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RELATIONSHIP OF ERGONOMICS, LIGHTING, AND NOISE WITH CHILDREN'S COMFORT AT TPA AL-MUNAWAR BUNGO

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ABSTRAK

Latar Belakang: Lingkungan belajar merupakan faktor penting dalam mendukung kenyamanan dan efektivitas belajar anak, khususnya pada lingkungan pendidikan nonformal seperti Taman Pendidikan Al-Qur'an (TPA). Komponen lingkungan seperti ergonomi, pencahayaan, dan kebisingan dapat memengaruhi kondisi fisik dan psikologis anak selama proses pembelajaran. **Metode:** Penelitian ini menggunakan desain kuantitatif dengan pendekatan *cross-sectional* yang melibatkan 30 anak di TPA Al-Munawar Bungo, Indonesia, yang dipilih menggunakan teknik *total sampling*. Variabel independen meliputi ergonomi, pencahayaan, dan kebisingan, sedangkan kenyamanan anak merupakan variabel dependen. Data dikumpulkan melalui observasi langsung terhadap kondisi lingkungan dan kuesioner terstruktur untuk mengukur tingkat kenyamanan anak. Analisis data dilakukan secara deskriptif dan bivariat menggunakan uji Chi-Square serta uji Fisher's Exact. **Hasil:** Hasil penelitian menunjukkan adanya hubungan yang signifikan antara ergonomi dan kenyamanan anak, sedangkan pencahayaan menunjukkan hubungan yang sedang dengan kenyamanan. Kebisingan tidak berhubungan secara signifikan dengan kenyamanan karena intensitasnya relatif rendah dan tidak terjadi secara terus-menerus. **Kesimpulan:** Faktor-faktor lingkungan, khususnya ergonomi, berperan penting dalam menentukan kenyamanan anak di lingkungan TPA. Oleh karena itu, diperlukan perbaikan fasilitas pembelajaran serta penelitian lanjutan dengan jumlah sampel yang lebih besar guna memperkuat dasar penyusunan kebijakan kesehatan lingkungan pada institusi pendidikan.

Kata kunci: Kenyamanan anak; ergonomi; lingkungan belajar; pencahayaan; paparan kebisingan

ABSTRACT

Background: Learning environment is a crucial factor in supporting children's comfort and learning effectiveness, particularly in non-formal education settings such as Taman Pendidikan Al-Qur'an (TPA). Environmental components such as ergonomics, lighting, and noise may influence children's physical and psychological conditions during learning activities. **Methods**: A quantitative cross-sectional design was conducted involving 30 children in TPA Al-Munawar Bungo, Indonesia, selected using total sampling. The independent variables were ergonomics, lighting, and noise, while children's comfort was the dependent variable. Data were collected through direct observation of environmental conditions and a structured questionnaire assessing comfort. Descriptive statistics and bivariate analysis using Chi-Square and Fisher's Exact tests were applied. **Results:** The findings revealed a significant relationship between ergonomics and children's comfort, while lighting showed a moderate association. Noise was not significantly related to comfort due to its relatively low and non-continuous intensity. **Conclusion**:Environmental factors, particularly ergonomics, play a vital role in determining children's comfort in TPA settings; therefore, practical improvements and further studies with larger samples are recommended to strengthen environmental health policies in educational contexts.

Keywords: Children's comfort; ergonomics; learning environment; lighting; noise exposure

BACKGROUND

Non-formal religious education institutions such as Taman Pendidikan Al-Qur'an (TPA) play a strategic role in shaping children's moral values, religious understanding, and character development from an early age. Beyond their spiritual objectives, TPAs function as complementary educational environments where children spend significant time engaging in structured learning activities. Because children in these settings are in critical stages of physical, cognitive, and psychological development, the quality of the learning environment becomes a crucial determinant of their comfort and learning effectiveness. A safe, healthy, and supportive environment is therefore essential not only for academic engagement but also for children's overall well-being.

Environmental health standards in educational settings have been widely discussed in the literature. The World Health Organization (WHO, 2018) emphasizes that inadequate environmental conditions in learning spaces may negatively affect physical health, concentration, and cognitive performance. Learning comfort is conceptualized as a subjective condition resulting from the interaction between physical environmental characteristics and individuals' psychological responses, influencing attention, participation, and learning endurance. This concept is supported by environmental health theory, which suggests that the physical environment directly affects human health, behavior, and productivity. In educational settings, environmental ergonomics further explains that learning facilities should match users' anthropometric characteristics to minimize physical strain and optimize performance.

Among the environmental factors influencing learning comfort, ergonomics, lighting, and noise are considered fundamental. Ergonomics refers to the compatibility between physical environmental conditions and users' anthropometric characteristics. Inadequate seating posture, inappropriate desk height, and prolonged sitting duration may lead to discomfort, muscle fatigue, and mild musculoskeletal problems in children (Tarwaka, 2015). Likewise, lighting plays a critical role in visual performance. According to visual ergonomics theory, insufficient or excessive lighting intensity may cause eye strain, headaches, and reduced reading efficiency (Suma'mur, 2014). Noise is another important environmental factor that may interfere with verbal communication, concentration, and cognitive processing. Basner et al. (2014) reported that chronic noise exposure among children can reduce attention, impair cognitive performance, and increase psychological stress.

Although numerous studies have investigated environmental health factors in formal school settings, limited attention has been given to non-formal religious education institutions such as TPAs. Existing research predominantly focuses on primary and secondary schools, leaving a lack of empirical evidence regarding environmental conditions in community-based religious learning centers. Moreover, previous studies have generally examined ergonomics, lighting, or noise separately, while few have analyzed these three environmental factors simultaneously in relation to children's perceived learning comfort. Consequently, the relationships among these variables remain insufficiently understood in non-formal educational contexts.

Preliminary observations at TPA Al-Munawar Bungo revealed several environmental limitations. Children commonly sit on floor mats or low wooden benches without back

support, which may not meet ergonomic principles. Lighting conditions depend on a combination of natural and artificial sources that are unevenly distributed throughout the classroom. Furthermore, nearby construction activities and small-scale workshops generate intermittent environmental noise that may disrupt learning activities. Despite these observable conditions, no systematic assessment has been conducted to determine whether these environmental factors influence children's learning comfort.

Based on these issues, the present study addresses the following research question is there a relationship between ergonomics, lighting, and noise and children's learning comfort at TPA Al-Munawar Bungo? To answer this question, the study adopts the perspectives of environmental health theory, environmental ergonomics, and visual ergonomics, which explain how physical environmental conditions influence health, comfort, and learning performance.

Therefore, the objective of this study is to analyze the relationship between ergonomics, lighting, and noise and children's learning comfort at TPA Al-Munawar Bungo. The findings are expected to provide empirical evidence for improving environmental health conditions and to support policy development aimed at creating safer, healthier, and more comfortable learning environments in non-formal Islamic educational institutions.

METHOD

1. Study Design

This study employed a quantitative analytic observational design using a cross-sectional approach. The cross-sectional design enables the assessment of relationships between environmental factors and children's comfort at a single point in time without intervention (Setia, 2016). The study investigated the association between ergonomics, lighting, and environmental noise and children's comfort in a non-formal Islamic educational setting.

The study was conducted at TPA Al-Munawar Bungo, Bungo Regency, Jambi Province, Indonesia, from December 2025 to January 2026. The research period included preparation, data collection, data analysis, and report writing.

2. Population and Sample

The target population consisted of children attending non-formal Islamic educational institutions, while the accessible population comprised all children actively enrolled at TPA Al-Munawar Bungo during the study period.

A total sampling technique was employed, whereby all eligible children were included in the study. Inclusion criteria were: (1) registered as active students at TPA Al-Munawar Bungo, (2) regularly attending learning activities during the study period, and (3) parental or guardian consent obtained. Exclusion criteria included absence during data collection and temporary health conditions that could influence subjective comfort assessment. Based on these criteria, the final sample consisted of 30 children.

3. Study Variables

The independent variables were classroom ergonomics, lighting, and environmental noise. The dependent variable was children's learning comfort.

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4. Operational Definition of Variables

Classroom ergonomics was operationally defined as the suitability of seating posture, learning surfaces, and sitting duration with ergonomic principles and was categorized as appropriate or inappropriate based on the observation checklist. Lighting was defined as the adequacy of classroom illumination during learning activities according to environmental health standards and was categorized as adequate or inadequate. Environmental noise was defined as surrounding sound conditions that could interfere with learning activities and was categorized as acceptable or high according to observational assessment. Children's learning comfort was defined as the child's subjective perception of physical comfort during learning activities, measured using a structured questionnaire and categorized as comfortable or uncomfortable based on the total questionnaire score.

5. Study Instruments

Environmental conditions were assessed using a structured observation checklist developed from ergonomic and environmental health standards (Tarwaka, 2015; WHO, 2018). Children's learning comfort was measured using a structured questionnaire adapted to their developmental level and employing categorical response scales. Prior to data collection, the questionnaire was pilot-tested to evaluate clarity and comprehensibility. Data were collected through direct observation and interviewer-assisted questionnaire administration.

6. Data Analysis

Data were processed through editing, coding, data entry, and data cleaning before statistical analysis. Descriptive statistics were used to summarize participants' characteristics and study variables. Bivariate analysis was conducted using the Chi-square test to examine the relationship between independent variables and children's learning comfort. Fisher's Exact Test was applied when the expected frequency in any cell was less than five. Statistical significance was determined at a p-value ≤ 0.05.

7. Research Ethics

Permission to conduct the study was also obtained from the management of TPA Al-Munawar Bungo. Written informed consent was obtained from parents or legal guardians of all participating children. Participants' confidentiality and anonymity were maintained throughout the study, and all collected data were used solely for research purposes.

RESULTS

1. General Description of the Research Setting

This study was conducted at Taman Pendidikan Al-Qur'an (TPA) Al-Munawar Bungo, a non-formal Islamic educational institution for early childhood and elementary school-aged children. Learning activities were carried out in a single main classroom with ceramic flooring and low wooden benches without backrests. Children studied either sitting on the floor (cross-legged) or on long benches, engaging in activities such as reading the Quran, writing, and memorization.

Field observations showed that the classroom had permanent walls and maintained good cleanliness. A whiteboard was available at the front of the room. Lighting was provided

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by a combination of natural daylight and artificial lamps. Sources of noise were incidental and originated from surrounding community activities.

2. Ergonomic Conditions of the Learning Environment

Observations indicated that most children studied while sitting on the floor or on low wooden benches without back support. This posture required children to bend forward for extended periods while reading and writing, potentially leading to neck and back muscle fatigue. Several children were observed frequently changing sitting positions, standing up, or moving around during the learning process. This suggests that the sitting posture was not fully ergonomically appropriate. According to ergonomic theory, working postures that do not match children's anthropometric characteristics may cause physical discomfort and reduce learning concentration.

3. Lighting Conditions of the Learning Environment

Lighting in the classroom was derived from a combination of natural and artificial sources. Visually, the light intensity appeared adequate for reading and writing activities, although light distribution was not evenly spread across all areas of the room. Suboptimal lighting in certain corners caused some children to bring reading materials closer to their eyes or bend further forward while reading. This condition may increase eye strain and affect learning comfort. However, overall lighting levels were still considered sufficient to support the learning process.

4. Noise Conditions of the Learning Environment

The level of noise in the TPA environment was relatively low and non-continuous. Noise mainly originated from the children's activities and occasional external sounds such as passing vehicles or nearby community activities. During learning sessions, noise did not appear to significantly disrupt the process. Children were generally able to follow lessons well, although attention was occasionally diverted by sudden external sounds. This indicates that noise levels were still within a tolerable range.

5. Children's Comfort Level

Based on questionnaire responses and observational findings, most children demonstrated a moderate level of comfort during the learning process. They appeared active, interacted with peers, and followed the teacher's instructions. However, several indicators of discomfort were observed, such as frequent changes in sitting posture, standing without instruction, or signs of fatigue. These findings suggest that children's comfort was not yet optimal and was primarily influenced by ergonomic factors.

A. Respondent Characteristics

A total of 30 children participated in this study. Respondent characteristics included age, gender, and duration of attendance at TPA Al-Munawar Bungo. The distribution of respondent characteristics is presented in:

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Table 1. Characteristics of Respondents

Characteristics	Category	Frequency (n)	Percentage (%)
Age	5–6 years	8	26,7
	7–9 years	14	46,6
	>10 years	8	26,7
Gender	Male	16	53,3
	Female	14	46,7
Duration of Attendance at TPA	< 1 Year	9	30,0
	≥ 1 Years	21	70,0

Based on Table 2, the majority of respondents were in the 7–9 years age group (46.6%). In terms of gender, the number of male respondents was slightly higher than that of females. Most children had attended learning activities at the TPA for one year or more, indicating that the respondents were relatively familiar with the learning environment at TPA Al-Munawar Bungo.

B. Relationship Between Learning Environment and Children's Comfort

The results of the analysis showed that there was a relationship between learning environment conditions and the level of children's comfort at TPA Al-Munawar Bungo. The analysis was conducted by comparing ergonomic conditions, lighting, and noise levels with the children's comfort observed during the learning process. Overall, the ergonomic aspect demonstrated the most prominent association with children's comfort. Children who studied in a cross-legged sitting position without adequate support or used benches with inappropriate height tended to exhibit signs of physical discomfort, such as frequently changing sitting positions, leaning, stretching their legs, or moving to another place. These findings indicate that inadequate ergonomic conditions may affect children's physical comfort during learning activities.

Lighting conditions also showed an association with children's comfort. Classrooms with adequate lighting, both from natural and artificial sources, enabled children to read the Qur'an more clearly and reduced complaints of eye strain. Children in rooms with relatively good lighting appeared more focused and were able to participate in learning activities more calmly compared to those in less optimal lighting conditions. Meanwhile, environmental noise also contributed to children's comfort, although its effect was not as strong as that of ergonomics. Noise sources from the surrounding environment, such as business activities and traffic, had the potential to distract children's concentration. However, when the noise was not continuous, children were still able to adapt and continue participating in learning activities, although their attention was occasionally diverted. To clarify the relationship between learning environment conditions and children's comfort levels, the results of the bivariate analysis are presented in the following table.

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Table 2. Results of Bivariate Analysis Between Learning Environment Conditions and Children's Comfort

Independent Variable	Kondisi	Nyaman	Kurang Nyaman	*p-value*
Ergonomics	Appropriate	12	3	0,012
	Not Appropriate	4	11	
Lighting	Adequate	11	4	0,041
	Inadequate	5	10	
Noise	Low	10	5	0,086
	High	6	9	

Based on Table 2, the Chi-Square test was applied to the ergonomics and lighting variables. Fisher's Exact test was used for the noise variable because at least one cell had an expected count of less than 5. The statistical analysis indicated a significant association between ergonomics and children's comfort level ($p = 0.012 < 0.05$). Children who studied under appropriate ergonomic conditions tended to report higher levels of comfort compared to those exposed to less appropriate ergonomic conditions. This finding suggests that proper seating posture and furniture suitability play an important role in supporting children's physical comfort during learning activities.

For the lighting variable, the Chi-Square test also revealed a significant relationship with children's comfort ($p = 0.041 < 0.05$). Adequate lighting conditions contributed to improved comfort during the learning process. Classrooms with sufficient natural and artificial lighting enabled children to read more clearly and reduced visual strain, thereby supporting better concentration and engagement. In contrast, the noise variable did not show a statistically significant association with children's comfort ($p = 0.086 > 0.05$). However, descriptively, children who studied in environments with lower noise levels tended to be more comfortable than those exposed to higher noise levels. This finding indicates that noise may still influence children's comfort, even though the association was not statistically significant in this study.

Overall, these results confirm that ergonomic factors were the most dominant aspect associated with children's comfort, followed by lighting, while noise had a relatively smaller effect. These findings are consistent with previous studies stating that learning environments that meet ergonomic and environmental health principles can enhance comfort, concentration, and the effectiveness of the learning process. Therefore, improving the learning environment at the TPA—particularly in terms of ergonomic arrangements, adequate lighting, and noise control—is essential for creating a child-friendly and comfortable learning atmosphere.

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DISCUSSION

This study examined the relationship between the learning environment and children's comfort at TPA Al-Munawar Bungo. The findings indicate that, overall, the learning environment has supported the educational process; however, limitations remain, particularly in the ergonomic aspect. Children commonly studied in a cross-legged sitting position on the floor or on low wooden benches without backrests, which do not fully comply with ergonomic principles for children. Prolonged non-ergonomic sitting postures may contribute to musculoskeletal discomfort, fatigue, and reduced concentration. The statistical analysis demonstrated a significant association between ergonomic conditions and children's comfort. This finding supports the initial hypothesis that better ergonomic conditions are related to higher levels of comfort during learning activities. It is consistent with previous studies showing that furniture suitability, posture alignment, and anthropometric compatibility play essential roles in promoting physical comfort and learning effectiveness among children. An ergonomically appropriate environment helps minimize muscle strain and allows children to maintain attention for longer periods.

Lighting was also found to have a significant relationship with children's comfort, although its influence was less dominant than ergonomics. Adequate lighting, whether natural or artificial, facilitates visual clarity and reduces eye strain. In line with environmental health principles, sufficient illumination supports better visual performance and enhances students' focus. However, uneven light distribution observed in certain areas of the classroom suggests the need for improved lighting arrangements to optimize visual comfort. In contrast, noise did not show a statistically significant association with children's comfort. This may be explained by the relatively low and non-continuous nature of noise in the study setting, allowing children to adapt to occasional disturbances. Although not statistically significant, descriptive findings indicated that lower noise levels were associated with better comfort. Previous literature suggests that continuous and high-intensity noise can negatively affect concentration and cognitive performance; therefore, maintaining a quiet learning atmosphere remains important.

From a broader perspective, these findings highlight the importance of integrating ergonomic and environmental health considerations into non-formal educational settings. Improving simple ergonomic features—such as providing appropriate seating support and adjusting furniture height—may substantially enhance children's comfort and learning experience. Future research should involve larger sample sizes to increase generalizability, apply objective measurements of environmental factors (e.g., lux meter for lighting and sound level meter for noise), and explore additional variables such as temperature, ventilation, and duration of study. Longitudinal or intervention-based studies could also be conducted to evaluate the effectiveness of ergonomic improvements on children's comfort and academic engagement.

AUTHOR CONTRIBUTION

Tiara Nurcihikita was responsible for conceptualizing the study, formulating the research background, designing the research methodology, collecting and analyzing the data, interpreting the findings, and drafting the manuscript. Febri Mubin contributed to the study design, supervised the research process, provided critical revisions to the manuscript, and assisted in interpreting the results. Ayudhia Fasha contributed to data validation, manuscript editing, and the review of the final version for intellectual content. All authors have read and approved the final version of the manuscript and agree to be accountable for all aspects of the work.

CONFLICT OF INTEREST

There is no conflict of interest in this research.

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