JOURNAL OF CIVIL ENGINEERING PLANNING and DESIGN
Faculty of Civil Engineering and Planning Institut Teknologi Adhi Tama Surabaya - ITATS

Journal of Civil Engineering, Planning, and Design Vol.1, No.2, November 2022: Page 104-111

Product Design of Surabaya City Park Bench with The Development of The Concept Of 5 Ergoncomic Attributes

Yosef Richo[1a], Desita Rizky[2a], Duta Pemadani[3a]

[a] *Universitas Dinamika, Indonesia*

Abstract. Parks have an important role for residents of the city of Surabaya, in addition to functioning as a place of relaxation, parks also have various important roles such as as a source of city lungs, family recreation facilities, entertainment, health, sports to sharing knowledge and culture. Park Bench is one of the important facility products that can increase the value of satisfaction in the minds of visitors. The research here tries to explore further the design of the park bench by looking at the suitability of various aspects to support the comfort and safety of its use.

In this study, trying to harmonize the design of park benches by developing the concept of comfort and safety on ergonomic standards, first the researchers studied and analyzed the existing conditions of several parks in the city of Surabaya and also analyzed the sources of supporting literature. Existing in this study took several samples of city park benches that matched the criteria to be used as subjects in the study, the two researchers then analyzed the criteria for developing product design management by looking at the needs of the user's aspects by combining them with the suitability of Ergonomics standards. Furthermore, the researchers also tried to look at other supporting attributes in supporting the level of comfort and safety of park benches such as product quality consisting of aesthetics and functional. The three researchers carried out data processing and calculations for calculating ergonomic values that could be applied to product design.

The research here is expected to be able to understand more deeply related to the development of the Surabaya city park bench design by applying the comfort and safety attributes in more detail and also to understand the standard characters that can be applied to the next park bench product design.

Keywords: *Product Design Management, Park, Ergonomics*

1. Introduction

Park is an important area for the community, density and air pollution as well as busy population activities make the role of the park as a family recreation place or a place to unwind is suitable for the community, especially in the city of Surabaya. The large parks in the city of Surabaya are owned by the city government (Pemkot) so that the parks in the city of Surabaya are public facilities. According to Kusmaryani [1], the function of the park is that in addition to being a place of recreation and relieving fatigue, city parks also have other functions such as: as a place for visitors to carry out positive activities, a place for social interaction, a place for greening or the lungs of the city, accessibility place. Public facilities in Surabaya city parks are generally also equipped with supporting facilities for other activities such as: prayer rooms, canteens, sports areas, public telephones, outbound locations, education, and others [1].

Head of the Green Open Space Section of the Surabaya City Government's Green Open Space Cleaning Service (DKRT), Rochim Yuliadi, said that in 2019 the City of Surabaya, East Java, had a total of 613 parks which are believed to be able to reduce air temperatures. Of the 613 parks, 470 are passive parks, and 143 are active parks and can be used as public facilities and from these various parks there are 12 of the best parks in the city of Surabaya, according to traveloka.com, namely: Taman Cahaya, Surya, Bungkul, Flora Bratang, Harmoni, Pelangi, Apsari, Mundu, Jeyengrono, Expression, Achievement and Surooboyo. These parks are good destinations for the people of Surabaya or from outside Surabaya because of the beauty of the park, wide area, interesting themes and various facilities provided to visitors [2].

Figure 1. an example of the beauty of a Surabaya Garden design

1.1 Problem: Unattractive and Ergonomic Park Benches

In each area of Taman Surabaya, equipped with product design facilities to support the role of the area, the design of 'furniture' products in this certainly cannot be separated from the function of the public facilities area, Product Design, the role of product design in the public facilities area other than as an add-on to functionality value. from the facility area as well as a sweetener for the beauty of the place which can further increase the level of visitor satisfaction, one of the park facilities is a sitting bench facility for visitors.

Seating facilities are central in the park for visitors. Seating benches are usually functional as a comfortable and safe seat for visitors after walking around the park, besides that park benches also have several other functions such as being able to also be used as a place to chat between visitors or take shelter from the heat and rain (if it has a canopy). In addition to the functional side that can be used by visitors, benches with aesthetic value can also function as an addition to the attractiveness of the garden with an attractive design.

But unfortunately, in some park areas in the city of Surabaya, the bench seating facilities are not paid attention to the value of function and aesthetics by the park management, researchers found that several existing park benches in the city of Surabaya are still designed simply and even seem less feasible, thereby reducing the beauty and function of the park itself, the researcher through his review found several problems in existing park benches as follows:

JCEPD-ISSN: 2830-3628

1. Size is less ergonomic
2. Colors are less attractive
3. Unattractive design and aesthetics
4. There is no canopy and armrest
5. Has no other attributes
6. The material has started to break down

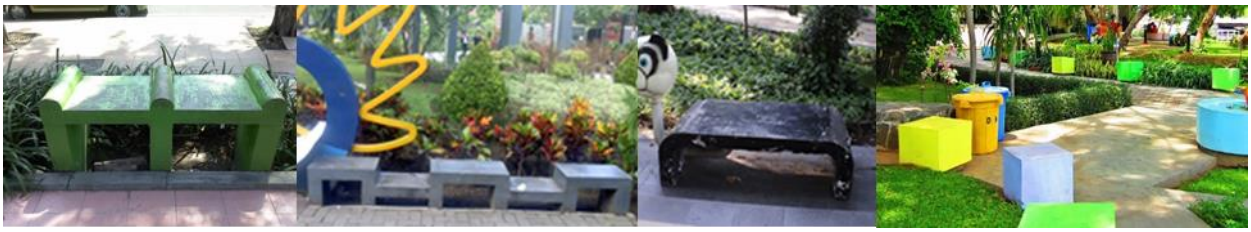

Figure 2. Example of uncomfortable garden bench

Based on the observations and reviews above, it is necessary to research for the development of garden bench product designs that are in accordance with comfort and safety standards as well as aesthetics and can improve the image of parks in the city of Surabaya.

1.2 Research purposes

The main objective of this study is to develop a product design for supporting benches in a Surabaya city park that is in accordance with comfort and safety standards, so that it is hoped that the design results will be able to improve the image of the place.

1.3 Research Limits

Because there are so many types of supporting products in Surabaya city parks in each park, this research is limited to developing product designs for supporting benches in Surabaya city parks.

2. Materials and Methods

Based on the above background, this study tries to see the gap from several studies related to aspects of product quality according to Jahanshahi [3] with factors in ergonomic design according to Berlin and Adams [5].

2.1 Product Quality

According to Jahanshahi [3] explains that product quality is the totality of features and characteristics of a product that has the ability to meet the needs to meet the expectations of its consumers, furthermore, the higher the quality provided by the product to its consumers, it can increase satisfaction and even loyalty after using the product. This needs to be considered in the development of product design at the Alun-alun facility later, with more attention to product quality, it is expected that consumers who have visited and used the Alun-alun product facility product can give a positive response and even loyalty [3]. Furthermore, Jahanshahi continued that the attributes of product quality are: safety, comfort (which is closely related to ergonomics), attractive design, and quality of function. So, from the attributes above we can know that the role of ergonomics, design and function is the main attribute in determining the design of a product. Furthermore, according to Hanaysa, Hilman and Ghani [4] mention the linkage of product quality with consumers, namely the quality of products contained in a product or service to consumers must be in accordance with the needs of consumers. Consumer needs here are the form of behavior, expectations and standards of consumer activity when using the product. The researcher continued that consumer needs related to their activities can be used by designers in determining product design, the same thing was said by Hoe and Mansori 2018 in determining the quality of related products in designing the design of a product, it is necessary to have a synergy between the needs of consumers or visitors and the ability of designers who interpret the intentions of consumers in a design [4]. So, from the above review it is important that the attributes of product quality which consist of ergonomics, attractive design forms and clear functions can be applied in the design also taking into account aspects of the suitability of consumer needs for use of the product in relation to its activities. This concept can be used as a reference in the design process in this study.

2.2 Ergonomics Factors in Product Design

Berlin and Adams [5] further explain the linkage factor of human activity with product facilities, Berlin and Adams then argue that there are several ergonomic factors that can be applied to product design based on the work system or user activity: Anatomy and physiology, physical loading, Anthopometry, Cognitive Ergonomics, Psychosocial [5].

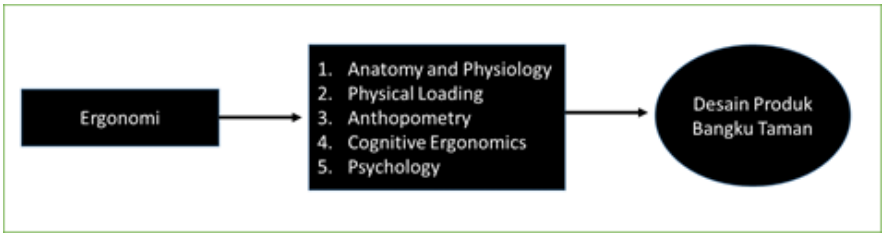

Figure 3. Ergonomic attributes in product design according to Berlin and Adam [5]

In accordance with this, in their research, Zair and Croq (2015) state that the influence of the comfort factor or ergonomics on a good product application will be able to cause several effects, such as the influence of the human effect and the system effect.

a. The human effect is an influence on the psychology department where this effect can play a role in creating a sense of security and calm when using a good product ergonomically

b. System effect, namely the comfort factor in the ergonomic quality of the product, can improve the control system outside the scope of human effects, such as the relationship between the surrounding environment which can influence each other,

better relations between product users who already feel comfortable and safe when using the product. The results of a good influence on the human effect and system effect after using an ergonomic product can then increase consumer satisfaction [6].

2.3 Stages and Research Methods

The objects in this study are park benches in the city, which are found in the existing 12 best parks in the city of Surabaya according to traveloka.com, namely: Taman Cahaya, Surya, Bungkul, Flora Bratang, Harmoni, Pelangi, Apsari, Mundu, Jeyengrono, Expression, Achievement and Suroboyo. This study uses a qualitative descriptive method, which is a method which is usually used to obtain detailed results based on a study of data obtained from previous documents related to the product design of public facilities in the square. In line with matters related to qualitative descriptive research methods, Subandi (2011) continues that qualitative research research requires data in the form of descriptive information. In qualitative research, the main characteristics come from the background of case studies in the community or in the field, qualitative methods can be carried out by reviewing documents from various sources. Then the next step, theory and design can be built based on the data from the document [7].

According to the researcher, this method is suitable for use in this study, by using descriptive methods, researchers can continue to review document data in the product design process.

The study activities when this research was written to obtain primary data such as: deductive from the description of the theory builder to obtain design attributes were carried out through data collection based on observations of the literature study in this study. After the data is collected, the researcher can continue the steps for data analysis and processing. The collected data is processed and analyzed to get a decision result for the design of park bench products. After the results of data processing and analysis are obtained, then the researcher continues the stages by designing the design solution criteria.

3. Discussion

Here the researcher chooses the product that will be used in the design development, the researcher uses a classification based on the level of importance. After conducting a review, the following are the results of the discussion.

a. Anatomy and physiology, is the suitability of product design with the anatomical shape of the body.

b. physical loading: is related to the suitability of the design with posture and movement at a certain time at the same time

c. Anthopometry: is the conformity of design with physical anthropology, referring to individual human measurements to determine human physical variations.

d. Cognitive Ergonomics is the suitability of convenience descriptions on the ability of the human brain to capture the meaning or meaning of the product design that is in front of them, and also the meaning obtained after using the product.

e. Psychosocial: is comfort in the minds of consumers related to the suitability of product design with environmental or social conditions around it.

3.1. ***Anatomy and physiology*** the suitability of the design with the anatomical shape of the sitting bench can be identified through the activities and body parts that interact with the bench when sitting, here are the anatomical requirements of the body with the design. a. Conformity to the anatomy of the hip in general, the human pelvis consists of the hip bone, sacrum, and coccyx. The front view of the pelvis is fan-like or curved. The hipbone consists of three fused bones, namely: Ilium. The largest part of the broad, fan-like pelvis. You can feel the curvature of this bone when you place your hands on your hips. pubic. Located in front of the hip bone close to the genital organs. ischium. Also called sitting bones because most of the body weight is focused on these bones when sitting. [8].

The seat design solution by taking into account the anatomical shape of the hip is slightly curved and widened to match the shape of the hip bone

b. Conformity to the anatomy of the thigh the thigh bone is also known as the femur. These bones fall into the category of long bones. This very strong and unbreakable bone extends from the hip to the knee. Typically, the femur is about 48 centimeters (cm) long and weighs 283 grams, in an adult male

c. Femur bone anatomy

1. Proximal femur: proximal femur is the part of the thigh bone, which is adjacent to the hip or pelvic bone. The proximal femur consists of the head, neck, to the trochanter (small hump of the thigh bone), both large and small.
2. Trunk of femur: the shaft of the femur is the part of the femur which makes the knee closer to the center of gravity of the body, and improves stability.
3. Distal femur: the distal end of the femur, characterized by the presence of medial and lateral condyles. The distal femur plays a role in forming the knee joint, to which the kneecap is attached. [9].

Design Solution: the seat with regard to the anatomical shape of the thigh is slightly curved and the depth is between 40-45 cm to match the length of the thigh bone / femur.

d. Conformity to the anatomy of the back:

The back is the back of the body located between the waist and the head. Used as a support for the body when sitting. The back is usually protected by a curved spine like a guitar. The spine contains 33 bones in humans, 5 of which join to form the sacral portion, and 4 bones form the coccyx [10].

The seat design solution can be given a backrest by paying attention to the anatomical shape of the back which is slightly curved and tilted to match the shape of the lumbar arch.

e. Conformity with knee anatomy

The knee is one of the largest and most complex joints in the body. This joint is also the most vulnerable because it bears heavy loads and pressure loads while providing flexibility of movement. The knee joins the femur above and with the tibia below. There are two joints in the knee joint: the tibiofemoral, which joins the tibia to the femur and the patellofemoral joint, which joins the patella to the femur. The two joints work together to allow the knee to be flexed and extended, and rotated externally and internally. [11].

Design solution: the end of the seat is not sharp or curved so that the lower knee area is not injured when the anatomy bends or rotates because it is in a sitting position.

f. Conformity to the anatomy of the elbow

Elbow in anatomical position, the longitudinal axis of the humerus and antebrachii forms an angle called the carrying angle which is seen when the elbow is fully extended and the antebrachii is fully supinated. This angle is greater in women than in men. Normally the angle is 5° for men and 10°-15° for women. This angle is formed because the distal end of the humerus is not the same height. This angle disappears when the elbow is extended and the antebrachii is pronated [12].

Design solution: on the sides of the seat, an elbow rest can be added which measures about 25 cm from the seat surface so that the elbow can be positioned when extended and the antebrachii pronated

3.2. *Physical loading*

The following are activities that can be done on a park bench comfortably and safely a. Sitting: Bend your knees and put your hips on the seat Needs: the comfort of placing the hips on the seat, the comfort of the back leaning when sitting, the comfort of placing the elbow rest, b. Interacting: is doing activities related or related to people nearby Needs: 1. Convenience The bench can be used by more than 1 person so that users can interact with each other when sitting 2. Convenience Users can meet each other 3. Convenience of views between bench users when interacting

3.3. Anthopometry

a. Backrest: height 45.7 – 61 cm, tilt degree 105-110 degrees
b. Seat depth from hip to thigh:39.4-40.1 cm
c. Height of the seat from the ground: 40.6-43.2 cm
d. Width of seat to right and left elbow: 76.2 cm
e. Seat width: 61.0 cm [16].

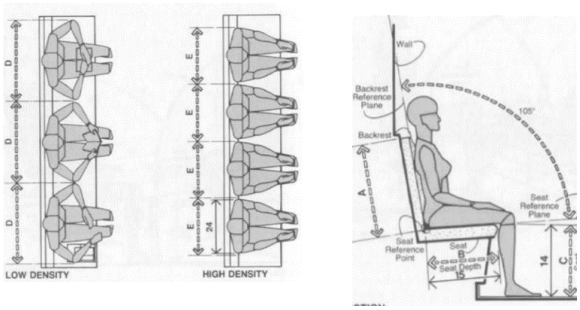

Figure 4. Anthropometry of the sitting bench

3.4. Cognitive Ergonomics

In adjusting the comfort description on the ability of the human brain to capture the intent or meaning of product design, in general through the stages of adjustment to perception and memory, according to Nurhayati and Pribadi (2009) the stages of cognitive ergonomics in the human mind are as follows:

a. Perception

Perception is part of the cognitive process. Perception is the process by which an individual selects, organizes, and implements information inputs to create a meaningful picture of the world. The sequence of cognitive processes that form perceptions begins with a selection process that occurs when individuals see several stimuli and choose which stimulus to pay attention to. [13].

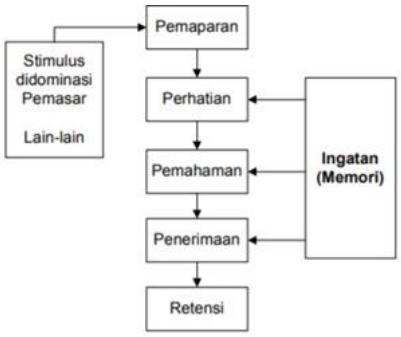

Figure 5. Flow of perception according to Nurhayati and Pribadi (2009)

b. Memory

Memory is the process of obtaining information and storing what we have and need at all times. Memory involves storing information over time. Information processing is the process by which stimuli are received, interpreted, stored in memory (memory) and how they are retrieved.

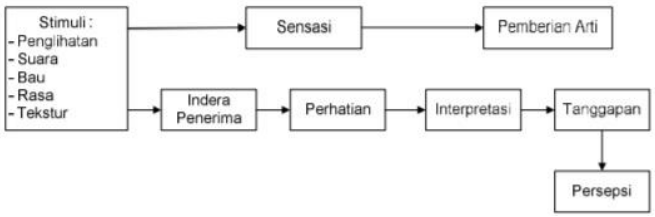

Figure 6. Process memory flow

Furthermore, according to Tama, Azlia and Hardiningtyas [14] stated that there are attributes in product design that can affect the level of comfort in the perception and memory of the human brain, namely the shape, decoration, color and exploration contained in the product. It is considered appropriate to determine the comfort attribute in product design. The following are cognitive attributes according to Tama, Hazlia and Hardiningtyas that can be applied to park bench designs [14].

Table 1. cognitive according to Tama, Azlia and Hardiningtyas [14]

Attribute	Information
Shape	The shape of the bench can be comfortable and avoid sharp corners, several forms that can be used such as; a. curved round b. Parabolic c. Ellipse d. Spiral e. S Curve
Decoration	Better decorations that are not too excessive and stand out so that they interfere with movement and activities as well as eye sight. Here are some kinds of decorations that can be used in garden bench designs: a. Plain (Colored, Glazed) b. 2D (Pattern, Drawing) c. 3D (Relief)
Color	The use of colors is not too much, just 1-3 colors, but not excessive color gradations are also allowed, here are some kinds of color schemes that can be used in garden bench designs a. 1 Color b. Blocked / solid colors c. Color gradation
Texture	The texture that can be used is a smooth texture and does not cause many scratches on the skin
Shape Exploration	The form of exploration can be free, such as the form of flora or fauna as long as it is not too complicated and causes sharp angles, here are: a. Landscape b. Flora c. Fauna d. Geometric e. Artificial

C.Pyschosocial

Pyschosocial or social psychology is a study of the relationship between humans and groups. Experts in this interdisciplinary field are generally psychologists or sociologists, although all social psychologists use both individuals and groups as their unit of analysis.

Definition of Social Psychology itself is a study that investigates how the thoughts, feelings, and behavior of individuals are influenced by the presence of other people, both actual and imaginative. Social psychology of Surabaya city park bench In its application there are several aspects that need to be considered with the suitability of social psychology based on consumer behavior or users based on their social conditions.

Consumer behavior is part of the act or movement of a person in order to show his attitude as a result of his interaction with the products and services that have been used. Consumer behavior is closely related to social factors because consumers or users also interact with the surrounding environment. The following are the main factors that influence consumer behavior socially:

a. Cultural factors (culture, sub-culture, social class)
b. Social Factors (Reference group, family, role and status)

Table 2. Ergonomic Psychological Factors

Faktor	Keterangan
Cultural factors of the Surabaya community Soedarso, Nurif, Sutikno and Windiani (2013) Multicultural Dynamics of Surabaya City Society-Journal of Social Humanities, Vol 6 No.1, June 2013	People of Surabaya's Culture as followed: a. Social Integration b. Multicultural
Social Factors (Reference group, family, role and status)	Social influence factor a. typical social character of Surabaya b. Norms and religion

3.5 Product Design Process

After the researcher collects the required documents into a review, then analyzes the document to determine the attributes needed in the design process, then the researcher processes these attributes to become a design classification flow. The design attributes are ergonomics, aesthetics and functions that can be used to determine the design direction for researchers.

3.5.1 Design Concept

Next, the researcher sorts based on the level of importance and needs that have been obtained previously from the respondent's data to be processed on the design concept. The researcher in this study used the results of the highest respondent's choice which could be used as the basis for the design, the following will be used by the researcher:

Anatomy and Physiology

a. Conformity with hip anatomy

Design solution: the seat with respect to the anatomical shape of the hip is slightly curved and widens to match the shape of the hip bone.

b. Conformity to the anatomy of the thigh

Design solution: the seat with regard to the anatomical shape of the thigh is slightly curved and the depth is between 40-45 cm to match the length of the thigh bone / femur.

c. Conformity to the anatomy of the back

Design solution: the seat can be provided with a backrest taking into account the anatomical shape of the back which is slightly curved and tilted (105 degrees) to match the shape of the lumbar arch

d. Conformity with knee anatomy

Design solution: the end of the seat is not sharp or curved so that the lower knee area is not injured when the anatomy bends or rotates because it is in a sitting position.

e. Conformity to the anatomy of the elbow

Design solution: on the sides of the seat, an elbow rest can be added which measures about 25 cm from the seat surface so that the elbow can be positioned when extended and the antebrachii pronated.

1. ***Physical loading***

a. Sit down:

1. There is a comfortable seat according to the size of the hip and according to the shape of the hip
2. There is a backrest
3. There is a tribal backrest on the seat

b. Interact:

1. The bench can be used by more than 1 person
2. Users can meet each other face to face with
3. There is no barrier to view between bench users when interacting

2. ***Anthopometry***

a. Backrest: height 45.7 – 61 cm, tilt degree 105-110 degrees
b. Seat depth from hip to tip of thigh: 39.4-40.1 cm
c. Height of the seat from the ground: 40.6-43.2 cm

d. Width of seat to right and left elbow: 76.2 cm
e. Seat Width: 61.0 cm

3. *Cognitive Ergonomics*

a. Shape

Better decorations that are not too excessive and stand out so that they interfere with movement and activity as well as eye sight, here are some kinds of decorations that can be used in garden bench designs

1. Curved round
2. Parabolic
3. Ellipse
4. Spiral
5. S Curve
6. Decoration

Decorations that are not too excessive and prominent so that they interfere with movement and activities as well as eye sight.

a. Plain (Colored, Glazed)
b. 2D (Pattern, Drawing)
c. 3D (Relief).

b. Color

The use of color is not too much, just 1-3 colors, but the color gradation is not excessive.

a. 1 Color.
b. Blocked / solid colors.
c. Color gradation.

c. Texture

The texture that can be used is a smooth texture and does not cause many scratches on the skin.

d. Shape exploration

Exploration of forms can be free, as long as it is not too complicated and sharp angles,
a. Landscape b. Flora c. Fauna d. Geometric e. Artificial

4. *Psychosocial*

a. Cultural factors of the Surabaya people
1. social integration: can be used for more than 1 person
2. multicultural: can be used a variety of cultures and ethnicities
b. Social Factors (Reference group, family, role and status)
1. Surabaya's distinctive social character: Has the characteristics of Surabaya
2. Norms and Religions: according to various cultures and religions

5. Conclusion

The main objective of this research is to obtain a park bench design that is in accordance with ergonomic attributes, namely Anatomy and Physiology, Physical loading, Anthopometry, Cognitive Ergonomics and Psychosocial. so that the results of data processing in this study can be used as the basis for determining a comfortable and safe design for visitors. This study also shows how the attributes of ergonomics can be applied in the form of designs that can be applied.

This study has limited time and also time constraints, the researchers did not test the validity based on questionnaire data or direct interviews with park visitors because the conditions of the city of Surabaya at the time this research was running did not allow it to do so. Secondly, this research also has the disadvantage of not discussing the important aspects of design aesthetics which can actually be combined with the attributes of comfort and safety in park bench products.

Suggestions in further research is how the next researcher is how to develop data processing by involving the results of questionnaires or interviews with park visitors, so that the results of the data obtained based on the needs of visitors can be maximized. Next is how the development possibilities in this research are related to the addition of other attributes such as aesthetics or production systems so that the design results can be more complex.

5. Acknowledgments

We would like to thank Dinamika University who assisted in this research process as well as fellow lecturers and students of Dinamika University Product Design who collaborated with each other to complete this research stage and also do not forget to the management of the Wonorejo Surabaya Nursery Gardens who have been friendly and open in accept the process of this research activity.

References

[1] Kusmaryani, Buletin Psikologi, Tahun IX, No. 2 Desember (2011)
[2] https://surabaya.bisnis.com/read/20190902/531/1143718/akhir-tahun-ini-surabaya-punya-613-taman
[3] Jahanshahi and Gashti *(2011)*, Study the Effects of Customer Service and Product Quality on Customer Satisfaction and Loyalty, International Journal of Humanities and Social Science Vol. 1 No. 7; [Special Issue –June 2011]
[4] Hanaysa, Hilman dan Ghani (2014), Direct and Indirect Effects of Product Innovation and Product Quality on Brand Image: Empirical Evidence from Automotive Industry. International Journal of Scientific and Research Publications, Volume 4, Issue 11, November 2014. ISSN 2250-3153
[5] Berlin dan Adams (2017), Production Ergonomics: Designing Work Systems to Support Optimal Human Performance. Ubiquity Press Ltd.
[6] Jahanshahi (2011), Study the Effects of Customer Service and Product Quality on Customer Satisfaction and Loyalty, International Journal of Humanities and Social Science Vol. 1 No. 7; [Special Issue –June 2011]
[7] Sumin, Kalangi, Wongkar (2012), Ukuran lebar panggul mahasiswi fakultas kedokteran universitas sam ratulangi dengan tinggi badan di bawah 150 cm. Jurnal Biomedik, Volume 4, Nomor 3, Suplemen, November 2012, hlm. 93-100
[8] https://www.sehatq.com/artikel/mengenal-fungsi-tulang-paha-si-tulang-terbesar-dalam-tubuh-manusia.
[9] https://id.wikipedia.org/wiki/Punggung_manusia
[10] http://www.leutikaprio.com/
[11] Dr. Al-Muqsith, M.Si. Anatomi dan biomekanika sendi siku dan pergelangan tangan. Unimal Press 2018
[12] Julius Panero. Dimensi Manusia dan Ruang Interior. Erlangga, 1979
[13] Nurhayati dan Pribadi (2009), Analisa Aspek Ergonomi Kognitif Terhadap Fenomena Buku Elektronik (eBook). Prosiding Seminar Nasional Ergonomi IX. Semarang, 17-18 November 2009
[14] Tama, Azlia dan Hardiningtyas (2015). Development of Customer Oriented Product Design using Kansei Engineering and Kano Model: Case Study of Ceramic Souvenir. Procedia Manufacturing Volume 4, 2015, Pages 328-335

JCEPD-ISSN: 2830-3628