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ENVIRONMENTAL • SOCIAL • GOVERNANCE

THE 13<sup>TH</sup> INTERNATIONAL INNOVATION, INVENTION & DESIGN COMPETITION 2024

**EXTENDED ABSTRACTS**

**e-BOOK**

# EXTENDED ABSTRACTS e-BOOK

THE 13th INTERNATIONAL  
INNOVATION, INVENTION &  
DESIGN COMPETITION 2024



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## FRESH AIR KINDER HUB

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### ABSTRACT

Indoor air pollution is a major concern for the health and well-being of occupants in various types of buildings. Kindergarten buildings are particularly vulnerable to indoor air pollution due to the presence of young children who are more sensitive to air pollutants. The importance of internal layout and spatial organization in early childhood education environments is underscored by the philosophy of fostering active learning in children. However, in the specific context of kindergarten design in Malaysia, a noteworthy challenge emerges. Many private kindergartens operate in buildings not intended for education. The change in use of building contributes to poor IAQ. Thus, developing a physical setting framework that targets indoor air pollution is crucial for promoting healthy indoor environments. The aim of this innovation is to provide guidance on spatial arrangement for kindergarten. A physical setting framework is designed based on identified sources of indoor air pollution to improve indoor air quality. The development of the framework using primary and secondary data and the usability evaluation of the framework are by experts. The physical setting framework which includes orientation, occupancy, floor plan depth, window opening, window to wall ratio, ventilation system and location can contribute to the improvement of indoor air quality in kindergartens at shop office buildings.

**Keyword:** indoor air quality, pollution, kindergarten, spatial arrangement

### 1. INTRODUCTION

Clean air is crucial for children's optimal health and brain development which are the key factors that significantly affect students' feelings when they are in indoor environments (Sadriyadeh et al., 2022). Thus, the quality of air plays a significant role in shaping the cognitive and academic performance of children in educational settings. However, there is growing scientific evidence during the last decade which indicates that the air inside buildings can be more polluted than outdoors (Anake & Nnamani, 2023). Children attend kindergartens for approximately 40 hours per week and almost one-third of their time is spent in indoor areas such as the classrooms (Baharfar & Mohammadyan, 2021). Indoor areas enable potential contaminants to build up more concentrated than open spaces (Kankaria et al., 2014). Furthermore, many studies have reported that kindergartens' environment contains various types of organic and inorganic contaminants with potential toxicity and allergenicity (Baharfar & Mohammadyan, 2021; Oluchi, 2017), to the extent that kindergartens are considered hazardous for children. The investigation of indoor air quality in different kindergarten typologies by Sarijuddin et al. (2018) recorded higher CO<sub>2</sub> in kindergarten at shop office buildings which possibly contributed to the lack of fresh air intake for the

air-conditioned space and the higher occupant density. Pollution accumulates indoors when there is insufficient air flow (López-Chao et al., 2020).

In the context of kindergarten spaces, the challenges presented by shop office buildings directly affect the spatial arrangement, potentially impinging on the ability to provide a conducive environment for learning and play. When observed from both design and environment perspective, it becomes clear that the physical setting of kindergartens in change of use building is still immature and underdeveloped. Local authorities undoubtedly offer guidelines for the design of kindergarten spaces, but are limited to general aspects and less guidance especially regarding air-conditioned spaces (Uniform Building By-Laws 1984 (Amendment 2021), 2022; Private Education Division of the Ministry of Education Malaysia, 2021; . Current guidelines may not sufficiently address the nuanced challenges presented by these structures as highlighted by Zakaria et al. (2023). Therefore, there is an urgent need for a comprehensive physical setting framework tailored to kindergartens located in shop office buildings.

## **2. METHODOLOGY**

The proposed framework was developed based on the findings of the following completed activities: a) Reviewed extensive literature and guidelines governing kindergarten establishment [Guidelines on the Establishment of Kindergarten and Child Care Centre (2017), Guidelines for the Establishment, Registration and Operation of Private Kindergartens of the Ministry of Education Malaysia (2021), Uniform Building By-Laws 1984 (Amendment 2021) and Street, Drainage and Building Act 1974 (Act 133)]; b) 2784 minutes / 232 hours (9:00 a.m. to 5:00 p.m.) on monitoring indoor air quality in each of kindergarten spaces such as classrooms, common areas and kitchens located in six (6) shop office buildings using calibrated IAQ apparatus; c) The compliance of indoor air quality levels according to Malaysian Industry Code of Practice on Indoor Air Quality (ICOP), 2010 and World Health Organization, 2021; d) Experts review

## **3. FINDINGS**

The proposed framework comprises three key components: adherence to kindergarten guidelines and building regulations, identification of factors contributing to indoor air pollution, and recommendations for appropriate physical settings for kindergartens in shop office buildings. The overall outcome of the framework validation exercise was very positive where all validation aspects show a mean score of 3.50. This shows that the performance of the developed framework is good.

1. Degree of Practicality: The mean and median scores are both 3.50 with a standard deviation of 0.58, suggesting a moderate level of agreement on the practicality of the framework. This indicates that the framework is seen as offering somewhat realistic strategies to improve indoor air pollution.
2. Degree of Reliability: With a mean of 3.75 and median of 4.00, this aspect is viewed quite positively, suggesting that the framework is seen as reliable and grounded in research. The low standard deviation (0.50) shows consensus on this opinion.
3. Degree of Completeness: This aspect mirrors the results of reliability, with a mean of 3.75 and a median of 4.00, alongside a standard deviation of 0.50. This suggests the framework covers all the important aspects of kindergarten physical setting.

4. Degree of Applicability: This encompasses different areas within the kindergarten setting, such as the classroom, common area, and kitchen. Each component has been rated on specific elements like orientation, occupancy, floor plan depth, window-to-wall ratio, ventilation systems, and location. Generally, the feedback for each aspect indicates a consensus that the framework is applicable to the early childhood education setting, with most scores around 3.75.

5. Degree of Appropriateness: The mean and median scores are 3.50, with a standard deviation of 0.58, indicating the framework as moderately suitable for kindergarten guidelines.

#### 4. CONCLUSION

The successful accomplishment of this objective not only enables the transformation of findings into practical recommendations but also presents an opportunity to contribute to new knowledge and understanding. The framework is a valuable resource, offering insights into enhancing the physical setting by establishing guidelines for key areas to contribute to the development of IAP in kindergartens.

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