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## Kano Model and QFD integration approach for Ergonomic Design Improvement

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### Abstract

Increasing consideration has been given to Ergonomics in product design since the last several decades. Nowadays, more companies apply ergonomic aspects to their products to fulfill customer requirement and satisfaction of new products development. Customer requirement and satisfaction measurement can be achieved through various methods. This paper presents joining methods of Kano Model and Quality Function Deployment to improve the school workshop's workstation design for adolescent in terms of ergonomic and users need. A survey was done to 336 students to identify problems of the current workstation. Data gathered was translated into Kano questionnaire and answered by 255 students. Then it was clarified and used in the House of Quality matrix. At the end of the study, we find that both methods were able to prioritize the modification elements to be implemented into the new ergonomically designed workstation.

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*Keywords:* Kano Model; House of Quality; school workshop; workstation; student; ergonomic design improvement

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### 1. Introduction

School workshop is provided as school facility in order to be used as technical and vocational education class. In Malaysia, this kind of subject is called Integrated Living Skill, which in objective of preparing students to real job based on manual and practical activities (Ministry of Education, 2002). The

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major function of school workshop is to support practical activities and as an alternative classroom purposely for Vocational education. Just like other facilities in school such as classroom and laboratory, workshop's workstation has great impact in teaching and learning activity. Students need good furniture to sit/stand comfortably during teaching – learning process. Sam Murphy et al. (2004) stated that children are more likely to adopt flexed postures while working at the desk, with trunk flexion more than 20° prone to suffer from postural discomfort in school. Therefore, not ergonomically designed school furniture may generate growing back pain to children in the future. As suggested by Jfm et al. (2003), the size of school workstation should be based on their stature, rather than any other body segments. These sizes should be matched to anthropometry characteristics of at least 50<sup>th</sup> percentile of the user population (Milanese and Grimmer, 2004). They also made an assumption that there is an optimal relationship between anthropometry characteristics and furniture dimensions which would result an increased symptom of spinal and back pain.

This research was conducted at a rural secondary school in Klang district of Selangor, Malaysia. Workstation in the school workshop consists of a worktable to be shared by four to five students at a time. As a practical subject, students need to make a product made of woods and composite materials. This woodworking project must be completed usually within three to four months for every student. From author's observation and investigation, most students complained of back and muscle pain while using the workstation. A pilot study was carried out and results showed eight teachers and ten students, who completed a survey questionnaire, confirmed that 44% of subjects rated the workstation as average in comfort and 39% rated discomfort. 67% and 72% of subjects experienced back and neck pain respectively. This result proved that there are risk factors in the school workshop that can contribute to musculoskeletal disorder.

The objective of this study is to demonstrate how Kano Model and quality function deployment (QFD) were able to improve the design of school workshop's workstation via ergonomic design.

### *1.1. Ergonomic design*

Most companies always concentrate on developing and enhancing product design in order to fulfil customer satisfaction. Sometimes, the design cannot satisfy all user expectation and ergonomics in the design process. Overall stages of product development usually are handled by engineering specialist. The absence of ergonomist for example may result in undesirable product design (Marsot, 2005). Ergonomic design considers upon users capability and limitation while handling the products, workstations and machineries (Helander and Lin, 2002). Ergonomic design knowledge is focused on the relationship of objects and environments with human factors. This knowledge is very important for design engineers when making crucial decisions regarding the ergonomic parameters for product and layout design (Kaljun and Dolsak, 2012). In human – workstation interaction, it is important that the workstation should be adapted to the task so the task should fit to the man. As such, ergonomic design of workstation and furniture must be based on the anthropometry and biomechanics of a human body (Oyewole et al., 2010).

Several studies have implemented the ergonomic oriented-designs were done by Park, Liu and Paschoarelli. Park demonstrated a new design workstation chair to minimize physical discomfort and the risk of Cumulative Trauma Disorder (CTD) in Video Display Terminal (VDT) workstation. The ergonomically-designed chair attached with keyboard-mouse support was proven more suitable for computer work because it was able to decrease muscle activity (Park et al., 2000). A helmet design suggested by Liu based on head shape had successfully improved the helmet's stability and reduces its weight. Ergonomic aspects were easier to be considered with the integration of helmet and human head

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