These incidents are termed Repetitition Strain Injury (RSI), which was introduced in Australia, referring to all pain syndromes due to work.

Conclusion

A. Students' Ergonomic and Anthropometric Dimensions

Research data presented in Table 4.2 up to Table 4.5 is the data of students' ergonomic. Information on the movement of the arm in the horizontal and vertical (angular motion) dimension has been used in analyzing the workbench design and student work chair. Student's work chair has a range of dimensions of 30.48 (Table 4.8 column 13) - 41.8 cm (Table 4.7 column 13). Meanwhile, according to the Australian Standard on 'Ergonomics in Factory and Office Work' the range recommended is 34.0 cm - 48.0 cm. Dreyfuss in the book 'The Measure of a Man' recommended range of 38.1 cm - 45.7 cm and there is a lumbar support in the sitting position. This recommendation emphasizes the provision of the backrest that can be adjusted to support the lumbar region or lower region of the spine. It is intended to reduce the tendency toward spinal kyphosis form. The election of the chair size (height, width, and depth of the seat) should be based on anthropometric data of the corresponding user.

Moment of gravity lies in the prominent bone on the buttocks, while the weight of the foot will be supported by leg. The minimum leg weight will be supported by the lower thigh, since compression in the area given below this will cause tingling. Therefore anthropometric data is the main basis in designing the seat height/chair.

In summary, the design of work chair should be based on the type of employment, dimensions of user's ergonomics, the force required, and integrated visual views with tables or benches that is used for work.

Overall, the analysis of the furniture is the same, by using the percentiles of the largest and small percentile after the Mean (X) and Standard Deviation (SD) of known ergonomics students dimensions.

In analyzing all furniture, the standard vertical working are, which is the Elbow-Free Move (SBB) column should be considered, as well as the students' anthropometric dimensions in Table 4.7 column 3, which is visual height.

The data of the horizontal working area is therefore used to analyze the horizontal field such as the table width, total room space, total space motion, the seat width, cupboard depth and length, width and length of the corridor, etc. While the vertical working area is the data that will be used to analyze object height such as work table height, chair height, stool height, cabinet height, ceiling height, etc.

B. Student Movement Dimension While Doing Practicum

The weight and center of mass (center of gravity) of a body part, body shape, the distance to the circular movement (angular motion) of the hands and feet should be taken into account.

The dimensions of the student body are grouped into two types: structural and functional dimension. Structural dimension is also called static dimension, which include measurements over the head, torso and limbs. Functional dimension is also known as dynamic dimension, which includes measurements while students are working in a practicum or a movement that occurs in the context of work. Ten major dimensions are used as a benchmark for measuring anthropometric dimensions, they are: height, sitting height, weight, length of the buttocks to the front of the knees the buttocks to the popliteal part, the range between the elbow to the hip in a sitting position, knee height (front and the back), and thigh height.

From the table it is known that average value (mean) and standard deviation (SD) is 1.96. While the 95 percentile of the body size and the 5th percentile indicates a small body. To accommodate 95% of the population the 2.5 and 97.5 percentile range limits can be applied.

The dimensions of the fancy furniture available in studio of Arts Education mostly use 50^{th} percentile, or average dimensions. As a result, the amount of furniture cannot accommodate all of the users. Furniture is supposed to be used comfortably by all the dimensions of the student body. It would be better if in designing the furniture, the installation can be set or changed (the built -in adjustment), that can be adjusted to the student user. Furniture such as office chair or shelves which can be installed differently is a product that can be applied to the system's built-in adjustment.

Furniture inconvenience due to non-compliance of anthropometic and ergonomics standard has no effect on student achievement. Effect might occur if algias, or muscle pain produced by leaning forward, is present. Effect might also occur if there is vertebral syndrome or osteo articular deviations: scoliosis and kyphosis in students might affect the work that resulted in the minimum quality of the work.

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7. Gugum Pratama, SPd, MSn. sebagai Fotografer dan pengumpul data yang selalu siap setiap saat dalam membantu penelitian ini.

BIBLIOGRAFY

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APPENDICES OF RESULTS

Appendix 1

Table 4.1 Ergonomics Data of Male Students Class B Batch 2012/2013

No	NIM	NAMA MAHASISWA	Gender		DAERAH KERJA HORIZONTAL		DAERAH KERJA VERTICAL	
			L	P	Daerah Normal	Daerah Maksimum	SBB*	STBB**
1	1204588	FREIDY JAELANI	L		90	170	210	190
2	1203034	AHMAD KHOERUDIN	L		90	170	210	188
3	1204973	WAHYU WIRA PUTRA	L		92	178	222	198
4	12	NONO HARYONO	L		90	169	210	188
5	1203040	YOPI SAMSUL ARIFIN	L		86	168	210	186
6	1203046	MANSUR SALDI	L		82	161	210	179
7	1203045	RIFALDI EFRIANSYAH	L		82	163	202	180
8	1205209	M. RIZAL HAFIYAN	L		84	167	206	184
9	1203040	JUNAEDI	L		80	159	200	178
10	1203506	AWAB ABDULLAH	L		88	170	212	186
11	1203038	ILYAS YAA RACHMAN	L		92	175	214	192
12	12023O	VICKY ISYANATA	L		80	160	202	179
13	1202603	MUHAMAD SHIDDIQ	L		82	162	202	179
14	1202570	MUHAMAD TAUFIK	L		80	160	200	179
15	1103670	DIDIK NURAHMAN	L		80	162	204	180
16	1101053	AGUNG ADITYA P.	L		88	170	210	188

17	1101056	ADHISMA ANJAR	L	86	169	210	186
18	1103098	YOGI FEBRIYANSYAH	L	90	172	212	190
19	1205570	ILFAN FAUZI	L	80	162	202	179
			∑n:	1622	3167	3948	3509
			X:	85.37	166.68	207.79	184.68
			SD:	2.134	4.167	5.194	4.617
			Percentil 97.5%::	87.503	170.85	212.98	189.30
			Persenti 2. 5%:	83.234	162.52	202.59	180.067

Catatan:
***SBB : Siku Bebas Bergerak**
****STBB: Siku Tidak Bebas Bergerak**

Table 4.2 Ergonomic Data of Female Students Class B Batch 2012/2013

No	NIM	NAMA MAHASISWA	Gender		DAERAH KERJA HORIZONTAL		DAERAH KERJA VERTICAL	
			L	P	Daerah Normal	Daerah Maksimum	**SBB***	**STBB****
1	1205460	NURANI PUSPASARI		P	80	158	208	174
2	1203044	YOSI SAPITRI		P	78	153	194	170
3	1206169	ELSA NUR SAADAH		P	82	160	200	178
4	1205161	NENTY NOVIANTY		P	82	164	206	180
5	1205804	NENI NURINAYAH		P	80	159	200	178
6	1206111	ZESIKA HAYATUL K.		P	82	160	210	178
7	1203037	DEA RAHAYU		P	75	145	184	163
8	1203547	WIDYA INRIYANTI		P	80	158	208	176
9	1206447	ANGEL LIMBONG		P	80	160	200	176

10	1202559	RIANI DEA PRATIWI	P	80	158	200	176
11	1203035	GITA RONIA	P	80	158	198	177
12	1203357	KAROLINA BR K.	P	84	168	210	186
13	1202524	MAYANG CHAIRUNNIS	P	78	157	208	175
14	1204355	WAHYUNI MARKOTIM	P	80	159	200	176
15	1202437	DINA NOVENTIN M.	P	80	161	202	180
16	1104363	NINING LESTARI	P	76	145	185	162
17	1100896	SHOFIYAH RIGAN	P	82	163	204	180
18	1100223	GITA MARDIAN K.	P	78	157	208	172
			∑n:	1437	2843	3625	3157
			X:	75.63	149.63	190.79	166.15
			SD:	1.89	3.74	4.77	4.15
			Percentil 95%::	77.52	153.37	195.56	170.31
			Persenti 5%:	73.74	145.89	186.02	162.00

Catatan:
***SBB : Siku Bebas Bergerak**
****STBB: Siku Tidak Bebas Bergerak**

Table 4.3 Ergonomic Data of Male Students Class A Batch 2012/2013

No	**NIM**	**NAMA MAHASISWA**	**Gender**		**DAERAH KERJA HORIZONTAL**		**DAERAH KERJA VERTICAL**	
			L	**P**	**Daerah Normal**	**Daerah Maksimum**	**SBB***	**STBB****
1	1201711	KAFFAH IMADUDIN M.	L		92	172	212	192
2	1201900	RIDWAN BADAR R.	L		84	165	204	183
3	1201947	AMIRULLOH ZULFIKAR	L		100	182	224	200
4	1202168	RAHADYAN	L		81	172	211	190

5	1202262	YUDANTAR SALSA SOLLI NAFSIKA	L	90	171	211	190
6	1202296	ALDI FAHRIANSYAH	L	90	170	210	190
7	1202302	ARDHIATUL ARDHA	L	96	175	214	192
8	1202435	WILDAN RACHMAN	L	84	165	206	184
9	1203580	RENDY DWI DHARMA	L	85	168	206	187
10	1204331	RENDRA ZULIAN R.	L	85	166	206	185
11	1204372	MARIO M. SUYATNA	L	85	167	206	185
12	1204884	BONI PURNAMA	L	90	170	210	189
13	1205638	SELMA FEBBY SA'ADILL	L	80	161	201	181
14	1205784	TUBAGUS HOKINOF J.	L	91	172	213	191
15	1205939	MUHAMAD ALIFIA N.	L	90	172	212	190
16	1205961	NASSUHAD	L	89	170	209	190
17	1206422	PRISMA DENENSI	L	90	172	213	191
18	1206488	YAYAN MULYANA	L	72	154	194	173
19	1206630	REGA OKTAVIANA	L	90	170	212	189
			∑n:	1664	3214	3974	3572
			X:	87.58	169.16	209.16	188
			SD:	2.19	4.23	5.23	4.7
			Percentil 95%::	89.77	173.38	214.38	192.7
			Persenti 5%:	85.39	164.93	203.93	183.3

Catatan:
***SBB : Siku Bebas Bergerak**
****STBB: Siku Tidak Bebas Bergerak**

Tabel 4.4 Ergonomic Data of Female Students Class A Batch 2012/2013

No	**NIM**	**NAMA MAHASISWA**	**Gender**	**DAERAH KERJA HORIZONTAL**	**DAERAH KERJA VERTICAL**

			L	P	Daerah Normal	Daerah Maksimum	SBB*	STBB**
1	1201795	AI NUR ASIAH		P	75	150	192	169
2	1201800	DELIA ANGGIANI		P	78	157	197	177
3	1201834	ERSHA DIANY PRATIWY		P	86	165	204	182
4	1201846	IRSALINA ZATA DINI		P	80	161	200	182
5	1201860	AJENG PRATIWI		P	75	155	196	176
6	1201903	WIDYA HERAWATI		P	88	159	200	178
7	1201978	LIZWANTI C.		P	75	155	195	175
8	1202008	FATHIN HANIFAH		P	78	160	200	178
9	1202280	RISTA SUNDARI		P	75	156	195	175
10	1202286	LENI APRILLIANI		P	75	155	195	176
11	1202330	WIDYASARI		P	85	166	206	194
12	1202339	**SALMA SABILLA N.**		P	72	150	190	170
13	1202416	TERA GARNIDA		P	75	155	193	174
14	1205146	HILDA NURHANIFA		P	74	155	204	176
15	1205203	CHINTIA AGUSTIN W.		P	75	155	206	176
16	1205454	NENG SITI ZAKIYYAH		P	74	155	205	175
17	1205550	RUNI PUSPA AMALIAH		P	86	166	205	184
18	1206347	ANGGI SUGIHARTI		P	78	160	201	178
				∑n:	1404	2835	3584	3195
				X:	73.89	149.21	188.63	168.16
				SD:	1.85	3.73	4.72	4.20
				Percentil 95%::	75.74	152.94	193.35	172.36
				Persenti 5%:	72.05	145.48	183.92	163.95

Catatan:
***SBB : Siku Bebas Bergerak**
****STBB: Siku Tidak Bebas Bergerak**

Appendix 2

Tabel 4.5 Data of Anthropometric Dimension of Class A Students Batch 2012/2013

No	NIM	NAMA MAHASISWA	Tinggi Badan	Tinggi tubuh saat duduk	Tinggi Mata	Tinggi Siku	Tinggi Badan pada posisi Duduk	Tinggi Mata pada posisi	Tinggi Bahu Pada Posisi	Tinggi Siku pada posisi	Tebal Paha	Jarak dari Pantat ke Lutut dan Lipat Lutut ke Pantat	Tinggi Lutut
			1	2	3	4	5	6	7	8	9	10	11	12
1	1201711	KAFFAH IMADUDIN M. R	174	142	165	109	75	112	97	59	18	59	49	56
2	1201795	AI NUR ASIAH	150	120	142	95	50	88	76	52	13	34	27	36
3	1201800	DELIA ANGGIANI	157	127	145	97	57	92	82	54	14	37	29	38
4	1201834	ERSHA DIANY PRATIWY	165	133	151	105	66	90	94	60	16	45	37	51
5	1201846	IRSALINA ZATA DINI	161	131	152	100	63	92	96	56	14	46	38	46
6	1201860	AJENG PRATIWI	155	128	146	90	57	95	79	52	13	40	32	41
7	1201900	RIDWAN BADAR RAHMAN	165	132	156	105	68	100	92	60	16	50	42	51
8	1201903	WIDYA HERAWATI	159	127	150	103	59	95	94	56	14	44	36	40
9	1201947	AMIRULLOH ZULFIKAR	182	152	171	163	83	120	108	74	18	67	57	58
10	1201978	LIZWANTI C.	155	123	146	100	56	95	87	57	13	30	24	41
11	1202008	FATHIN HANIFAH	160	128	142	107	62	95	86	55	14	35	27	46

12	1202168	RAHADYAN YUDANTARA	172	140	163	112	74	107	98	68	16	47	38	56
13	1202262	SALSA SOLLI NAFSIKA	171	138	162	110	72	106	99	72	15	46	38	55
14	1202280	RISTA SUNDARI	156	124	144	102	57	97	84	53	13	36	28	37
15	1202286	LENI APRILLIANI	155	126	143	100	55	94	83	52	13	35	27	36
16	1202296	ALDI FAHRIANSYAH	170	138	161	108	72	105	96	67	16	45	37	51
17	1202302	ARDHIATUL ARDHA	175	143	166	115	76	112	103	72	18	60	50	56
18	1202330	WIDYASARI	166	134	157	107	67	104	96	63	14	51	43	52
19	1202339	SALMA SABILLA N.	150	124	143	98	49	92	83	47	13	35	28	31
20	1202416	TERA GARNIDA	155	127	144	90	55	90	87	52	13	40	32	36
21	1202435	WILDAN RACHMAN	165	133	156	105	695	102	94	62	14	50	43	51
22	1203580	RENDY DWI DHARMA	168	136	159	103	68	103	92	67	14	53	45	54
23	1204331	RENDRA ZULIAN R.	166	134	147	108	67	102	95	66	14	51	42	48
24	1204372	MARIO M. SUYATNA	167	134	158	102	72	102	93	67	14	52	43	53
25	1204884	BONI PURNAMA	170	138	161	105	73	105	96	67	16	55	47	54

26	1205146	HILDA NURHANIFA	155	123	146	100	60	92	87	52	14	40	32	36
27	1205203	CHINTIA AGUSTIN WIND.	155	123	147	95	60	92	89	52	13	40	33	36
28	1205454	NENG SITI ZAKIYYAH	155	124	146	97	62	93	86	54	13	40	32	37
29	1205550	RUNI PUSPA AMALIAH	166	134	157	103	67	103	96	63	16	51	43	46
30	1205638	SELMA FEBBY SA'ADILL	161	129	152	102	59	97	93	58	14	41	34	41
31	1205784	TUBAGUS HOKINOF	172	140	163	108	78	107	97	69	18	57	49	49
32	1205939	MUHAMAD ALIFIA NURFI	172	142	163	105	74	103	98	67	18	57	49	48
33	1205961	NASSUHAD	170	128	161	107	73	105	96	65	16	55	47	47
34	1206347	ANGGI SUGIHARTI	160	128	152	100	57	97	92	57	14	45	37	41
35	1206422	PRISMA DENENSI	172	140	163	108	74	112	98	69	16	57	49	58
36	1206488	YAYAN MULYANA	154	122	143	95	56	97	86	53	14	39	32	35
37	1206630	REGA OKTAVIANA	170	138	162	107	72	107	96	67	16	55	57	51

Tabel 4.5 Data of Anthropometric Dimension of Class A Students Batch Angkatan 2012/2013 (continued)

No	NIM	NAMA MAHASISWA	Tinggi Lipat Lutut	Lebar Bahu	Lebar Panggul	Tebal Dada	Tebal Perut	Jarak dari siku ke	Kepala	Tangan	Lebar Tangan	Jarak Bentang Ujung Jari Kanan Ke
			13	14	15	16	17	18	19	20	21	22
1	1201711	KAFFAH IMADUDIN M. R	47	46	33.5	25	27	47.5	16	19	8.5	179
2	1201795	AI NUR ASIAH	28	38	34.5	23	23	40	14.6	16.8	7.1	152
3	1201800	DELIA ANGGIANI	32	40	37.5	26	25	41	16	17.3	7.5	161
4	1201834	ERSHA DIANY PRATIWY	43	43	38.4	26	27	47	17	18.8	7.4	163
5	1201846	IRSALINA ZATA DINI	38	40	37	25	26	42	16	17.6	7.5	161
6	1201860	AJENG PRATIWI	36	37	34	24	23	42	14.5	17.3	7.5	161

7	1201900	RIDWAN BADAR RAHMAN	43	42	32	23	22	43.5	13.5	18.8	7.4	163
8	1201903	WIDYA HERAWATI	32	38	34.5	26	23	42	15	17.3	7.5	161
9	1201947	AMIRULLOH ZULFIKAR	48	48	33.5	25	27	48	15	19	8.5	179
10	1201978	LIZWANTI C.	34	38	36	24	22.5	42	13.5	17.3	7.5	161
11	1202008	FATHIN HANIFAH	35	38	35.6	26	22.5	43	15.5	17.3	7.5	161
12	1202168	RAHADYAN YUDANTARA	48	42	32	25	26	47	14.5	19	8.5	179
13	1202262	SALSA SOLLI NAFSIKA	47	43	31	23	26	44.5	15	19	8.5	179
14	1202280	RISTA SUNDARI	29	36	34.5	25	23	43.5	14	16.8	7.1	152
15	1202286	LENI APRILLIANI	28	35	32	26	24	44.5	13.5	16.8	7.1	152
16	1202296	ALDI FAHRIANSYAH	43	40	31	23.5	22.5	45.5	15	18.8	7.4	163
17	1202302	ARDHIATUL ARDHA	48	42	34.2	24.5	27	46	15	19	8.5	179
18	1202330	WIDYASARI	44	41	36	27	23.5	43.5	15	18.8	7.4	163
19	1202339	SALMA SABILLA N.	25	36	34.3	24.5	26.5	43	14.5	16.8	7.1	152
20	1202416	TERA GARNIDA	28	37	32.5	24.5	23	43	13.5	16.8	7.1	152

21	1202435	WILDAN RACHMAN	43	42	32	23.5	26	47	14	18.8	7.4	163
22	1203580	RENDY DWI DHARMA	48	40	33	23	26	46	14	19	8.5	179
23	1204331	RENDRA ZULIAN R.	40	40	31.5	23	25.5	46	14.5	18.8	7.4	163
24	1204372	MARIO M. SUYATNA	46	41	32.5	25	26	47	15.5	18.8	7.4	163
25	1204884	BONI PURNAMA	46	43	32	24	26	45	15.5	18.8	7.4	163
26	1205146	HILDA NURHANIFA	28	39	34.5	25.6	22.5	43.5	13.5	16.8	7.1	152
27	1205203	CHINTIA AGUSTIN WIND.	28	37	34	25	22.5	43	14.5	16.8	7.1	152
28	1205454	NENG SITI ZAKIYYAH	29	37	33	24	23.5	43	13.5	16.8	7.1	152
29	1205550	RUNI PUSPA AMALIAH	38	38	35.6	27	23.5	45	14.5	18.8	7.4	163
30	1205638	SELMA FEBBY SA'ADILL	33	36	34.5	23.5	26.5	46.3	16	17.3	7.5	161
31	1205784	TUBAGUS HOKINOF	42	39	31.7	23.5	25	47	13.5	18.8	7.4	163
32	1205939	MUHAMAD ALIFIA NURFI	40	41	32	24	26	46.5	14.5	18.8	7.4	163
33	1205961	NASSUHAD	39	40	31	23	25.6	46	14.5	18.8	7.4	163
34	1206347	ANGGI SUGIHARTI	34	39	34.6	26	23	43.5	13.5	17.3	7.5	161

35	**1206422**	**PRISMA DENENSI**	**50**	**43**	**34**	**25.7**	**27**	**47**	**16.5**	**17.3**	**7.5**	**161**
36	**1206488**	**YAYAN MULYANA**	**26**	**38**	**29**	**22.4**	**24**	**43**	**14.5**	**16.8**	**7.1**	**152**
37	**1206630**	**REGA OKTAVIANA**	**44**	**42**	**32**	**25.3**	**24.5**	**47**	**15.5**	**18.8**	**7.4**	**163**

Table 4.6 Anthropometric Data of Male Students Class A Batch 2012/2013

No	Nama Mahaiswa / Variabe	Tinggi Badan	Tinggi tubuh saat duduk tegak	Tinggi Mata	Tinggi Siku	Tinggi Badan pada posisi Duduk	Tinggi Mata pada posisi Duduk	Tinggi Bahu Pada Posisi Duduk	Tinggi Siku pada posisi Duduk	Tebal Paha	Jarak dari Pantat ke Lutut	Jarak dari Lipat Lutut ke Pantat	Tinggi Lutut	Tinggi Lipat Lutu	Lebar Bahu	Lebar Panggul	Tebal Dada
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	KAFFAH IMADUDIN M. R	174	142	165	109	75	112	97	59	18	59	49	56	47	46	33.5	25
2	RIDWAN BADAR R'	165	132	156	105	68	100	92	60	16	50	42	51	43	42	32	23
3	AMIRULLOH ZULFIKAR	182	152	171	163	83	120	108	74	18	67	57	58	48	48	33.5	25
4	RAHADYAN YUDA..	172	140	163	112	74	107	98	68	16	47	38	56	48	42	32	25
5	SALSA SOLLI NAFSIKA	171	138	162	110	72	106	99	72	15	46	38	55	47	43	31	23
6	ALDI FAHRIANSYAH	170	138	161	108	72	105	96	67	16	45	37	51	43	40	31	23.5
7	ARDHIATUL ARDHA	175	143	166	115	76	112	103	72	18	60	50	56	48	42	34.2	24.5
8	WILDAN RACHMAN	165	133	156	105	695	102	94	62	14	50	43	51	43	42	32	23.5
9	RENDY DWI DHARMA	168	136	159	103	68	103	92	67	14	53	45	54	48	40	33	23
10	RENDRA ZULIAN R.	166	134	147	108	67	102	95	66	14	51	42	48	40	40	31.5	23
11	MARIO M. SUYATNA	167	134	158	102	72	102	93	67	14	52	43	53	46	41	32.5	25
12	BONI PURNAMA	170	138	161	105	73	105	96	67	16	55	47	54	46	43	32	24
13	TUBAGUS HOKINOF	172	140	163	108	78	107	97	69	18	57	49	49	42	39	31.7	23.5
14	MUHAMAD ALIFIA N.	172	142	163	105	74	103	98	67	18	57	49	48	40	41	32	24
15	NASSUHAD	170	128	161	107	73	105	96	65	16	55	47	47	39	40	31	23
16	PRISMA DENENSI	172	140	163	108	74	112	98	69	16	57	49	58	50	43	34	25.7
17	YAYAN MULYANA	154	122	143	95	56	97	86	53	14	39	32	35	26	38	29	22.4
18	REGA OKTAVIANA	170	138	162	107	72	107	96	67	16	55	57	51	44	42	32	25.3
	∑n :	3055	2470	2880	1975	1922	1907	1734	1191	287	955	814	931	788	752	578	431
	MEAN (X) :	170	137.2	160	110	106.78	105.94	96.33	66.2	16	53.1	45.2	51.7	43.8	41.8	32.1	24
	Standar Deviasi (SD):	1.96	1.96	1.96	1.96	1.96	1.96	1.96	1.96	2	1.96	1.96	1.96	1.96	1.96	1.96	1.96
	Persenctil 97.5 % :	172	139.2	162	112	108.74	107.9	98.29	68.1	18	55	47.2	53.7	45.7	43.7	34.1	25.9
	Persentil 2.5 % :	168	135.3	158	108	104.82	103.98	94.37	64.2	14	51.1	43.3	49.8	41.8	39.8	30.1	22

Table 4.6 Anthropometric Data of Male Students Class A Batch 2012/2013 (continued)

No	Nama Mahaiswa	Tebal Perut	Jarak dari siku ke Ujung Jari	Lebar Kepala	Panjang Tangan	Lebar Tangan	Jarak Bentang Ujung Jari Kanan Ke Ujung Jari Kiri
	Variabel	17	18	19	20	21	22
1	KAFFAH IMADUDIN M. R	27	47.5	16	19	8.5	179
2	RIDWAN BADAR RAHMAN	22	43.5	13.5	18.8	7.4	163
3	AMIRULLOH ZULFIKAR	27	48	15	19	8.5	179
4	RAHADYAN YUDANTARA	26	47	14.5	19	8.5	179
5	SALSA SOLLI NAFSIKA	26	44.5	15	19	8.5	179
6	ALDI FAHRIANSYAH	22.5	45.5	15	18.8	7.4	163
7	ARDHIATUL ARDHA	27	46	15	19	8.5	179
8	TERA GARNIDA	26.5	43	14.5	16.8	7.1	152
9	WILDAN RACHMAN	23	43	13.5	16.8	7.1	152
10	RENDY DWI DHARMA	26	47	14	18.8	7.4	163
11	RENDRA ZULIAN R.	26	46	14	19	8.5	179
12	MARIO M. SUYATNA	25.5	46	14.5	18.8	7.4	163
13	BONI PURNAMA	26	47	15.5	18.8	7.4	163
14	TUBAGUS HOKINOF	26	45	15.5	18.8	7.4	163
15	MUHAMAD ALIFIA NURFI	26.5	46.3	16	17.3	7.5	161
16	NASSUHAD	25	47	13.5	18.8	7.4	163
17	PRISMA DENENSI	27	47	16.5	17.3	7.5	161
18	YAYAN MULYANA	24	43	14.5	16.8	7.1	152
19	REGA OKTAVIANA	24.5	47	15.5	18.8	7.4	163
	∑n :	483.5	869.3	281.5	349.4	146.5	3156
	MEAN (X) :	25.45	45.75	14.816	18.389	7.711	166.1053
	Standar Deviasi (SD):	-1.96	-1.96	-1.96	-1.96	-1.96	-1.96
	Persenctil 97.5 % :	27.41	47.71	16.776	20.349	9.671	168.0653
	Persentil 2.5 % :	23.49	43.79	12.856	16.429	5.751	164.1453

Table 4.7 Anthropometric Data of Female Students Class A Batch 2012/2013

No	Variabel	Tinggi Badan	Tinggi tubuh saat duduk tegak	Tinggi Mata	Tinggi Siku	Tinggi Badan pada posisi Duduk	Tinggi Mata pada posisi Duduk	Tinggi Bahu Pada Posisi Duduk	Tinggi Siku pada posisi Duduk	Tebal Paha	Jarak dari Pantat ke Lutut	Jarak dari Lipat Lutut ke Pantat	Tinggi Lutut	Tinggi Lipat Lutu	Lebar Bahu	Lebar Panggul	Tebal Dada
No	Nama Mahaiswa	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	AI NUR ASIAH	150	120	142	95	50	88	76	52	13	34	27	36	28	38	34.5	23
2	DELIA ANGGIANI	157	127	145	97	57	92	82	54	14	37	29	38	32	40	37.5	26
3	ERSHA DIANY PRATIWY	165	133	151	105	66	90	94	60	16	45	37	51	43	43	38.4	26
4	IRSALINA ZATA DINI	161	131	152	100	63	92	96	56	14	46	38	46	38	40	37	25
5	AJENG PRATIWI	155	128	146	90	57	95	79	52	13	40	32	41	36	37	34	24
6	WIDYA HERAWATI	159	127	150	103	59	95	94	56	14	44	36	40	32	38	34.5	26
7	LIZWANTI C.	155	123	146	100	56	95	87	57	13	30	24	41	34	38	36	24
8	FATHIN HANIFAH	160	128	142	107	62	95	86	55	14	35	27	46	35	38	35.6	26
9	RISTA SUNDARI	156	124	144	102	57	97	84	53	13	36	28	37	29	36	34.5	25
10	LENI APRILLIANI	155	126	143	100	55	94	83	52	13	35	27	36	28	35	32	26
11	WIDYASARI	166	134	157	107	67	104	96	63	14	51	43	52	44	41	36	27
12	SALMA SABILLA N.	150	124	143	98	49	92	83	47	13	35	28	31	25	36	34.3	24.5
13	TERA GARNIDA	155	127	144	90	55	90	87	52	13	40	32	36	28	37	32.5	24.5
14	HILDA NURHANIFA	155	123	146	100	60	92	87	52	14	40	32	36	28	39	34.5	25.6
15	CHINTIA AGUSTIN WIND.	155	123	147	95	60	92	89	52	13	40	33	36	28	37	34	25
16	NENG SITI ZAKIYYAH	155	124	146	97	62	93	86	54	13	40	32	37	29	37	33	24
17	RUNI PUSPA AMALIAH	166	134	157	103	67	103	96	63	16	51	43	46	38	38	35.6	27
18	SELMA FEBBY SA'ADILL	161	129	152	102	59	97	93	58	14	41	34	41	33	36	34.5	23.5
19	ANGGI SUGIHARTI	160	128	152	100	57	97	92	57	14	45	37	41	34	39	34.6	26
	∑n :	2996	2413	2805	1891	1118	1793	1670	1045	261	765	619	768	622	723	663	478.1
	MEAN (X) :	157.68	127	147.63	99.526	58.842	94.368	87.895	55	13.7	40.3	32.58	40.421	32.74	38.05	34.89	25.16
	Standar Deviasi (SD):	1.96	1.96	1.96	1.96	1.96	1.96	1.96	1.96	1.96	1.96	1.96	1.96	1.96	1.96	1.96	1.96
	Persenctil 97.5 % :	159.64	128.96	149.59	101.49	60.802	96.328	89.855	56.96	15.7	42.2	34.54	42.381	34.7	40.01	36.85	27.12
	Persentil 2.5 % :	155.72	125.04	145.67	97.566	56.882	92.408	85.935	53.04	11.8	38.3	30.62	38.461	30.78	36.09	32.93	23.2

Table 4.7 Anthropometric Data of Female Students Class A Batch 2012 (continued)

No	Variabel / Nama Mahaiswa	Tebal Perut	Jarak dari siku ke Ujung Jari	Lebar Kepala	Panjang Tangan	Lebar Tangan	Jarak Bentang Ujung Jari Kanan Ke Ujung Jari Kiri
		17	18	19	20	21	22
1	AI NUR ASIAH	23	40	14.6	16.8	7.1	152
2	DELIA ANGGIANI	25	41	16	17.3	7.5	161
3	ERSHA DIANY PRATIWY	27	47	17	18.8	7.4	163
4	IRSALINA ZATA DINI	26	42	16	17.6	7.5	161
5	AJENG PRATIWI	23	42	14.5	17.3	7.5	161
6	WIDYA HERAWATI	23	42	15	17.3	7.5	161
7	LIZWANTI C.	22.5	42	13.5	17.3	7.5	161
8	FATHIN HANIFAH	22.5	43	15.5	17.3	7.5	161
9	RISTA SUNDARI	23	43.5	14	16.8	7.1	152
10	LENI APRILLIANI	24	44.5	13.5	16.8	7.1	152
11	WIDYASARI	23.5	43.5	15	18.8	7.4	163
12	SALMA SABILLA N.	26.5	43	14.5	16.8	7.1	152
13	TERA GARNIDA	23	43	13.5	16.8	7.1	152
14	HILDA NURHANIFA	26.5	46.3	16	17.3	7.5	161
15	CHINTIA AGUSTIN WIND.	25	47	13.5	18.8	7.4	163
16	NENG SITI ZAKIYYAH	27	47	16.5	17.3	7.5	161
17	RUNI PUSPA AMALIAH	24	43	14.5	16.8	7.1	152
18	SELMA FEBBY SA'ADILL	24.5	47	15.5	18.8	7.4	163
19	ANGGI SUGIHARTI	23	43.5	13.5	17.3	7.5	161
	∑n :	462	786.8	268.6	314.7	132.2	2852
	MEAN (X) :	24.316	43.711	14.922	17.4833	7.3444	158.44
	Standar Deviasi (SD):	1.96	1.96	1.96	1.96	1.96	1.96
	Persenctil 97.5 % :	26.276	45.671	16.882	19.4433	9.3044	160.4
	Persentil 2.5 % :	22.356	41.751	12.962	15.5233	5.3844	156.48

Appendix 3

Tabel 4.8 Anthropometric Data of Furniture in Studio of Arts Education Department

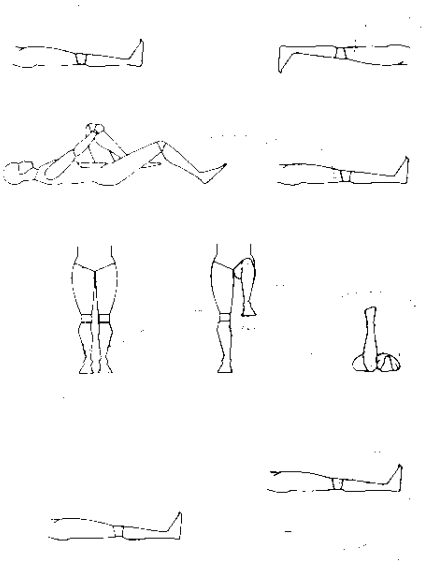
NO	NAMA STUDIO	JENIS FURNITURE	DIMENSI			SANDARAN		
			Tinggi	Panjang	Lebar	Kaki	Tangan	Punggung
I	STUDIO LUKIS dan STUDIO DASAR	Standard	145	145	57	112	0	0
		Meja Kerja	77	210	86	66	0	0
		Almari	0	0	0	0	0	0
		Sketsel	200	252	61	80	0	0
II	STUDIO GRAFIS							
		Meja Kerja	74	140	70	70	0	0
		Kursi Kerja	45	32	32	44	0	0
		Meja Cetak	0	0	0	0	0	0
		Almari	170	120	45	80	0	0
III	STUDIO DESAIN KOMUNIKASI VISUAL DAN MULTI MEDIA							
		Meja Komputer	76	80	65	17	0	0
		Kursi Kerja	78	50	47	0	0	15
		Meja Cetak	0	0	0	0	0	0
IV	STUDIO KRIA							
1	KRIA ANYAM	Meja Anyam	77	210	86	66	0	0
		Meja Celup	77	210	86	66	0	0
		Meja Irat	77	210	86	66	0	0
		Kursi Kerja	45	32	32	44	0	0
2	KRIYA BATIK DAN TEKSTIL							
a	KRIYA BATIK	Gawangan	76	120	30	0	0	0
		Dingklik	16	25	18	0	0	0
		Kompor	21	20	20	0	0	0
		Bak Celup	30	120	60	10	0	0

		Meja Pola	78	120	84	69	0	0
		Wajan	10	31	26	0	0	0
		Panci Pelorot	24	40	36	0	0	0
	b KRIA TEKSTIL	Meja Weaving	0	0	0	0	0	0
		Msin Spinning	0	0	0	0	0	0
		Meja Makrame	0	0	0		0	0
		Kursi Kerja	0	0	0	0	0	0
V	STUDIO PATUNG	Pustek	0	0	0	0	0	0
		Meja Putar	90	82	40	53	0	0
		Kursi Kerja	50	28	28	26	0	0
		Meja Bengkel	85	200	119	65	0	0
		Dingklik	50	28	28	26	0	0
		Stol	52	20	20	0	0	0
VI	STUDIO KERAMIK	Meja Putar	85	170	88	70	0	0
		Kursi Kerja	50	28	28	26	0	0
		Tungku Pemanas	210	160	105	53	0	0
		Meja Bengkel	90	82	40	53	0	0
VII	STUDIO GAMBAR TEKNIK							
		Meja Gambar	75	100	61	73	0	0
		Kursi Kerja	45	32	32	44	0	0
VIII	STUDIO GAMBAR BENTUK/MODEL							
		Kursi	77	73	41	41	57	18^{O}-25^{O}

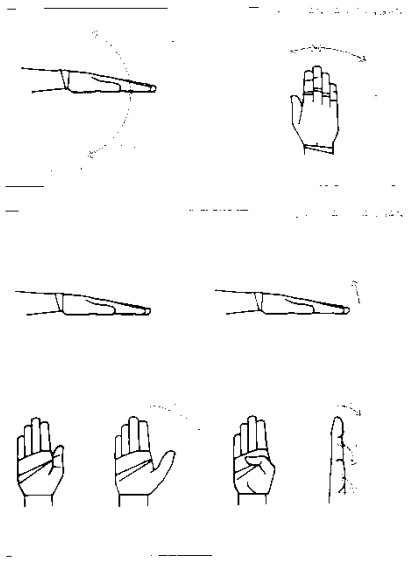
NO	NAMA RUANG	JENIS FURNITURE																	
		Meja Pola	Meja Gambar	Meja	Meja Putar	Meja Press	Almari	Rak	Kursi Kerja	Stool	Dingklik	Tungku / BB Gas	Base/Puste l	Standard/ Treeport	Etsel	Tungku/BB Solar	Meja Komputer	Bck Drop	Gawangan
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
A	**Studio Dasar**																		
	1 Studio Gambar Bentuk		**30**							**5**									
	2 Studio Gambar Model		**X**							**X**									
	3 Studio Gambar Konstruktif		**28**						**10**	**25**							**X**		
	4 Studio Nirmana		**28**						**15**										
B	**Studio Kriya**																		
	1 Studio Kriya Batik	**2**					**2**	**X**	**X**		**15**						**X**		**15**
	2 Studio Kriya Anyam								**X**										
	3 Studio Kriya Kayu			**6**			**X**			**X**									
	4 Studio Kriya Keramik			**6**	**12**		**X**	**2**	**X**	**15**		**2**	**X**			**X**			
C	**Studio Lukis**							**X**	**X**	**X**				**25**	**15**				
D	**Studio Patung**			**8**	**8**			**2**	**X**	**15**			**8**						
E	**Studio Grafis**	**X**	**6**			**2**	**X**	**X**	**X**	**X**					**X**				
F	**Studio Fotografi**						**X**	**X**	**X**	**X**				**2**	**X**		**X**	**2**	
G	**Studio DKV**		**X**						**X**										
H	**Studio Multi Media**								**15**	**X**							**18**		

Appendix 4

Sistem Sambungan Kerangka

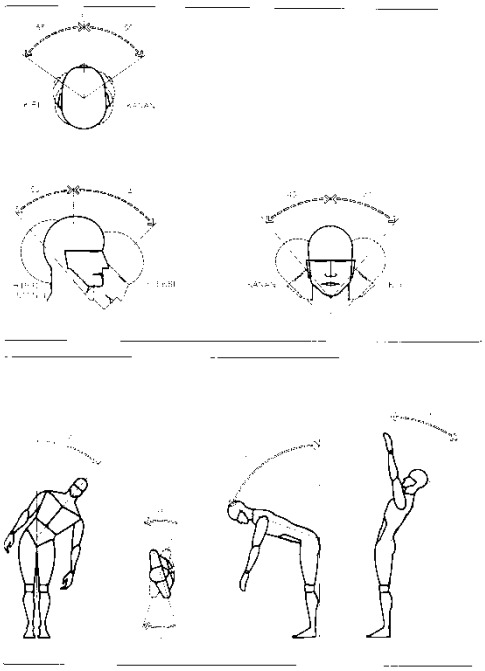


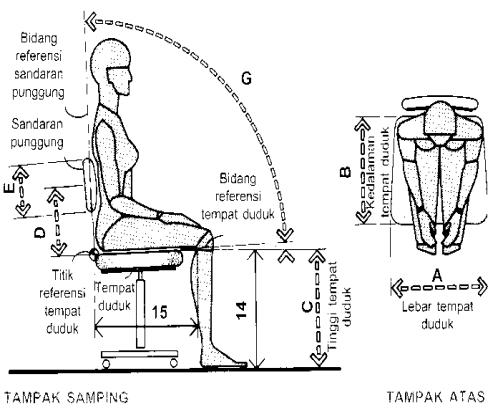
Gambar 1:
Terminologi Untuk Pergerakan Tangan dan Lutut Flexsion
Sumber : Panero, Julius da Zelnik Martin, P. 116



Gabar 2:
Hyper Extension and

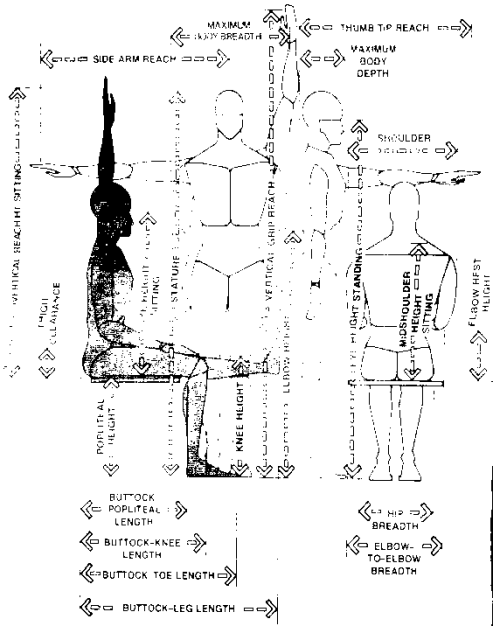
Sumber : Panero, Julius dan Zelnik Martin P 115

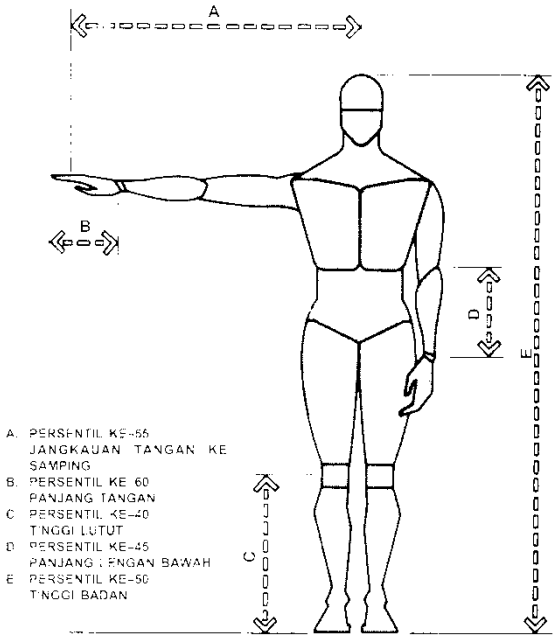




Gambar 3: Terminologi Gerak Sendi kursi kerja

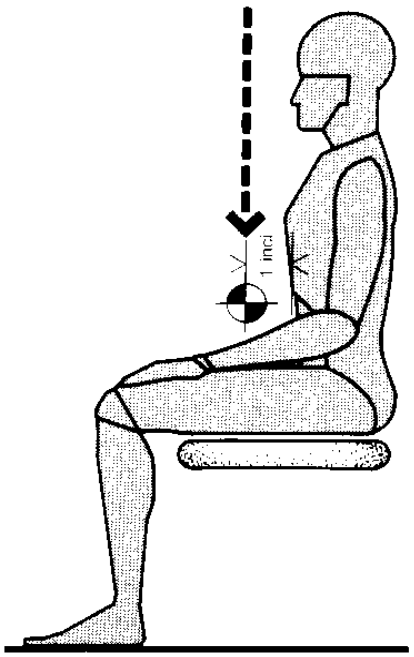
Gambar 4 : Standar perancanngan



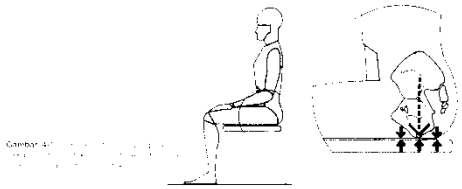


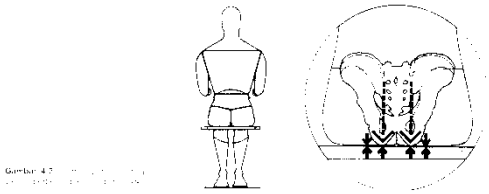
Gambar 5 :
Manusia
Berbagai Ukuran Tubuh Manusia

Gambar 6: Ukuran Tubuh

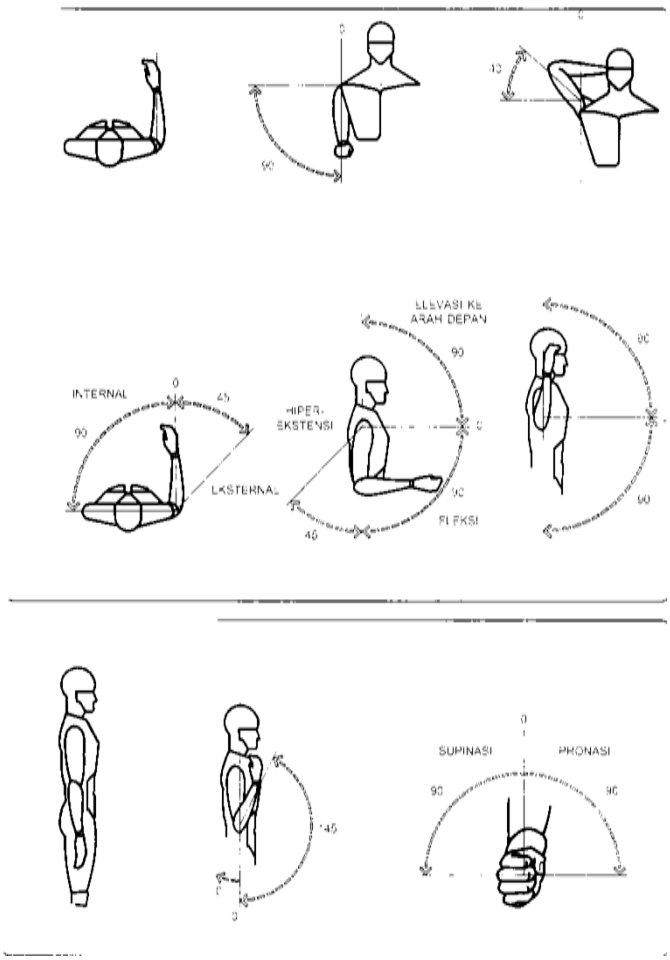


Ganbar 7: Centre of Grafity (Gaya beban dalam duduk)





Gambar 8: Duduk Posterior



Gamvar 9 : Angular Motion