Compact Workstation from Kelempayan *(Neolamarckia cadamba)*

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Abstract: Furniture is a necessity that has become a trend in accordance with the latest technology and development. There are high demands for multifunctional furniture that can fit into small space, especially for consumers staying in small houses, apartments or hostels. The objective of this study was to design a space-saving, multifunctional compact workstation from Kelempayan (*Neolamarckia cadamba*). At the end of the design and manufacturing phases, a survey was taken to evaluate the characteristics of the product. A set of questionnaires were distributed to 100 correspondents of University Teknologi (UiTM) based on gender, profession and range of age. The characteristics evaluated were suitability of material, compact concept, design, portability, comfortability, spacing, multifunction, commercialization and price of product. Results showed that gender factor influenced the evaluation on the characteristics of the product, but there was no significant difference on the evaluation based on the profession and range of age. It can be concluded that Kelempayan (*Neolamarckia cadamba)* is a suitable material to produce this compact workstation. This compact workstation has proven to be multifunctional, suitable for limited space and has great potential to be commercialized in the furniture industry of Malaysia.

Keywords: Compact workstation, Furniture, Kelempayan, Multifunction, Space

1. Introduction

Furniture can be identified as a product of design and is the mass noun for the movable objects that support human activities such as sitting on chairs, resting on beds, holding objects at a convenient height and placing or storing things. Basically, there are many types of furniture such as residential furniture, office furniture and institutional furniture. Each type of furniture has its own super characteristics, designs and functions (Harry, 2011). Design is one of the most important bases in furniture production, as it is known as an area of human experience, skill and knowledge which concerns human's ability. Then, the design of a high end product can be influenced by three important aspects namely aesthetics, function and engineering. Aesthetics design skill and knowledge may assist in constructing a furniture structure and load capability is not really a concern. This is due to its roles to amaze and convince consumers in buying or getting a particular product (Effie, 2009). Meanwhile, functional design will design furniture that can perform efficiently in its intended or specific function. Besides fulfilling the main function, for example, a chair must be able to support a person's seating position; the design should also satisfy other functions being considered as accessories such as the arm rest and back rest. Based on engineering design, furniture that is being constructed should safely resist the loads imposed upon the furniture in service. Furniture developed using this design is normally tailored to fulfil specified requirement, in terms of strength and capability (Norhafizah, 2013).

Besides supporting human activities, furniture is also needed as decorative art especially in private residences. But limitation of space in dwellings such as apartments, flats, rental houses and

hostels has become a problem to the consumers when buying furniture. Small areas require furniture that is small, simple and flexible (Kate, 2012). Compact furniture is thus seen as a potential product in solving all these problems as it is designed to save space (Jack, 2013). Plus, it can also provide comfortability, then providing convenience to the consumers. Furthermore, it may show the sophistication of the latest furniture technology. Multifunctional furniture is also recommended for houses with limited space as one product may be used with various functions. It may decrease the cost of raw materials, time, energy and space.

Rubberwood is one of the most popular materials used in furniture production due to its good characteristics and appearance. However, over the years, the cost of raw materials has increased and its availability has reduced. Therefore, to overcome this problem and be competitive, new raw materials are introduced, especially fast growing species (Cheah, 1995). The suitability of material is identified based on the characteristics of the furniture to be produced and its intended function.

The purpose of this study was to design and produce a product that was both compact and multifunctional using Kelempayan *(Neolarckia cadamba).* Basically, Kelempayan *(Neolarckia cadamba)* is a species that grows in Peninsular Malaysia (Ismail, 1993). It is from Rubiaceae family, with 290-465 kg/m^3 density classified as light hardwood (Lim, et al., 2005) Texture is moderately coarse and even. The mechanical and physical properties of its sapwood portion are not well determined from the heartwood portion, which is white turning to yellow on exposure (Lim, et al., 2005).

2. Materials and Methods

2.1 Materials

Kelempayan *(Neolamarkia cadamba)* was obtained from *Hutan Simpan* of UiTM Pahang. Mechanical hardware used included screw, L-bracket, hinges, retainer, drawer holder and roller, supplied by *Bengkel Industri Perkayuan* of UiTM Pahang.

2.2 Methods

a) Design Phase

Designing phase of product started with a case study/survey and ended with the production of the final product, as illustrated in Figure 1. During this phase, sketches, technical drawing and 3D drawing of product were analyzed.

b) Production of Final Product (Compact workstation)

Kelempayan *(Neolamarckia cadamba)* with a diameter range of over 45 cm to 60 cm was converted to sawn timber during sawmilling process. Then, it was dried using kiln drier until final moisture content (MC) was approximately 12% - 15% MC. The production of final product was conducted based on bill of materials (BOM) and route sheet. It started from cutting sample to end size for each component, edging process and till assembling phase. After being completely assembled, the product was sent to finishing phase. During finishing phase, sanding process was applied to produce a smooth surface. Then, sealer was used as an undercoat to cover the tiny holes on the product surface. Two layers of sealer were applied to the product. Finally, clear lacquer was used to make the product shine and create a protective layer.

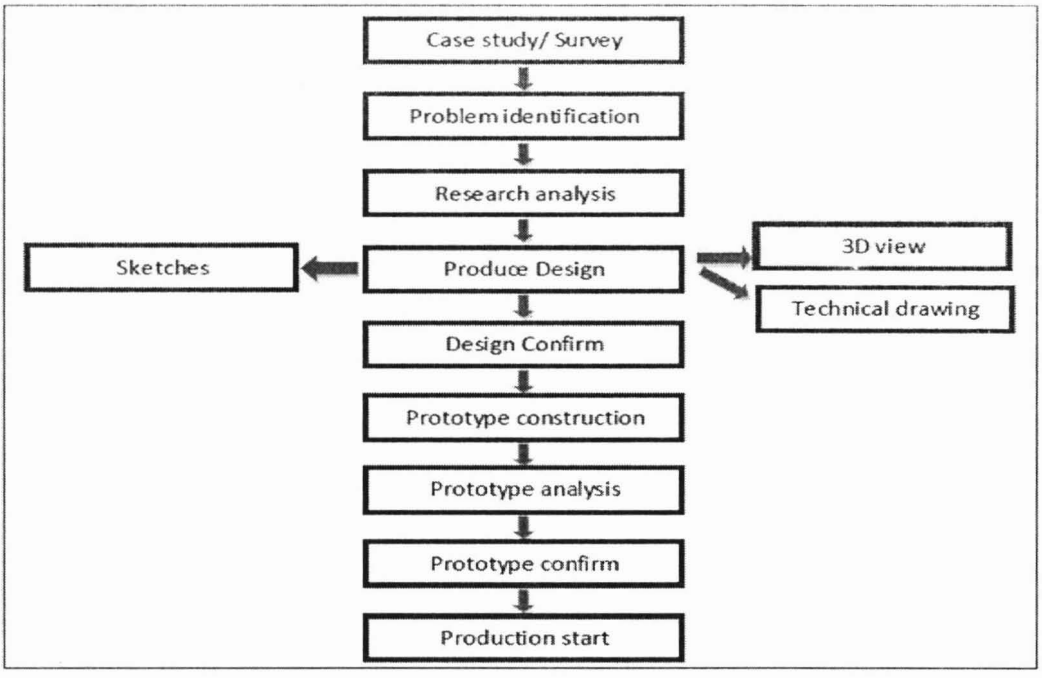

Fig. 1 Flowchart of furniture design

c) Questionnaires (survey)

A set of questionnaires were distributed to 100 correspondents of UiTM Pahang based on gender, profession and range of age. This was to gather information regarding the characteristics of this product. The characteristics evaluated were suitability of material, compact concept, design, portability, ergonomics, space, multifunction and commercialization. Values from 1 to 5 were applied (1: poor, 2: moderate, 3: good, 4: very good, 5: excellent).

3. Results and Discussion

3.1 Statistical Analysis

Table 1. Statistical Analysis of ANOVA on the Effect of Gender, Profession and Range of Age on the Characteristics of Compact Workstation from Kelempayan

SoV	df	Material	Compact	Design	Portable	Ergo Anthro	Space	Multifunction	Commercial
Gender	1	0.220^{ns}	6.075^{*}	5.567^{*}	7.525^{**}	4.734^{*}	2.699^{ns}	4.009^{*}	3.110^{ns}
Profession	1	0.036^{ns}	0.053^{ns}	1.154^{ns}	0.106^{ns}	2.894^{ns}	0.000^{ns}	0.093^{ns}	1.599^{ns}
Range of Age	2	2.341^{ns}	0.738^{ns}	0.916^{ns}	0.12^{ns}	1.05^{ns}	1.076^{ns}	0.005^{ns}	0.658^{ns}

***-Highly Significant P<0.01, *-Significant P<0.05, ns-Not Significant P>0.05*

Three factors that influenced the evaluation on eight characteristics of compact workstation from Kelempayan *(Neolamarckia cadamba)* were gender, profession and range of age. There was a significant difference on the evaluation of the characteristics of product based on gender for compact concept (6.075), design (5.567), portability (7.525), ergonomics (4.734), multifunction (4.009) and commercialization (3.110) as tabulated in Table 1. The suitability of material used and were totally not affected by it. Meanwhile, there was no significant difference on the evaluation based on profession and range of age.

3.2 The Effects of Gender, Profession and Range of Age on The Characteristics of Compact Workstation from Kelempayan *(Neolamarckia cadamba)*

Table 2. Mean Rating on the Characteristic of Compact Workstation from Kelempayan *(Neolamarckia cadamba)* Based on Gender, Profession and Range of Age

Factors		Characteristic							
		Material	Compact	Design	Portable	Ergo Anthro	Space	Multifunction	Commercial
Gender	Male	4.10^{a}	4.30^{a}	4.10^{a}	3.90^{a}	3.70^{a}	4.10^{a}	3.80^{a}	4.20^{a}
	Female	4.00^{a}	4.60^{b}	4.50^{b}	4.50^{b}	4.10^{b}	4.40^{a}	4.20^{a}	4.40^{a}
Profession	Staff	3.90^{a}	4.30^{a}	4.20^{a}	4.20^{a}	3.80^{a}	4.10^{a}	3.90^{a}	4.30^{a}
	Student	4.30^{a}	4.60^{a}	4.40^{a}	4.20^{a}	4.10^{a}	4.40^{a}	4.00^{a}	4.30^{a}
Age	20-25	4.30^{b}	4.60^{a}	4.30^{a}	4.20^{a}	4.00^{a}	4.40^{b}	4.00^{a}	4.30^{a}
	26-29	4.10^{b}	4.40^{a}	4.40^{a}	4.20^{a}	3.90^{a}	4.30^{ab}	3.90^{a}	4.40^{a}
	30 and above	3.60^{a}	4.30^{a}	4.10^{a}	4.10^{a}	3.70^{a}	3.90^{a}	3.90^{a}	4.20^{a}

Rating: 1:poor, 2:moderate, 3:good, 4:very good, 5:excellent

Table 2 shows the statistical analysis of mean rating for the effects of gender, profession and range of age on the characteristics of compact workstation from Kelempayan. Both gender rated the characteristics of the product as very good (ratings 4 and above) except for the suitability of Kelempayan as a raw material and multifunction of the product. Male correspondents rated them at 3.90 and 3.80 respectively. Overall, female correspondents rated the characteristics of product higher than male correspondents did. They totally agreed that the product had been designed and produced based on compact concept as they rated the highest for it (rating 4.60). The reason could be because the shelves, drawer, table and chair had been compacted together as one cabinet as shown in Plate 1(a) and 1(b). Those characteristics help in reducing the space needed and thus can prevent a room from being congested.

This compact workstation was produced based on ergonomics and anthropometrics concept. Female correspondents gave higher ratings for ergonomics and anthropometrics. The reason could be because the product had a better interaction with the measurement of their body dimensions (shape and size) if compared to male correspondents. Due to the high evaluations towards this product, they suggested that the product be commercialized as they thought it had great potential to be sold.

Plate 1(a) Compact condition

Plate 1(b) Modular condition

Based on the profession factor, both staff and students gave similar ratings on the characteristics of the product as shown in Table 1. Staff rated it as very good (rating 4) for all characteristics except for suitability of Kelempayan as a raw material, multifunction and ergonomic & anthropometric product (rating 3). The reason was because most of the staff had vast experience in buying furniture. They had the tendency to choose materials that were of better quality and high durability. Meanwhile, students preferred Kelempayan as a raw material due to its light colour and moderate durability. In addition, high durability of furniture would cost more which students could not afford. Therefore, they agreed that Kelempayan was suitable as a raw material for compact furniture with multifunctional uses as shown in Plate 3. In its modular condition, this compact workstation can play a role as a chair, shelve/table, cabinet and drawer. Both staff and students also classified this product as portable due to its compact design concept combined with rollers at the bottom.

Range of age factor showed that correspondents aged between 20-25 and 26-29 years old agreed that Kelempayan was a very suitable material for this product as they rated it as very good (rating 4). Meanwhile, correspondents aged 30 years old and above just rated it as good (rating 3) due to their experience with furniture. They preferred materials with higher strength. With regards to ergonomics and anthropometrics characteristics, correspondents between the age of 20-25 years old rated it as very good (rating 4), as the size of this product fitted their body dimensions and working environment which could ensure comfortability during use as shown in Plate 4. Correspondents aged 30 years old and above gave the lowest rate for that characteristic (rating 3).

Plate 3. Compact furniture with multifunction uses

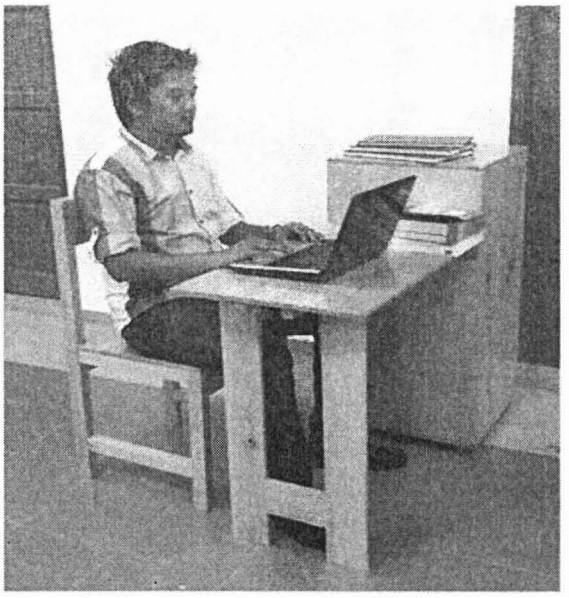

Plate 4. Ergonomics and anthropometrics

The results pattern was the same for space characteristic.Correspondents aged 20-25 years old agreed that this product was suitable for houses with limited space. This is because they were students and stayed at rental houses or hostels. By having this kind of furniture, they did not have to buy different types of furniture (chairs, tables, cabinet and drawer) to satisfy all of the required functions. They may save money and house space. In addition, this product can fulfil their needs while working and studying. Correspondents aged 30 years old and above gave the lowest rate for this characteristic but agreed that this product fulfilled the ergonomic and anthropometric concept (rating 3). Overall, all of the age ranges rated this product as suitable for commercialization as it had good value for money.

4. Conclusion

Overall, Kelempayan *(Neolamarckia cadamba)* can be a suitable material for this compact workstation, as it was accepted by all of the correspondents based on the survey conducted. It was agreed that this product was multifunctional, compact, space-saving and easily-handled. These characteristics have made it a potential piece of furniture to be commercialized in the furniture industry.

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