

HOW EFFECTIVE IS IMPLEMENTING MACRO ERGONOMICS FOR CHILDREN IN THEIR EARLY YEARS OF SCHOOLING? A QUALITATIVE STUDY AT MONTESSORI IN KARACHI

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Abstract

This study evaluates how effective macro ergonomics is in improving the learning environment for children in their early years of schooling. A phenomenological approach was employed in a qualitative research design to gain in-depth insights into the experiences and perceptions of teachers regarding the implementation of macro ergonomics at the Montessori level. Data were collected through a self-developed, semi-structured interview guide using a non-probability, purposive sampling technique from six teachers belonging to Advance Montessori and Preparatory sections. Teachers' perspectives on the impact of macro ergonomics on children's physical, cognitive, and socio-emotional development were explored through interviews. Classroom observations were also conducted to identify macro ergonomic elements such as seating arrangements, lighting, noise levels, and curriculum planning and their influence on children's engagement and learning experiences. The data were analyzed through thematic analysis, identifying recurring themes and patterns from the participants' responses. The study highlighted specific aspects contributing to children's well-being, engagement, and learning outcomes. It was revealed that macro ergonomics principles improve children's physical and cognitive development and motivate them to perform better academically. The study's implications can suggest to educators, policymakers, and school administrators to integrate macro ergonomics into the early years of education for which teachers' continuing professional training needs to be designed. The study also contributes to understanding the role of macro ergonomics in promoting optimal learning environments for young children.

Keywords: Cognitive Development, Early Years' learners, Macro ergonomics, Montessori, Optimal learning.

INTRODUCTION:

Ergonomics are broadly divided into physical, cognitive, and organizational ergonomics by International Ergonomics Association (IEA, 2000), which are further sub-grouped into micro and macro ergonomics (Karsh et al., 2014). However, macro ergonomics, like lesson planning, curriculum designing, and classroom layouts, have not been paid much attention (Legg et al., 2008). Abarghouei and Nasab (2012) believe that the ergonomics model, including micro and macro ergonomics, plays a vital role in children's holistic development at school. Jayaratne (2012) discloses that children in a school environment are exposed to environmental hazards and other ergonomics risk factors that affect their cognitive and physical development. Young children are more vulnerable to these hazards than adults (Sly & Carpenter, 2012). Early years teachers' perception of macro ergonomics and its implementation in classrooms is important for ensuring students' safety and well-being (Soltaninejad et al., 2021). Teachers play a pivotal role in creating a conducive learning environment that promotes students' physical health and reduces injury risk (Jabeen & Hussain, 2022). Therefore, micro and macro ergonomics greatly benefit students' well-being and performance. Alsaif (2014) suggests that



implementing macro ergonomics in Montessori class settings positively impacts children's learning outcomes, engagement, and well-being. Factors such as the design of classrooms, adequate lighting, proper ventilation, and safe educational equipment play a significant role in creating a conducive learning environment (Gumasing et al., 2023).

Zhang et al. (2022) posit that teaching techniques, classroom activities, and teachers' attitudes play a vital role in engaging students through effective lesson planning. He further predicates that students in their early years are active and energetic and learn actively with hands-on activities. A happy learning environment is also necessary to keep students well-engaged in the learning process. Therefore, teachers need to organize their classrooms, lesson plans, and activities according to the needs of their students.

A well-designed classroom layout, lighting, and temperature are all part of education macro ergonomics (Matthew & Lippman, 2020). However, optimizing children's learning outcomes at the Montessori level desire to address macro ergonomics factors like introducing music (Kulset & Halle, 2020) and including game-based activities in the curriculum (Lamrani & Abdelwahed, 2020). Likewise, micro ergonomics helps children concentrate by improving posture and lessening physical discomfort if the school environment is comfortable and conducive (Jabeen & Hussain, 2022).

Furthermore, macro ergonomics considers children's social and emotional well-being. Collaborative spaces and flexible learning areas encourage interaction and communication, providing a sense of belonging and positive relationships among students. By implementing principles of macro ergonomics in the early years of schooling, educators and administrators can easily create an overall physical and academic atmosphere that supports children's cognitive, social, and emotional development (Alam, 2022).

LITERATURE REVIEW:

Macro ergonomics directly focuses on the environment provided to students. It can be furniture, a light system, study hours, teaching methodology, lesson planning, etc. In short, all such aspects affect the effectiveness of children's early years of schooling (Karsh et al., 2014; Sam, 2013). Optimization in non-formal early childhood education programs emphasizes the importance of effectively implementing curriculum management and effective lesson planning in early childhood education to achieve the desired objectives (Firdaus & Ansori, 2019). Macro ergonomics also designs and organizes curricula, instructional materials, and teaching styles. The educationist must align these elements with early learners' developmental needs and abilities, which can help enhance their learning outcomes and classroom performance (Firdaus & Ansori, 2019).

Barret et al. (2019) stress that factors that influence the effectiveness of the early years of schooling are classroom layouts, climate, lighting, acoustics, curriculum design, and teaching methodology. The physical furniture arrangement at the learning stations for children and other resources within a classroom can impact the children's engagement during learning time (Stankovic-Ramirez & Vittrup, 2023). A well-designed classroom with appropriate furniture, moving space, and easy access to learning material can enhance learners' concentration, motivation, and involvement (Kulset & Halle, 2020).

Matthew and Lippman (2020) believe sufficient lighting and acoustics in a classroom are crucial for learners' attention during learning. Proper and accurate lighting systems and sound control can help in reducing distractions and help in creating a conducive environment for students. Applying macro ergonomics in early years' education creates a supportive and engaging environment that facilitates learning development and well-being for young children.

Teachers' awareness regarding classroom design makes educational gadgets accessible to children of different abilities ensuring that all children can participate fully in learning activities (Jabeen & Hussain, 2022; Firdaus & Ansori, 2019). They should also effectively create learning zones in the classroom by organizing the space into different learning areas, such as reading corners, exploration zones, and quiet spaces, to cater to various activities and learning styles (Dowdell et al., 2011). Chen et al. (2017) emphasize that teachers design the learning environment as flexible and adaptable to children, accommodating different learning activities which are directly related to their efficacy,



and finally, their performance is evaluated on the academic achievement of their students (Jabeen et al., 2023) and stimulating learning through appropriate visuals, colors, materials, and acoustics. A well-designed and optimized physical environment can foster better learning outcomes and cognitive development (Hargreaves & Shirley, 2021).

It's important to note that macro ergonomics is just one aspect of the complex educational environment. Other factors, such as teaching methods, curriculum design, student motivation, and individual differences, also play crucial roles in learning outcomes and cognitive development (Kennedy et al., 2012). Mastery and management help young learners at the Montessori level to develop motor skills, such as handling tools like scissors, staplers, and paper punches (Zeng et al., 2017).

Zhang et al. (2022) suggest that curriculum-based learning reforms and strategies can optimize children's learning outcomes, improve their motivation, and develop a positive attitude toward learning. Baranowska et al. (2023) warn that children in their early years may face mental health issues and postural deviations if macro ergonomics dimensions are not considered in the future in their educational settings.

Children's well-being is paramount for the school administration, teachers, and parents; hence, each plays a vital role in children's social, emotional, and cognitive development (Kleinkorres et al., 2023). Carter (2016) proclaims that High-quality preschool programs can help children develop essential cognitive skills such as problem-solving, language and communication, and social interaction. Each child is unique and responds differently to different learning stimuli (Sciaraffa et al., 2018). Therefore, teachers must provide personalized learning experiences to support children's optimal learning opportunities.

Purpose of the Study:

This study examines the effectiveness of implementing macro ergonomics for children in their early years at the Montessori level. The main purpose of this study is to investigate the impact of macro ergonomics on children's engagement, learning outcomes, and overall well-being in the learning environment. By exploring teachers' experiences and perceptions, the study seeks to understand the potential benefits and challenges of integrating macro ergonomics in early years' education.

Significance of the Study:

This study is significant for early years' education in several ways, particularly at the Montessori level. The study informs the administrators, educationists, and stakeholders about the benefits of implementing macro ergonomics in school settings. The study significantly fills the research gap in understanding the effectiveness of macro ergonomics in the early years. It can also serve as a foundation for future researchers and provide a platform for assessing the effectiveness of activity-based practices in young children's classrooms for their optimized learning outcomes (Tokarek, 2023).

Statement of the Problem:

Previous studies have not focused on implementing macro ergonomics practices in Montessori settings (Legg et al., 2008). The effectiveness and impact of ergonomics on children's engagement, learning outcomes, and overall health in educational contexts remain relatively unexplored (Eddy & Moradien, 2020). Parents' concerns and lack of research in the early years of schooling compel the attention of researchers to discover the potential impact of ergonomics in the early years of schooling. The link between implementing macro ergonomics and children's learning habits, learning outcomes, classroom engagement, and overall well-being is yet to be discovered. Teachers' and parents' concerns highlight the need to uncover young learners' problems in the Montessori setting and their effects on learning outcomes. This problem thus gave the idea of conducting research in this particular area. Moreover, the problem accentuates the importance of focusing on the role of the classroom environment in supporting children's development and optimizing their learning outcomes in the early years of education. Ivanova et al. (2020) suggest that parents and teacher strong association is required to address the issues of young learners' health and learning outcomes.

Research Objectives:

The research objectives of the study were:



1. To perceive early years teachers’ understanding of implementing macro ergonomics in their classrooms.
2. To assess the effectiveness of macro ergonomics on children’s learning outcomes, engagement, and well-being.

Research Questions:

The research questions of the study were:

1. How do teachers perceive the concept of macro ergonomics and its’ implementation in early years classrooms?
2. How does macro ergonomics impact children’s learning outcomes, engagement, and well-being?

The theoretical framework of the study:

Considering the learning environment, this framework provides a holistic perspective on how implementing macro ergonomics can shape children’s development and educational experiences. The theoretical framework of the study was based on the following theories:

The Constructivism learning theory by John Piaget (1896) emphasizes how each student learns and discourages passive teaching strategies. As educators, it is important to understand that every child is unique and has a different potential to learn. The approach of constructivist learning theory is that children learn through exploration. The theory emphasizes activity-based learning and cognition, allowing everyone to participate and share their knowledge and perceptions.

Macro Ergonomics Theory: This theory supports implementing ergonomic principles in schools and aims to create an environment that supports students’ physical health, comfort, and concentration, ultimately enhancing their learning experience. It is also important to educate students and teachers about ergonomic practices to encourage proper posture usage of technology and overall well-being in and outside the classroom (Hendrick & Kleiner, 2002).

METHODOLOGY:

The qualitative paradigm approach has been used to examine the effectiveness of macro ergonomics in improving the learning environment for children in their early academic years in one school in Karachi, Pakistan.

Research Design: The qualitative phenomenological research design was used to comprehend and illustrate the universal significance of a phenomenon. The researcher conducted lived experiences to attain a deeper understanding of how teachers in one school in Karachi, Pakistan, determine the effectiveness of macro ergonomics in the early years of children in schools. The researcher analyzes the participants’ emotions, perceptions, and assumptions to elucidate the phenomenon’s importance under interviewing (Delve & Limpacher, 2022). The researcher kept aside the preconceptions and a prior-speculations and concentrated mainly on the immediate experience of the school teachers of three sections of Advance Mont. & Prep. The research process is shown below:

The Qualitative Phenomenological Research Design

1 st Step	2 nd Step	3 rd Step	4 th step
In the first step, the researcher identified the preconceived beliefs and opinions concerning the phenomenon effectiveness of macro ergonomics in the early years of schooling but was held in suspension.	In this step, the researcher interviewed the participants to understand the effectiveness of macro ergonomics in the early years of schooling.	In this step, coding was done to categorize to make sense of the importance of the phenomenon of the effectiveness of macro ergonomics in the early years of schooling.	Interpret the qualitative phenomenon of the effectiveness of macro ergonomics in the early years of schooling.

Sampling: The researcher used non-probability purpose sampling to instigate subjective judgments, drawing on the theory of effectiveness of macro ergonomics in the early years of schooling from six teachers of three sections each of Advance Mont. & Prep in a reputable school in Karachi, Pakistan. The sampling frame of the study was:



School	Section - 1	Section - 2	Section - 3	Total Respondent Teachers
Montessori School	2	2	2	6

Data Collection: Data was collected through individual and group interviews along with class observations. The purpose of interviews with the teachers was to learn their beliefs and assumptions about the effectiveness of macro ergonomics in the early years of schooling. Class observations seconded to know the implementation of macro ergonomics in the early years of schooling. Semi-structured and open-ended questions with probing questions were used to unveil a deeper understanding of the universal phenomenon of the effectiveness of macro ergonomics in the early stages of education (Bliss, 2016). Six participants provided significant information to collect data. Maintained the record of Class observations to learn the status of enforcing macro ergonomics in the early stages of pedagogy.

Data Analysis: Interviews of six participants were transcribed into text. For the additional study, the transcribed data was divided into sections, and later used coding to obtain the themes. The obtained themes were analyzed and supported by the literature review (Bliss, 2016).

Findings:

The following themes were fetched from the interviews of six participants:

1. Macro Ergonomics Helps Designing Appropriate Classrooms Layout:

The classroom layout can be welcoming by implementing a macro ergonomics design. Different stations can be set in the classroom so students can move in and visit different learning areas, helping children engage in learning (Matthew & Lippman, 2020).

Respondent 1 conceded that:

“No doubt students’ movement during lesson time is important because it helps them to make active learners. And as per understanding, it is one of the disciplines of macro ergonomics.”

Respondent 3 agreed with her colleague and added that:

“Movement is important. Sitting for longer hours makes us even more tired, and students also start feeling lazy after a certain duration.”

2. Optimize Learning Outcomes and Enhance Cognitive Development:

Children’s cognitive development depends on the internal and external environment. A pleasant and friendly environment promotes a child’s cognitive development and enhances class participation in academic and physical activities (Jabeen & Hussain, 2022; Lamrani & Abdelwahed, 2020).

Respondent 2 explained:

“We cater to children from different backgrounds and know their learning abilities differ. So, our focus is on enhancing their cognitive development by providing different opportunities.”

Respondent 4 expressed her views as follows:

“I believe access to books and toys supports children in many ways. When the child starts thinking and asking questions, their cognitive development process is taking place.”

3. Promote Physical Development and Supports Well-being:

A child’s Physical development is mainly important for the teachers and parents (Soltaninejad et al., 2021). Teachers at schools focus on their general health and well-being by guiding them to perform different activities (Alam, 2022; Kleinkorres et al., 2023).

Respondent 5 was concerned about children’s well-being and proclaimed:

“We provide students and their parents guidelines regarding body posture with disadvantages because children’s well-being is vital for us.”

Respondent 6 emphasized that:

“Children show a reluctant attitude if they’re not sitting comfortably. They do not respond even if they are not in a happy mood.”

4. Accelerate Students’ Motivation and Participation in School Activities:



Good lesson planning, school curriculum, and teachers' behavior significantly impact the learning process. Teachers' positive attitude toward child's learning encourages them to participate completely in classroom activities (Firdous & Ansori, 2019; Kulset & Halle, 2020).

Respondent 1 expressed her views enthusiastically and said:

"My students are lively like me. I am friendly with them, involve them in playful activities, and support them at every learning step."

Respondent 6 added that:

"Colourful environment and engaging activities like music, games, and drawings keep my children very active, and I can see that spark of happiness in their eyes."

5. Develop a Positive Attitude Towards Learning:

Internal and external environments of the classroom and schools make a lot of difference in students' lives. It completely changes their attitude toward learning. Teachers' motivation, classroom furniture decor, and physical activities accelerate the learning process (Hargreaves & Shirley, 2021).

Respondent 5 mentioned that:

"I remember my students were overwhelmed when I hung up a new picture in the classroom and modified their chairs arrangement."

Respondent 4 also agreed that:

"Catering to students with new ideas and styles is important. They show their enthusiasm and excitement and move forward to participate actively."

Conclusion:

The literature review and analysis of the identified themes have shed light on the effectiveness of macro ergonomics for children in their early years of schooling. Implementing macro ergonomics principles in early years' classrooms has positively impacted learning outcomes, engagement, physical development, and overall well-being.

The review indicates that the proper design and layout of classrooms, including ergonomic furniture, space utilization, lighting, and acoustics, play a significant role in creating optimal learning environments for young children. Such environments enhance cognitive development, including information processing, problem-solving skills, and memory retention. Additionally, ergonomic seating and promoting physical activity contribute to children's physical development and musculoskeletal health.

Incorporating interactive learning tools and flexible seating options influences engagement and motivation in learning. A comfortable and stress-free learning environment, facilitated by macro ergonomics, promotes emotional well-being, reduces anxiety levels, and enhances overall satisfaction with the learning experience.

Recommendations:

Teachers' Training: Training is crucial in implementing macro ergonomics principles and practices. If teachers are unaware of ergonomics' basic principles, they can never practice it. Therefore, providing awareness and training is a must.

Support from Administration: A proper support mechanism for teachers to effectively incorporate macro ergonomics in their classrooms is needed.

Ergonomics interventions: Ergonomics interventions must be introduced regularly to maximize learning outcomes.

Guidelines to Teachers: Early years teachers must be guided in designing classroom layouts by creating spaces for different physical activities to engage students. The guidelines should also address furniture arrangement, lighting, temperature, and acoustics.

Awareness to Parents and Stakeholders: Parents must be guided regarding the importance of ergonomics to raise awareness. Advocate for allocating resources and support to implement ergonomic interventions that enhance children's learning experiences and well-being.

Policy Guidelines: Policymakers to ensure framing appropriate guidelines at a national level and a copy to be provided to every school administration for implementation.

Research and Evaluation: Encourage further research on the long-term effects of macro ergonomics implementation and the specific strategies that yield the most significant benefits. Regular



evaluation of ergonomic interventions should be conducted to assess their effectiveness and make necessary improvements.

Maximizing potential: Stakeholders can create an environment that maximizes the potential of macro ergonomics in the early years of schooling, leading to improved learning outcomes, engagement, physical development, and well-being for young children.

Limitations:


The data was collected only from six teachers from one of the schools in Karachi, Pakistan. Therefore, the findings cannot be referred to other institutes in Pakistan. However, rich information can be collected from large samples from different schools for a better understanding.

Ethical Considerations:

The ethical consideration explained by Aera Bera (Suri, 2020) has been followed. Participants were approached after taking consent from the administration in writing. They were categorically given a free hand as and when they felt comfortable to give appointments for interviewing them. They were free to quit at any point in time if they felt so. The confidentiality of the data was maintained by hiding the participants' identities. The result was shared with the administration to implement any school intervention for the betterment of their students and staff.

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