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THE ROLE OF ERGONOMICS: ENHANCING EDUCATIONAL QUALITY THROUGH AN OPTIMAL LEARNING ENVIRONMENT

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Introduction

The quality of education depends not only on the content and teaching methods but also on ergonomic learning environments. Ergonomics in education refers to adapting the learning environment to meet the physical and psychological needs of both students and educators. For instance, the design of workplaces or learning spaces, the use of appropriate furniture, and adequate lighting to ensure the comfort of both students and educators. Studies have shown that factors such as the design of tables and chairs, the positioning of computer screens and lighting levels can influence concentration and comfort during the learning process (Smith, 2013). However, there has been less focus on macro-ergonomics issues in schools such as discomfort learning environments, mismatch between student body sizes

and their tables and chairs, the weight of schoolbags and the prevalence of musculoskeletal disorders amongst school students (Legg & Jacobs, 2008). Therefore, it is essential for educational institutions to consider ergonomic concepts in their efforts to enhance educational quality.

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The Concept of Ergonomics in Education

Implementing ergonomic concepts in educational settings enhances students' performance and well-being by promoting health, comfort and safety. Ergonomics in education encompasses

several key aspects namely: 1. Physical Environment, 2. Ergonomic Use of Technology and 3. Posture and Movement during Learning Sessions.

1. Physical Environment

- Use of tables and chairs that are appropriate to the height of the student.
- Adequate lighting to avoid eye strain.
- Good ventilation to ensure comfort during learning sessions.

Physical ergonomic evaluations focus on analyzing individual's body structure, movement, and posture during activities. Studies have shown that students often rely on standard chairs, textbooks, prolonged sitting at tables, and extensive use of technology in their learning process (Gumasing et al., 2022). Additionally, many students face challenges such as lack of motivation and difficulty maintaining concentration. Various environmental factors, including workstation design, ventilation and lighting, play a crucial role in shaping students' learning experiences. Previous research has demonstrated that aspects like workstation ergonomics, temperature, noise levels, lighting conditions and even colour could affect focus, comfort and overall learning outcomes. When designed appropriately, these elements not only enhance student well-being but also improve motivation and

academic performance (Villarouco et al., 2011). Therefore, assessing an individual's anthropometric, environmental and psychosocial factors is essential for fostering an optimal learning environment that supports student success.

For an optimal learning environment, a classroom should be designed and furnished to meet the diverse needs, interests and aspirations of students. This is because, students spend most of their time in the classroom during the school day, so creating an ideal classroom environment is essential for effective learning (Barri, 2020). According to Maslow's humanistic approach (Maslow, 1943), students have fundamental needs such as comfort, well-being, safety, connection, self-worth and growth. When these needs are fulfilled, students are more likely to engage actively in learning activities and enjoy the classroom atmosphere. Conversely, if these needs are unmet, students may disengage from learning, hindering their ability to achieve the intended learning outcomes. In the classroom, the design of a workstation or learning space significantly impacts students' learning motivation and performance. A well-designed, ergonomic workstation enhances comfort, concentration, and productivity. Ergonomic tables and chairs provide proper support,

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promoting good posture and reducing discomfort (Castellucci et al., 2010). Furniture should be suited to students' ages and sizes, ensuring comfort for extended periods and allowing enough space to work. In contrast, traditional chairs and tables often cause discomfort, leading to fidgeting, poor concentration and decreased academic performance. Researchers recommend that tables include drawers and adjustable heights and angles, while chairs should have lumbar support, armrests, wheels, and footrests to improve ergonomics and overall learning experience (Cabugawan et al., 2021).

Temperature and noise levels in classrooms also play a key role in student motivation and academic performance. Research highlights that maintaining a comfortable classroom temperature enhances learning, with the ideal range being 20–24°C (Earthman, 2002). To regulate temperature, learning spaces should be equipped with heating, ventilation, and air

conditioning (HVAC) systems, which improve air circulation and create a more conducive learning environment. Fluctuations in temperature can negatively affect mood, memory, and cognitive function, impacting student success (Cui et al., 2013). Additionally, excessive noise in classrooms disrupts learning by making it difficult for students to hear their teachers clearly. Thus, a quiet learning environment, where desirable sounds are prioritized, can significantly enhance student concentration and academic performance (Barri, 2020).

Adequate lighting is crucial in preventing eye strain and enhancing student performance. Research highlights the benefits of natural lighting for health (Boyce, 2010), productivity (Leslie, 2003), and academic achievement (Tanner, 2008). Poor lighting, however, can cause discomfort, headaches and difficulty concentrating, lead to negatively impact learning (Cheryan et al., 2014). At the same time, excessive light exposure can lead to visual discomfort (Ibañez et al., 2017). To create an optimal learning environment, classrooms should use lighting techniques that ensure even distribution and minimize glare. Proper lighting setups, such as well-placed windows and adjustable artificial lighting, help maintain visual comfort and improve focus during learning activities.

2. Ergonomic Use of Technology

3. Posture and Movement during Learning Sessions

- a. Position the computer screen parallel to eye level to avoid neck and shoulder strain.
- b. Scheduling of device use time to reduce digital eye strain.

Proper ergonomic practices are essential for preventing discomfort and improving productivity when using technology. To avoid neck and shoulder strain, computer screens should be positioned at eye level, about an arm’s length away, with the top of the screen at or slightly below eye level. Ergonomic accessories such as keyboards, mice, footrests, and height-adjustable desks further support a neutral posture and reduce muscle strain. Simple adjustments, like using a monitor stand, can help achieve an optimal workstation setup (WorkSafe, 2020).

Managing screen time is equally important to prevent digital eye strain, also known as computer vision syndrome. The American Academy of Ophthalmology recommends the 20-20-20 rule: every 20 minutes, take a 20-second break to look at something 20 feet (6 m) away (Johnson & Rosenfield, 2023). This practice relaxes eye muscles and reduces fatigue from prolonged screen use. Implementing regular breaks not only alleviates eye discomfort but also enhances overall focus and productivity. For example, using reminders or apps to prompt these breaks can help maintain focus and improve overall productivity.

- a. Promotes regular movement during learning sessions to prevent muscle fatigue and improve blood flow.
- b. Proper sitting techniques to avoid long-term musculoskeletal problems.
- c. Correct posture training as an early day for students in schools

Encouraging regular movement during study sessions is essential to prevent muscle fatigue and enhance blood circulation. Prolonged periods of sitting can lead to decreased muscle activity and reduced blood flow, contributing to discomfort and decreased concentration. Incorporating

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short, frequent breaks—such as standing, stretching, or walking for a few minutes every 20 to 30 minutes—can alleviate these issues. This practice not only helps maintain physical comfort but also promotes mental alertness, thereby improving overall learning efficiency (Mailey et al., 2016). Besides, adopting proper sitting techniques is crucial for preventing long-term musculoskeletal problems. Key aspects of proper sitting posture include keeping the head and neck upright, shoulders relaxed, elbows close to the body, and feet flat on the floor or on a footrest. It’s also important to ensure ample leg and knee clearance under the table to maintain proper posture. In addition to maintaining a neutral posture,

it is essential to avoid static positions for prolonged periods. Muscles fatigue faster when held in one position, so it's beneficial to keep moving to increase blood circulation. Regularly changing positions and taking short breaks to stand or walk can help prevent muscle fatigue and discomfort. By implementing these proper sitting techniques, students can significantly reduce the risk of developing long-term musculoskeletal problems and promote overall well-being.

Educational institutions can play a pivotal role by raising awareness among students about the importance of good posture, especially considering the prevalence of prolonged sitting during classes (Spine Care, n.d). Long periods of sitting, carrying heavy schoolbags and long-lasting physical activity were the top three causes for back pain among school children (Dullien et al. 2018). Thus, teaching correct posture at an early age is essential for students' long-term health and academic success. Proper posture helps maintain body alignment, reducing the risk of musculoskeletal problems such as back and neck pain. Encouraging students to sit upright with relaxed shoulders and feet flat on the floor prevents discomfort and improves concentration. For example, sitting with a straight back and both feet on the ground supports spinal alignment and reduces strain. Early posture education also promotes lifelong healthy habits.

As children grow, maintaining proper posture helps prevent chronic musculoskeletal problems. Schools can integrate posture lessons into physical education classes or as part of daily routines, using visual aids and regular reminders to reinforce these practices. By prioritizing posture education, schools not only contribute to the immediate well-being of students but also instil habits that support their long-term health and academic performance.

The Role of Ergonomics on Students' Learning Motivation and Academic Performance

The use of ergonomic principles in education has been shown to have a positive impact on students' learning motivation and performance. Students who studied in an ergonomic environment experienced improvement in

academic performance compared to those who studied in an uncomfortable environment. In the other words, ergonomically designed classrooms can improve students' academic performance, learning motivation, and mental well-being (Barri, 2020).

In addition, the rate of mental and physical fatigue among educators can also be reduced by having an ergonomic working environment. Educators are also able to impart knowledge more effectively when their work environment is comfortable and supports physical health.

Figure 1 showed the role of ergonomics on students' learning motivation and academic performance modified from Gumasing & Castro (2023). It showed that the workstation design, adequate lighting, temperature, adequate lighting, temperature, posture and movement

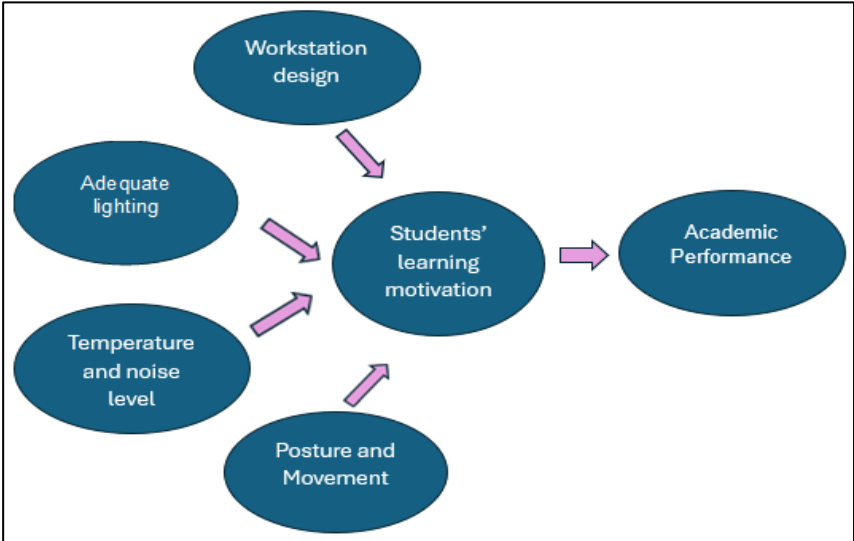


Figure 1: The role of ergonomics on students' learning motivation and academic performance modified from Gumasing & Castro (2023).

and noise levels, posture and movement were found to influence students' learning motivation, which then impacts the student's academic performance. Thus, it is essential for educators and educational institutions to keep in mind the factors that could motivate the students to learn and enhance their academic performance.

Suggestions for improvement

To ensure the importance and effectiveness of ergonomics in education, several measures can be taken such as:

1. Educational institutions need to invest in ergonomically friendly furniture and equipment.

2. Awareness of ergonomics should be instilled among students and educators.
3. Further studies on the effects of ergonomics on educational performance need to be undertaken.

Other suggestions include improving classroom design, incorporating diverse teaching methods and enhancing learning environments (Bashir et al., 2024).

Conclusion

Ergonomics plays a crucial role in improving the quality of education by creating a comfortable, safe, and conducive learning environment. By prioritising ergonomic factors in education,

we can ensure a more effective learning experience, thus contributing to the achievement of SDG 4 - *Quality Education*.

This article could be a reference for educational institutions, researchers, educators and students to determine the ergonomic factors that would enhance students' learning motivation and academic performance.

References

