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The development of an ergonomically designed product through an integrated product team approach

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Purpose. This article discusses the process of developing an ergonomic desk for students through an integrated product team approach. *Methodology*. Using an integrated product team approach, numerous quality tools, customization techniques, strategic tools and techniques including quality function deployment, ergonomic principles, Kano model, SCAMPER (substitute, combine, adapt, modify, put, eliminate, reverse), brainstorming, Pareto's principle and cause-and-effect diagrams were systematically applied. In addition, for detailed designs, anthropometric measurements were considered. *Results*. Having identified various health problems associated with use of unergonomic furniture by students, this study developed an ergonomic desk using SolidWorks version 2016. The ergonomic student desk considered the design for adjustability principle which accommodates 90% of all students (5th percentile female to 95th percentile male). *Conclusions.* Data obtained from three colleges were systematically verified, validated and evaluated and a design for an ergonomic student desk was the result. Adoption of these systematic processes gives the design practical validity, and once the ergonomic student desk has completed the manufacturing process its use is expected to lead to a reduction in the incidence of musculoskeletal disorders, neck problems, back pain and pressure on the hips. Ultimately, students having acquired a desk designed to fit their requirements will achieve comfort and satisfaction.

Keywords: ergonomic desk; adjustability mechanism; product development; bill of materials; musculoskeletal disorders; anthropometric measurement

1. Introduction

Students spend more than 5 h a day sitting in classes [1]. In India, it has been observed that students spend many hours in classrooms with poorly designed furniture including desks that have not been ergonomically designed. In total, students have been found to spend up to 40 h a week in college with timetables requiring them to be in the classroom on Monday to Friday from 10:00 to 12:00 (morning session) and from 13:00 to 18:00 (afternoon session) with a 1-h lunch break between 12:00 and 13:00. Students also have classes on Saturdays between 08:30 and 13:00. Over short periods the effects of improperly designed furniture may not be noticeable, but exposure to ergonomic risk factors over long periods, such as those described in India, leaves students at high risk of suffering musculoskeletal disorders (MSDs). Over time, the user starts to experience problems such as pain in the joints or some other parts of the body [2]. MSDs begin with a feeling of fatigue and pain and afterwards continue towards disease. Such a situation can result in reduced muscle power or limited limb movement [3]. Given such outcomes, ergonomics can serve to decrease the potential for pains, aches and damage to the shoulders, wrists and back of students and can reduce the incidence of ill health in the workplace.

It has been the case that for a number of years designers have paid little attention to the principles of ergonomics when designing their products, including the design of student desks. However, an awareness of ergonomics has begun to develop, appreciating the consequences of poorly designed furniture; attention is now being given to ergonomic principles in the design of student desks such that there is great optimism that the rates of MSDs and similar disorders might be reduced in the future.

Undoubtedly, there is a need in the 21st century to offer mechanical adjustments in the design of both sides of the desk, i.e., the writing and the seat positions. Such adjustments can help users adopt a suitable position that will not risk their health when completing tasks, and in so doing helping to prevent MSDs amongst users. It is the case that without the use of ergonomically designed furniture, users are in danger of acquiring MSDs [4]. For example, Prado-Lu [5] emphasizes the significance of having ergonomically designed equipment and Taifa and Desai [6] argue that there is a great need for considering ergonomics in the design of student desks. It is evident that the need for ergonomically designed desks creates an excellent opportunity for designers, manufacturers and users, and that having ergonomically designed products is

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