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Integration of Malay-Indonesian anatomical proportions in vocational education curriculum for technical illustration and engineering design

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ABSTRACT

This study aims to identify the anatomical body proportions of Malay-Indonesian males as an essential reference in vocational education, particularly for developing curricula in technical drawing and engineering illustration. Using a content analysis method, the study sample consists of 1,000 Malay men from various provinces in Indonesia. Data were collected through photographic documents and analyzed based on age, gender, and ethnicity. The ratio of body to head size was measured to identify relevant characteristics of body proportions. The results show that Malay male body proportions are shorter compared to Europeans; while the European body proportion is eight times the head size, the Malay proportion is seven times the head size. These findings have important implications for vocational education in designing curricula and instructional materials that are more accurate and relevant to local anthropometric characteristics. Understanding these body proportions enables vocational institutions to develop more effective programs in technical drawing and design education that are contextually appropriate. This research contributes to improving the quality of vocational education by providing empirical data as a reference for more culturally relevant and contextually appropriate drawing techniques and training.

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INTRODUCTION

Vocational education in the fields of engineering and illustration requires a deep understanding of the human body's anatomical proportions to support the development of curricula relevant to local needs. Human body proportions play a crucial role in technical education, particularly in the context of technical drawing and illustration, which demand an understanding of anatomical proportions in accordance with local cultural characteristics (Frederick & Haselton, 2007; Tiggemann & Slater, 2013). Current technical curricula often refer to body proportion standards based on European anthropometry, which are less representative of learners from diverse cultural backgrounds (Apicella, 2014; Sell et al., 2009). Therefore, this study aims to identify the body

proportions of Malay-Indonesian men as an important reference in vocational education to ensure that technical curricula are more contextualized and aligned with local anthropometric characteristics (Andersen et al., 1998).

Previous studies have shown that human body proportions differ by ethnicity and geographic location, with significant implications for product design, ergonomics, and technical education (Bhasin et al., 2001; Q. Rahman & Wilson, 2003). However, the existing literature predominantly relies on European standards, making technical curriculum approaches in Asian countries often less compatible with local anthropometric proportions (Dixson & Vasey, 2012; Dyer et al., 2011). In this context, the present study aims to provide the empirical data needed to strengthen the relevance of technical vocational education in Indonesia, particularly enabling learners to depict human proportions consistent with local characteristics (Rosa & Orey, 2015).

Previous research indicates that Southeast Asian ethnic body proportions tend to be shorter, with differing body-to-head ratios compared to European standards (Tiggemann & Slater, 2013). The eight-head proportion commonly used in European standards has been found less ideal for Malay-Indonesian men, whose proportions more closely align with a seven-head ratio (Apicella, 2014; Li et al., 2022). Thus, this study is designed to identify the anatomical body proportions of Malay-Indonesian men for application in technical and illustration vocational curricula, providing a more relevant and realistic teaching approach within the local cultural context (Dyer et al., 2011).

The research problem formulated in this study revolves around how to measure and determine appropriate body proportions for Malay-Indonesian men within the context of vocational education in Indonesia. The underlying research questions include: What are the anatomical body proportions of Malay-Indonesian men that align with teaching needs in vocational technical curricula? How can these proportional data support the development of more relevant technical teaching materials?

The objective of this study is to identify the body proportions of Malay-Indonesian men as a reference foundation for developing technical drawing curricula in vocational education. By understanding more accurate body proportions, vocational education is expected to deliver teaching materials that are more contextualized, enabling students to develop technical and illustration skills that are more relevant and applicable in various industrial fields (Frederick & Haselton, 2007; Yin et al., 2009).

The benefit of this research lies in the provision of empirical data as a basis for developing curricula oriented towards local body characteristics. The urgency of this research stems from the lack of data on Malay-Indonesian body proportions in international literature. Accurate anthropometric data on these proportions allows for the design of vocational curricula that are more responsive to local needs and enhances students' ability to produce high-quality technical and illustrative works that are culturally relevant (Andersen et al., 1998; Apicella, 2014).

The primary contribution of this research is the provision of Malay-Indonesian anatomical body proportion data as a significant reference for curriculum development in the fields of engineering and illustration. This study has the potential to strengthen the relevance of vocational education in Indonesia and Southeast Asia, as well as to improve the competitiveness of vocational graduates in the global market by equipping them with skills based on local anthropometric data (Bhasin et al., 2001; Tiggemann & Slater, 2013).

RESEARCH METHOD

This study employs a qualitative approach with content analysis methods to explore the body proportions of Malay-Indonesian men. This approach enables researchers to identify patterns in body proportions based on relevant visual documentation to support vocational education, particularly in the development of technical drawing and illustration curricula. Using this method, variations in body proportions influenced by factors such as age, region of origin, and other anthropometric characteristics can be explored in greater depth, providing richer insights into the factors affecting body proportions within the Malay-Indonesian population (Das & Roy, 2010; N. I. A. Rahman et al., 2018).

The research sample consisted of 150 Malay-Indonesian men randomly selected from various provinces in Indonesia. The sampling process accounted for diverse regional representation to ensure the data reflected the broad characteristics of the population. The subjects selected were aged 22 years and above. This age range was chosen as at this age, height growth is considered to have stabilized, providing more accurate and reliable anthropometric data (Gluckman et al., 2007; Shea & Bailey, 1996). This age range also represents the majority of the population in the workforce, making the findings particularly relevant for vocational education.

Data collection was conducted with the utmost adherence to ethical research standards, using direct photography techniques. All subjects were photographed standing upright to ensure accurate measurements from the crown of the head (cranium) to the chin. The photographs were not modified, maintaining the authenticity of the data. This technique was employed to calculate the height-to-head ratio as the basis for analysis, ensuring data integrity and producing valid and accountable documentation (Deros et al., 2011).

Data analysis was performed by calculating the height-to-head ratio for each subject. This ratio was then analyzed using descriptive statistics, including the calculation of mean values, standard deviations, and data distributions. The aim of this process was to determine the average body proportions of Malay-Indonesian men, which could serve as a reference for culturally accurate illustrations. Content analysis provided flexibility to explore variations in body proportions influenced by age and region of origin. For example, previous studies have shown that anthropometric characteristics can change over the course of life and exhibit significant variation across different regions (Vercellotti & Piperata, 2012; White & McCain, 1998).

To ensure the validity and reliability of the research findings, data triangulation was applied by comparing the results of this study with anthropometric data from previous research in Southeast Asia. Standardized measurement protocols were implemented to ensure consistency in data collection and reduce bias (Bhasin et al., 2001; Dixson & Vasey, 2012). Furthermore, the research findings were rigorously reviewed by experts in the fields of anthropometry and vocational education, ensuring their accuracy and relevance in academic and practical contexts.

This approach provides a strong empirical foundation to support locally based vocational education. By understanding the specific body proportions of Malay-Indonesians, this study not only supports the development of more accurate and relevant curricula but also enhances the quality of technical drawing and illustration education within the local cultural context. These findings significantly contribute to enriching vocational education with a stronger basis in empirical data and local relevance (Frederick & Haselton, 2007; N. I. A. Rahman et al., 2018).

FINDINGS AND DISCUSSION

Findings

This study successfully revealed that the body proportions of Malay-Indonesian men consistently exhibit characteristics distinct from the standard body proportions commonly used in vocational education based on technical illustration. Based on data analysis from 150 randomly selected samples from various regions in Indonesia, it was found that the average body proportion of Malay-Indonesian men is seven times the size of the head. The range of body proportions falls between 6.8 and 7.2 times the head size. These values indicate that the bodies of Malay-Indonesian men are significantly shorter compared to European body proportions, which reach eight times the head size as outlined in Andrew Loomis's theory. These findings reinforce the notion that European body proportion standards are not entirely relevant for Southeast Asian populations, particularly in Indonesia's vocational education context.

Figure 1. The Body Proportions of Malay-Indonesian Men Measured Based on the Height-to-head Ratio

Body Proportion Distribution

Our statistical analysis, a testament to the rigor of our study, reveals a crucial insight: the majority of the samples exhibit a remarkably consistent distribution of body proportions, with a low standard deviation. A significant 85% of the samples demonstrate body proportions ranging from 6.9 to 7.1 times the head size, a unique characteristic of Malay-Indonesian men. These proportions, slightly lower than the average in East Asian populations, are a key finding that contributes to our understanding of this demographic. The robustness of this distribution underscores the value of our study in describing the general characteristics of Malay-Indonesian men's body proportions.

However, there is minor variation in the data primarily influenced by several factors, including age, geographic region, and potential differences in access to nutrition. For instance, samples from urban areas tend to have slightly higher body proportions compared to those from rural areas, which may be attributed to better access to nutritious food and healthcare. Age also plays a significant role, with older age groups tending to have slightly lower body proportions than younger age groups. This reflects the decline in muscle mass and changes in body posture that occur with age, as observed in previous anthropometric studies (Gluckman et al., 2007).

Table 1. Regional Body Proportions

No.	Region/Group	Body Proportion (Times Head Size)	Description
1	Malay-Indonesian	6.9 – 7.1	The majority (85%) were within this range with homogeneous distribution and low standard deviation.
2	East Asia (Japan and China)	7.2 – 7.5	Average body proportions reported in the Wang et al., 2001 study
3	Europe	7.5 – 8.0	Body proportion standard according to Andrew Loomis, often used in art and illustration
4	America	7.5 – 8.0	Like European proportions, used as a reference in international design

Comparison with European Body Proportions

The findings of this study confirm significant differences between the body proportions of Malay-Indonesian men and European standards. These findings have significant implications for the fields of art education and technical illustration, where the European body proportion standard of eight times the size of the head is widely used. The study's results suggest that this standard may not

be as relevant when representing Southeast Asian populations, who tend to have proportionally shorter bodies.

For instance, if we consider the ideal European body proportion, which represents a man with a height of 176 cm and a head size of 22 cm, the average Malay-Indonesian proportion for the same head size corresponds to a height of 154 cm. This stark difference is a testament to the unique genetic characteristics and biocultural adaptations of Southeast Asian populations, including Malay-Indonesians. These adaptations, which are a response to local environmental conditions such as the tropical climate, favor smaller body sizes to reduce energy needs and improve thermal efficiency (Shea & Bailey, 1996; Vercellotti & Piperata, 2012).

Table 2. Comparison of Ideal Body Proportions between European and Malay-Indonesian Populations

No.	Aspects	Europe	Malay - Indonesia
1	Ideal Body Proportion	8 times head size	7 times head size
2	Body Height (cm)	178	154
3	Head Size (cm)	22	22
4	Description	The standard of ideal proportion according to Andrew Loomis' theory, widely used in art and illustration	Results show smaller bodies as an adaptation to tropical climate

Genetic and Environmental Factors

From a theoretical perspective, these findings underscore the role of biocultural adaptations in shaping human body proportions. The shorter stature of Malay-Indonesian men compared to European men is a reflection of these adaptations to geographic conditions and local lifestyles. Genetic factors, while crucial, are not the sole determinants of basic body dimensions. Environmental factors such as nutrition, physical activity, and health conditions also contribute to the variations observed within populations (Das & Roy, 2010).

For example, adaptations to the tropical environment of Southeast Asia, which is characterized by high temperatures and humidity, have resulted in more compact body characteristics, which are considered more efficient for regulating body temperature. In contrast, populations in colder regions, such as Northern Europe, tend to have larger bodies with longer limbs, which facilitate better heat retention (Gluckman et al., 2007). Furthermore, dietary differences between European and Southeast Asian populations also influence body dimensions. Diets rich in animal protein, more common in Western countries, are often associated with larger body development compared to plant-based diets prevalent in Southeast Asia (Nadadur & Parkinson, 2010).

Regional and Age Variations

This study has revealed significant regional variations in the body proportions of Malay-Indonesian men. Notably, samples from the Sumatra region exhibit slightly higher body proportions than those from Java or Kalimantan. These findings, which may be indicative of genetic differences among ethnic groups and variations in diet and lifestyle, underscore the critical need to consider regional factors in anthropometric analysis. This is particularly crucial in diverse populations like Indonesia, where such variations can significantly impact the design of products and facilities. Being mindful of these factors is essential for accurate and effective anthropometric analysis.

Furthermore, the study found that age is a significant factor influencing body proportions. Samples from the 22–30 age group demonstrated higher body proportions than those aged 45 and above, in line with previous research on age-related changes in muscle mass and body posture (Shea & Bailey, 1996). These findings have important implications for the application of anthropometric data, particularly in the design of products and facilities for diverse age groups. Understanding these variations can lead to more effective and inclusive design solutions.

Relevance of Findings

The findings of this study have broad relevance across various contexts, particularly in vocational education and ergonomic design. In vocational education, the body proportion data of Malay-Indonesians can be utilized to develop learning materials that are more aligned with local needs. For instance, students studying technical illustration can be trained to depict the human body based on local proportion characteristics, which not only enhances the relevance of the learning process but also enables students to create more realistic and contextually appropriate works.

In ergonomic design, this data can be applied to design facilities that better fit the dimensions of Malay-Indonesian bodies. For example, desks and chairs in educational settings can be tailored to ensure the comfort and efficiency of students during the learning process. Additionally, these findings are relevant for the design of workstations in the workplace, where good ergonomics can improve productivity and reduce the risk of injuries caused by improper posture.

Discussion

The findings of this study provide significant contributions to vocational education, particularly in the field of technical illustration and the development of curricula based on local data. By revealing that the body proportions of Malay-Indonesian men are shorter compared to European standards, this research offers an empirical foundation for improving teaching approaches in technical drawing. This is critical because, as noted by Nadadur and Parkinson (2010), curricula that fail to consider local anthropometric characteristics risk producing practically and culturally irrelevant outcomes.

Such mismatches can occur in various educational contexts, particularly in physical education, health, and technical vocational programs, where understanding local needs is essential for fostering student engagement and promoting well-being. For instance, furniture designed using foreign anthropometric data in Nigeria caused discomfort and potential health issues among students, underscoring the importance of locally relevant designs (Musa et al., 2012). It is, therefore, undeniable that curricula not based on local anthropometric data risk failing to meet students' specific physical needs, rendering teaching methods and outcomes ineffective.

In the context of body proportion theory, these findings offer a fresh perspective that expands upon the classic studies of Andrew Loomis. While Loomis emphasized that the ideal human body proportion is eight times the head size, this study demonstrates that such a standard is unsuitable for the Malay-Indonesian population. This conclusion is reinforced by the study of Shea and Bailey (1996), which highlighted differences in body characteristics based on ethnicity and geographic region, emphasizing the relevance of local anthropometric adaptations.

Research in other Asian regions, such as China and Japan, has produced similar patterns that support these findings, with body proportions ranging from seven to seven and a half times the head size (Nalipay et al., 2022). This comparison underscores the fact that the average body proportions in Southeast Asia exhibit distinct patterns compared to Western populations. The study also supports the view that variations in body proportions are influenced by adaptations to local environmental factors, including climate, diet, and physical activity (Vercellotti & Piperata, 2012).

To provide a more specific example, if the ideal body proportions for a European man reflect a height of 176 cm and a head size of 22 cm, the average Malay-Indonesian proportion for the same head size would correspond to a height of 154 cm. This difference reflects biocultural adaptations, which are changes in body size and shape due to a combination of biological and cultural factors, to local environmental conditions, such as the tropical climate, which tends to favor smaller body sizes to reduce energy requirements and enhance thermal efficiency (Shea & Bailey, 1996; Vercellotti & Piperata, 2012).

The primary implication of this research lies in developing more contextual and relevant vocational education curricula. By understanding that the body proportions of Malay-Indonesian men differ from international standards, educational institutions can develop learning materials that better address local needs. This practical insight can significantly enhance the quality of teaching in technical illustration, enabling students to depict the human body more realistically, aligned with local characteristics.

In the field of ergonomics, which is the study of designing equipment and devices that fit the human body, these findings also hold significant relevance. Workstations, desks, chairs, and work aids can be designed to match the dimensions of Malay-Indonesian bodies, ultimately enhancing comfort and productivity. Previous studies have shown that designs incompatible with local body dimensions can lead to health problems such as back pain and posture disorders (Dawal et al., 2012; Deros et al., 2011).

However, this study has several limitations that must be considered. Firstly, it focuses solely on the adult male Malay-Indonesian population, meaning the results cannot be generalized to women or other age groups. Additionally, the study sample was drawn from specific regions in Indonesia, which, although diverse, may only partially represent the national population. Further research encompassing a broader population, including women and other age groups, is needed to provide a more comprehensive picture. These limitations highlight the need for future studies to be more inclusive in their sampling and to consider a broader range of demographic factors.

Finally, this study employed photography techniques for data collection, which, while effective, may introduce potential biases due to the subject's positioning or orientation during photography. For instance, the angle of the camera or the subject's posture could affect the accuracy of the measurements. To address this limitation, it is recommended that future research consider direct measurements using modern anthropometric tools such as 3D body scanning. This technology enables more precise measurements and reduces potential errors caused by manual data collection techniques.

This study provides an empirical foundation for enhancing the relevance of vocational education curricula in Indonesia. Supplying local anthropometric data supports the development of technical illustration teaching tailored to local needs. Moreover, this data has broad applications in ergonomics, product design, and public health research, inspiring further studies and innovations in these fields.

CONCLUSION

This study has successfully unveiled a crucial finding-the body proportions of Malay-Indonesian males possess unique characteristics that are significantly different from the European body proportion standards commonly used in vocational education. With an average proportion of seven times the head size, these findings underscore the importance of using local anthropometric data to develop curricula that are more relevant and contextual. This discovery provides a robust empirical foundation for improving teaching methods in technical drawing and illustration that are aligned with local characteristics. Moreover, this data supports the development of ergonomic designs in educational and workplace settings, thereby enhancing comfort and productivity. This study's significant contribution to vocational education in Indonesia, particularly in providing culturally relevant body proportion data, underscores the need for further research. While the research has some limitations, such as its focus on adult Malay-Indonesian males, the call for further research with a broader scope is clear. This engagement is crucial to ensure the relevance and applicability of these findings. Consequently, the resulting data can be utilized not only for vocational education but also for product design, public health research, and data-driven policy development.

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