Environment – Behaviour Factors Model to Promote Pupils’ Creativity in Early Childhood Education Center

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Abstract. Learning environment is one way to form the future sustainable communities and cities by enhancing the quality of life. In early childhood education, attention to the environment – behavior aspects has an importance, because pupils do not have the same personality. This paper presents the study of connection between environment and behavior in early childhood education center. The study was aimed to identify which aspect from the environment-behavior factors model, that will affect in fostering pupils’ creativity. The results showed not all aspects in the environment – behavior factors model chosen as the main aspects, although all of them were necessary. This research was generally a qualitative study. The data was collected through the field observation and literature study. The result of the study showed that light, temperature, connection, flexibility and color will be the most important to be noted for design guidelines for early childhood education center to gain pupils’ creativity for enabling a productive learning environment.

Keywords: sustainable, early childhood education center, environment-behavior factors model, pupils’ creativity

1. Introduction

Learning environment is one way to form the future sustainable communities and cities by enhancing the quality of life. On the level of primary education, an increased focus on knowledge regarding sustainable design will be key in building the future sustainable development [5]. Early childhood education can be the need of pre-school for children before they entering their “real” primary education. Early Childhood Education is a branch of education theory for developing children aimed from birth to six years old. At this age period, children tend to have their “golden ages” which they are started to feel things/sensitive. Pupils’ potential are free for self-development in “prepared environment” where not only teacher, environment and material designed with specific reasons so environment could affect behavior. This prepared environment or “living lab” is designed by an adult before pupil enters it, it helped pupils independence and discipline to grow [1].

Schools, universities, and other educational institution are all require an architecture that enables a productive learning environment [5]. Several factors have an impact on increasing pupil’s creativity; these factors can be include time, encouragement, materials, and relationship with parents, child rearing and the stimulating environment. To enhance a pupil’s creativity, all environmental factors
including physical environment, family environment, learning environment, the educational environment, and system are also affective. Space has the main role in quality education and creativity presence. Human has innate creativity and it has relationship to the environment that his mind grows up in [4].

Several studies about the effect on of the increasing creativity prove that some factors of the physical environment are effective in growing creativity. These factors include natural environmental elements, materials, colors, the shape and size of the space, decoration, furniture and visual detail [4].

Environment-Behavior Factors Model appeared in a 2014 journal by Peter Barrett, Fay Davis, Yufan Zhang, and Lucinda Barrett [3]. They did a research that focused on environment-behavior on quality of school and classroom and connected individual statistics on pupils progress. Detailed of the brain’s implicit systems, a novel organizing model has been develop and proposed that reflect: the human “hard–wired” response to the availability of healthy, natural elements of our environment; our desire to be able to interact with spaces to address out individual preferences; and the various levels of stimulation appropriate to users engaged in difference activities. Thus three dimensions, or design principles, have been used to suggest and structure the factors to considered [3], namely *Naturalness* (Light, Sound, Temperature, Air Quality, Links to Nature); *Individualization* (Ownership, Flexibility, Connectivity); and *Stimulation* (Complexity, Color) (Table 1).These environment-behavior factors model includes design principles, parameters, indicators, factors and measurements.

### Table 1. Environment – Behaviour Factors Model

| Design Principles | Design Parameters | Indicators | Factors | Measurement criteria making up high rating |
|-------------------|-------------------|------------|---------|------------------------------------------|
| Naturalness | Light | A The quality and quantity of natural light the classroom can receive | 1 Glazing orientation | Larger windows from orientations with no direct sun (glare) |
| | | B The degree to which the lighting level can be controlled | 2 Glazing area/floor area | Both more and better quality |
| | | | 3 Quality of electrical lighting | Blinds with good functionality/quality |
| | | | 4 Shading covering control | |
| | Sound | C The frequency of the noise disturbance | 5 Noise from the school outside | Larger distance from traffic noise or presence of buffer zone |
| | | | 6 Noise from the school inside | Large distance from playground or busy areas |
| | | D The degree to which the pupils can hear clearly what the teacher say | 7 Length/width | Higher L/W ratio |
| | | | 8 Room volume | More coverage is better |
| | Temperature | E The quality and quantity of sun heat the classroom receives | 9 Orientation and shading control | Rooms with little sun heat, whether by orientation or shading |
| | | F The degree to which the central heating system can be controlled | 10 Central heating control | Thermostat and radiators in classroom give better control |
| | Air Quality | G The degree of respiration that affects the CO2 level in a fully occupied classroom | 11 Room volume | Greater volume is better |
| | | H The degree to which air changes can be adjusted manually | 12 Opening window size and position | More opening choices and bigger opening area |
| | | | 13 Mechanical Ventilation (MV) | MV present |
| Links to Nature | I | The degree to which the pupils can get access to natural elements | 14 Access to nature | Door directly to outside. Plats, and wooden chair/desks in the room |
|-----------------|---|---------------------------------------------------------------|---------------------|---------------------------------------------------------------|
|                 | J | The degree to which views of nature are available through the window | 15 View out | Window sills below child’s eye level and interesting or green near and far views |
| Individualization | Ownership | K | The degree to which distinct characteristics of the classroom allow a sense of ownership | 16 Distinct design features | Originality or novelty character to room. Personalized lockers or coat hooks. |
|                 | L | The degree to which the FF&E are comfortable, supporting the learning and teaching | 17 Nature of display | Child made display |
|                 |     | 18 Quality of the furniture, fixture and equipment | 19 Quality of the chairs and desks | Ergonomic and good quality furniture appropriate for age group |
|                 | Flexibility | M | The degree to which the pupils have an appropriate provision of space | 20 Classroom floor area and shape: key stage appropriate | Larger rooms with simpler shapes for older pupils, but more varied plan shapes for younger pupils. |
|                 |     | 21 Breakout and storage space attached to the classroom | 22 Learning zones: number of zones key stage appropriate | An attached & dedicated room for breakout and widened corridor for storage |
|                 | Connectivity | N | The degree to which the classroom and wall area allows varied learning methods and activities | 23 Wall area for displays opportunities | A greater number of well-defined zones for play based learning. Fewer zones and more formal zones for older pupils |
|                 |     | 24 Corridor width | 25 Orienting corridor | Larger is better |
|                 | Stimulation | P | The degree to which the classroom provides appropriate visual diversity | 26 Visual diversity of layout and ceiling | Curvilinear effect: overall visual complexity including room layout and display should be balanced; no to high nor too sterile. |
|                 | Q | The degree to which the display provide appropriate visual diversity | 27 Visual diversity of display | |
|                 | Colour | R | The degree to which the ‘colour mood’ is appropriate for the learning and teaching | 28 Wall colour and area | Light/white walls the bright highlight and feature wall |
|                 |     | 29 Colours of blinds, carpet, chairs & desks | 30 Display colour | Bright colour works better |

Source: Barrett et al [4]

2. The Methodology
This research is generally a qualitative research. The study used an environment – behavior factors model based on a study by Barrett et al. [3]; the method is a comparative review (observation and
literature review) on five schools. These schools were chosen because they have the same total average area. The comparative analysis used the method of assessing whether each school has applied the design principles of the environment-behavior factors model, including its aspects (Naturalness – Light, Sound, Temperature, Air Quality, Links to Nature; Individualization – Ownership, Flexibility, Connectivity; and Stimulation – Complexity, Color).

The analysis used references in the form of pictures and articles of the case studied schools. The assessment tools used a comparative review chart, to measure whether the school has applied the aspects of environment-behavior factors model (+++), has applied but insufficient (++), or have not applied yet (+), the factors chosen were the ones that applied the most in all five schools. The results of the study is the aspects that will be applied on early childhood education classroom based on environment – behavior factors model. The schools selected for case study was Salwa Islamic School, Els Color Nursery School, Montessori Xiamen, Montessori Waalsdorp and My Montessori Garden.

a) Salwa Islamic School
Daycare-Playgroup-Kindergarten-Elementary Salwa Islamic School (Figure 1) is based in Kebon Jeruk, West Jakarta. This school has completed early childhood education program in one area, which is a rare moment because in Indonesia, mostly they only have 2 (two) kind of programs only in one area (i.e playgroup and kindergarten only).

![Figure 1. Salwa Islamic School (Source: Writer’s Analysis)](image1)

b) Els Color Nursery School
This is RCR Aranda Pigem Vilalta Arquitectes’s project in Barcelona, Spain (Figure 2), with total area 2500 sqm built in 2004. This an early childhood education center’ project located in the best area because this project placed in the middle of main old town, so this building adopted old and contemporer architecture also.

![Figure 2. Els ‘Color’ Nursery School (Source: Archdaily [6])](image2)

c) Montessori Xiamen
This is L&M Design’s project in Xiamen, China (Figure 3), with total area 5000 sqm built in 2019. This project built with the needs of pupils around 2-6 years old. The facilities divided for the needs of 1.5-3 years old and 3-6 years old children.
3. Result and Discussion

3.1. Comparative Review of Case Studies Based on Environment-Behavior Factors Model
The comparative analysis used the method of assessing whether on each school has applied the design principles of the environment-behavior factors model. The analysis used references in the form of pictures and articles of the schools. The comparative review can be seen in Table 2.

d) Montessori Waalsdorp
This is De Zwarte Hond’s project in The Hague, The Netherland (Figure 4), with total area 2480 sqm built in 2014. This new building of this school is located in the “triangle school” in Benoordenhout. This school placed with the environment because of their unique. Wide interior and flexible make a dynamic accommodation for Montessori Program.

Figure 4. Montessori Waalsdorp (Source: Archdaily [8]).

e) My Montessori Garden
This is HGAA’s project in Quang Ninh, Vietnam (Figure 5), with total area 2500 sqm built in 2020. This pre-school oriented in Montessori program. This school made with garden-natural rooms for pupils, classroom between trees and flowers.

Figure 5. My Montessori Garden (Source: Archdaily [9]).
| Design Principals | Parameter | Salwa Islamic School | ‘Els Color’ Nursery School | Montessori Kindergarten Xiamen | Montessori Waalsdorp | My Montessori Garden Preschool |
|-------------------|-----------|----------------------|---------------------------|-----------------------------|------------------|-----------------------------|
|                   | Light     | Classroom            | Artificial light | Natural light | Artificial light | Natural light | Natural light |
|                   | Sound     | Located not in the main street | In the main street | Located not in the main street | In the main street | In the main street |
| Naturalness       | Temperature | Small window | Big window | Big window | Big window | Big window |
|                   | Air Quality | Small classroom | Big classroom | Big classroom | Big classroom | Big classroom |
|                         | Links to Nature | Ownership | Individualization | Flexibility | Connectivity |
|-------------------------|-----------------|-----------|-------------------|-------------|--------------|
|                         | No              | No locker for each pupils | No locker for each pupils | Not easy access | Not oriented to anything |}
|                         | Yes             | It has locker for each pupils | It has locker for each pupils | Easy access | Oriented to outdoor playground |}
|                         | No              | It has locker for each pupils | It has locker for each pupils | Easy access | Oriented to indoor playground |}
|                         | Yes             | It has locker for each pupils | No locker for each pupils | Not easy access | Not oriented to anything |}
|                         | Yes             | It has locker for each pupils | Yes | Easy access | Oriented to outdoor playground |
For naturalness, the design principles compared on the case studies was light, sound, temperature, air quality, and links to nature. Indicators for light is the quality and quantity of natural light the classroom can receive. Natural lights are very important for learning process in classroom. For the light aspect, Salwa Islamic School and Montessori Xiamen are depend to artificial light. In another case, Els Color Nursery School, Montessori Waalsdorp and My Montessori Garden have a lot of big window in the classroom. Sound indicates to the frequency of disturbance, either from outside or inside the school. Sound level of each schools are affect pupils’ concentration. Salwa Islamic School and Montessori Xiamen’s sound level are quite good because they are not on the main street, also the distance between classroom to main road and playground are not that close. In another case with Els Color Nursery School, Montessori Waalsdorp and My Montessori Garden are located in the main street. The quality and quantity of sun heat the classroom receive and controlled is the indicator for temperature. Rooms in Salwa Islamic School is quite got light from small windows, but those windows are ice-glare window, so it doesn’t use for natural light and air circulation. But all the other schools are have quite big windows. Air quality indicated to the degree to which air changes can be adjusted, either opening window size or position. Air Quality in Salwa Islamic School is quite not good because the size of the classroom are quite small. So, air quality of those classrooms are depend on air conditioner. Also, there is no open space or big playground in this school. But for the other schools, already have big windows that can be used for light and air exchange. Link to nature indicated to the degree which pupils can get access and easy view to natural elements. There is no links to nature in Salwa Islamic School, open playground in/outside. Montessori Xiamen also has not open playground, although it has big space in the middle of school. Montessori Waalsdorp has a big open outside space. In the different case with Els Colors Nursery School and My Montessori Garden that have links to open space.

Individualization’s design principles that compared on the case studies was owne ship, flexibility, and connection. For ownership, the characteristic of the classroom that allow a sense of ownership to pupils, such as personalized lockers or coat hooks. On the wall of Salwa Islamic School, the pupils’ made was already displayed, but they did not have locker for each pupils. for Els Color

| Stimulation | Complexity | Source: Writer’s Analysis |
|-------------|------------|---------------------------|
|             |            |                           |
|             |            |                           |
|             |            |                           |
|             |            |                           |
|             |            |                           |
Nursery School, Montessori Xiamen and Montessori Waalsdrop did not displayed pupils’ made, but they had lockers for each pupils. My Montessori Garden did not have any lockers and pupils’ made on the wall. Flexibility indicated to the degree to which the pupils have an appropriate provision of space. All those schools have a square-shaped building. But, because all of the classrooms in Salwa Islamic School and Montessori Waalsdrop are on the upper floor, the access is not as easy as Els Color Nursery School and My Montessori Garden. Montessori Xiamen’s classroom is in the upper floor but it has an enjoyable access for pupils. Connection indicated to the presence of wide pathaway and orienting object with identifiable destinations, like corridor width, larger and wider is better. The size of Salwa Islamic School’s classroom is not based on pupils behavior. In another case for the other four schools that have quite large classroom. Els Color Nursery School and My Montessori Garden are oriented to outdoor playground, Montessori Xiamen oriented to indoor playground, but Salwa Islamic School and Montessori Waalsdrop are not oriented to anything.

For stimulation, appropriate level of complexity and color compared on the case studies. For complexity, the degree to which classroom or display provides appropriate visual diversity, overall visual complexity should be balanced between room layout and display. In Salwa Islamic School, rooms layout and pupils’ made that displayed are not balanced, because the school’s size is not that big but pupils’ made are everywhere. In another case with the four other schools, the school’s size are quite big but pupils’ made are so minimum. For color, the degree to which ‘color mood’ is appropriate for the learning and teaching. White wall colour with bright display and features bright colour works better. All those five schools already adopted bright color, but Salwa Islamic School’s color is not that balanced.

3.2. Identification of Environment-Behavior Factors to Promote Pupils’ Creativity

Based on comparative result (Table 3.), most of the ten aspect of environment – behavior factors model are all necessary to be applied in designing school, especially early childhood education center classroom, but the most necessary are light, temperature, air quality, flexibility, connection, and colour.

Table 3. Comparative Review Chart

| Variable                        | Salwa Islamic School (1) | ‘Els Colors’ Nursery School (2) | Montessori Kindergarten Xiamen (3) | Montessori Waalsdrop (4) | My Montessori Garden (5) |
|--------------------------------|--------------------------|---------------------------------|------------------------------------|-------------------------|--------------------------|
| Naturalness                    |                          |                                 |                                    |                         |                          |
| 1. Light                       | ++                       | +++                             | ++                                 | +++                     | +++                      |
| 2. Sound                       | +++                      | +                               | ++                                 | ++                      | ++                       |
| 3. Temperature                 | ++                       | +++                             | ++                                 | +++                     | +++                      |
| 4. Air Quality                 | ++                       | +                               | ++                                 | +++                     | +++                      |
| 5. Links to Nature             | +                        | +++                             | +                                  | +++                     | +++                      |
| In di avidation                |                          |                                 |                                    |                         |                          |
| 6. Ownership                   | ++                       | +                               | ++                                 | +                       |                          |
| 7. Flexibility                 | +                        | +++                             | +++                                | +++                     | +++                      |
| 8. Connection                  | +                        | +++                             | +++                                | +++                     | +++                      |
| 9. Complexity                  | +                        | +                               | +                                  | +                       | +                        |
| 10. Color                      | ++                       | +++                             | +++                                | ++                      | +++                      |

Legend:

+ : Not Applied
++ : Applied, Insufficient
+++ : Applied
Light, temperature flexibility, connection and color; these aspects support the improvement of pupils’ creativity because all those five aspects, they included naturalness, individualization and level of stimulation of each pupils. Light on classroom towards the east and west can receive abundant daylight and have a low risk of glare. Natural light significantly influences and has the highest impact on overall progress among other design parameters. Poor quality of electrical lighting causes headaches and impairs visual performance. Not only the quality but also the quantity of electrical lighting has significant positive correlation with pupils’ learning progress [3].

Temperature of classroom receives a little sun heat or has adequate external shading devices. Factors affecting the temperature were correlated with the learning progress. Unwanted sun heat was a problem where external shading was absent. Pupils perform better in the room that where the temperature was easy to control [3]. Flexibility of easy access to attached breakout space and widened corridor for pupils area. Significantly more exploratory behavior, social interaction and cooperation occurred in spatially well-defined behavior settings [3].

Connections are closely related to circulation in the school. wide pathway and identifiable destinations of connection for pupils. Wider and more orienting corridors showed a bivariate with better learning progress Color to promote creativity mostly is white. White walls with feature wall produces a good level of stimulation for pupils. Room with balance of light colour (white walls) with highlight of feature wall or bright display colors had the best correlation with learning progress[3].

4. Concluding Remarks

The study of environment – behavior in order to be applied in a classroom of early childhood education center can be conclude as follows; most of the ten aspect of environment – behavior are necessary for increasing pupils’ creativity. The result of the study (Table 3.) that, light, temperature, connection, flexibility and color will be the most important to be noted for design guidelines for early childhood education center for gaining pupils’ creativity for enable a productive learning environment.

Lastly, this study is still and initial research. Due to pandemic, this research obtained only one site observation (Salwa Islamic School), the rest are literature study. Therefore, further result still needs to be tested and done with more project site observation

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