

## CHAPTER 2 LITERATURE REVIEW

### 2.1. Children Development

Children went through several phases of growth and development, including infancy, early childhood, and adolescence. Each phase had different characteristics, so it was necessary to pay attention to and evaluate the child's overall development. Physical growth was a measurable process that could be expressed in numbers. Usually, physical growth was considered an indicator of a child's health that reflected the fulfillment of nutrition as well as a supportive environment. Meanwhile, development was defined as gradual changes and the expansion of individual abilities that included progress from simpler to more complex stages, such as motor skills, learning ability, and central nervous system development (Hantmann et al., 2022).

The development of children aged four to six years needed special attention. This period was a critical phase that played an important role in the formation of children's physical growth and cognitive development (Borghini & Sachdev, 2024). Children's cognitive development included their ability to process information, remember, think, and solve problems. This was an important aspect of brain development that allowed children to understand their surroundings and interact with their social environment (Mulyana & Nurcahyani, 2022). There were several factors that affected a child's development, including biological factors, social factors, and environmental factors such as the environment where the child grew and developed (Faye et al., 2019).

Another factor in the environment that was also important for a child's growth and development was the element of lighting. According to previous research, natural lighting could help reduce stress levels in children and make children feel happier. Natural lighting also had an effect on children's health, such as regulating body temperature and reducing the risk of myopia, as well as playing a role in the production of vitamin D to maintain bone health in the body (Gaminiesfahani et al., 2020).

## **2.2. Kindergarten Effects for Children Development**

Kindergarten was an educational institution that provided basic education for children aged three to six years before they entered elementary school. Kindergarten had an important role in children's education that supported children's social, emotional, and cognitive development. In addition, a quality learning environment, such as an effective kindergarten design, could enhance the learning experience and encourage children's independence and creativity (Mohidin et al., 2015). This included flexible, open, and safe spaces, diverse play resources, balanced activities between learning and play, and emotional and social support from both teachers and staff at school and parents at home (Cheng et al., 2019).

Learning in kindergarten had a great influence on children's growth and development. For example, learning about hygiene and safety awareness, as well as regular physical activity, could support children's health development. A learning environment rich in verbal interaction and reading materials could help children's language development. Interaction with peers and social interaction with others could improve children's ability to socialize. Outdoor activities involving nature could stimulate children's curiosity and help them learn about their surroundings. Learning such as coloring, drawing, or making crafts could provide opportunities for children to express themselves through art and develop their creativity (Mei & Luen, 2023).

Interaction between children and their environment during play and learning could be analyzed through behavioral mapping. Behavioral mapping involved observing and recording children's behaviors in specific locations within play environments. By analyzing how children interacted with various play equipment and areas, the study provided insights into which types of environments and activities were more engaging for children (Onojeghuo et al., 2019).

## **2.3. Kindergarten Natural and Artificial Lighting**

### **2.3.1 Natural Lighting in the Kindergarten**

Natural lighting had a positive impact on children's physiological health. Research showed that natural lighting could lower children's stress levels while learning in the classroom. Children tended to be more active when they were in bright and visually

comfortable lighting (Meng et al., 2023). In addition, bright and fun colors could boost children's energy and creativity. So, the classroom in the kindergarten had to have visual appeal with a combination of a well-designed classroom and harmonious colors with optimal lighting. Natural lighting was essential for highlighting the colors in the classroom. When sunlight entered the classroom, it enhanced the vibrancy of the walls, furniture, and decorations. This not only made the space more visually attractive but also boosted children's mood and encouraged their motivation to learn (Salleh et al., 2015).

Children had their own lighting preferences that suited their activities. Based on research that had been conducted, when the curtains in the classroom were opened, they preferred natural lighting and visual contact with the outside environment. However, if the curtains in the classroom were closed, children were more likely to use brighter artificial lighting when doing assignments (reading, writing, or drawing), citing reasons related to maintaining visual comfort and facilitating engagement in various activities (Vásquez et al., 2019).

### **2.3.2 Artificial Lighting in the Kindergarten**

One of the important aspects for the kindergarten environment was the lighting aspect. Lighting not only supported visual comfort in the classroom but also affected concentration levels, reduced the risk of eye fatigue, and maintained the health and well-being of children in the classroom. Appropriate lighting could also create a positive and supportive environment, which could increase children's motivation and involvement in classroom learning (Ana, 2015).

Brighter artificial lighting with cool colors could increase children's ability to focus more on learning. Research showed that children felt more comfortable reading in a well-lit classroom, which also helped prevent myopia. Lighting with a higher color temperature could help improve cognitive performance in children, including the ability to digest information and memory (Lekan-Kehinde & Asojo, 2021). In contrast, lighting with warm color temperatures was used when children were napping. Additionally, combining ambient lighting with task lighting in artificial setups could help minimize glare. Consistent and uniform lighting could reduce distractions and prevent visual discomfort for children. Furthermore, it created a safer indoor environment that supported various types of play while helping to avoid injuries (Samiou et al., 2022).

To find out the lighting measurements in the classroom, this study conducted a simulation with Dialux Evo. This simulation paid attention to the interior reflection coefficient and openings in the classroom. According to the European Standard EN 12464 (BS, 2011), the bounce coefficients that were widely used for major interior surfaces, which were walls, floor, and ceiling in an indoor area, were as follows:

- Ceiling : 0.7 to 0.9
- Walls : 0.5 to 0.8
- Floor : 0.2 to 0.4

The use of this simulation aimed to find out the distribution pattern of light levels in the classroom (artificial and natural lighting).

## 2.4. Object Review: Kindergarten

Here are some of the kindergartens that will be used in this study:

### 2.4.1 Kindergarten A (新 OO 幼兒園)

This kindergarten location is in the Wujie Township, Yilan (figure 10). The age range of children who attending the school is 2 to 6 years old.



**Figure 10 新 OO 幼兒園**

(<https://maps.app.goo.gl/Vq8kv3UH1RXdhL5Z9>)

Total area for the whole park is  $1.423,52 \text{ m}^2$  and the total for the indoor area is  $642,82 \text{ m}^2$ . This kindergarten has two floors. Here is the layout plan for each the floor:



Figure 11 First Floor Plan  
(source: Kindergarten's Principal)

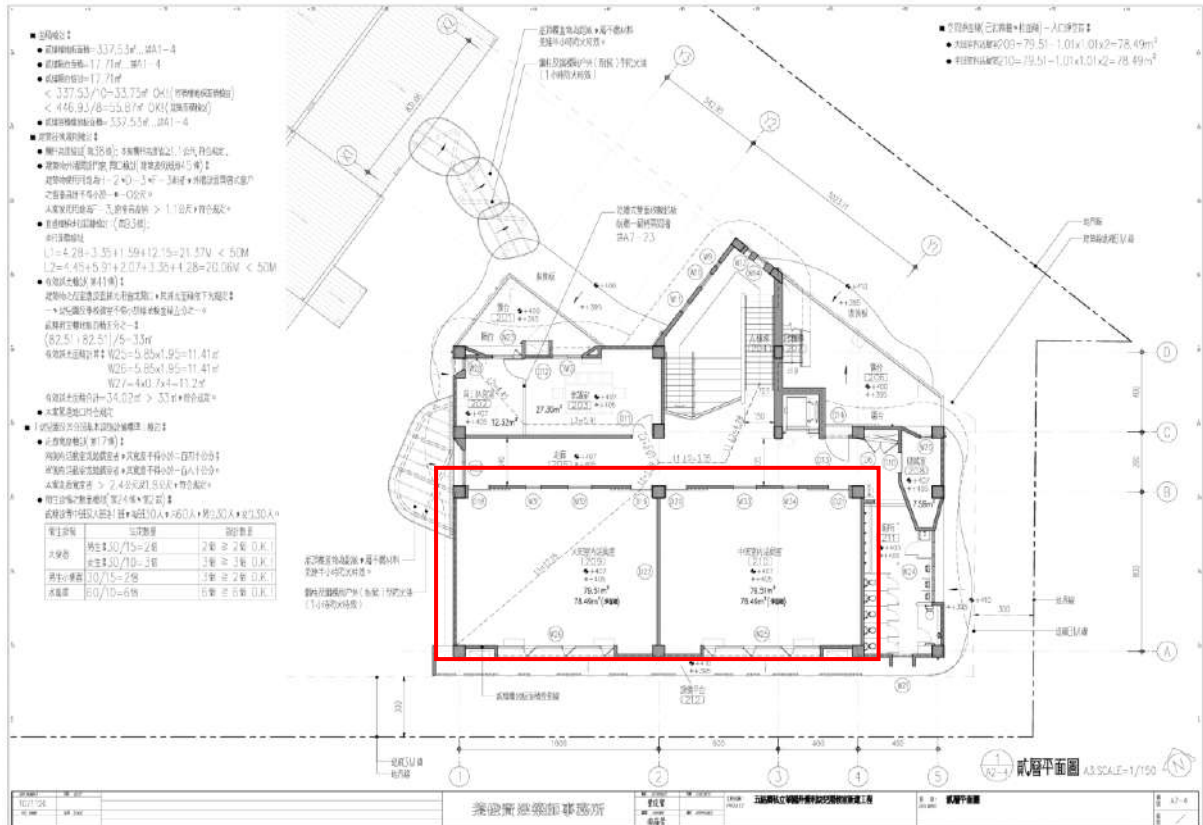


Figure 12 Second Floor Plan  
(source: Kindergarten's Principal)

The classroom that was the object of the research was for children aged 4-5 years old (red box in figure 12). This kindergarten's classes depended on age. There was a class for 2-year-olds and a class for mixed ages from 3 to 6 years old. However, there were no significant differences in the children's activities in each class. The children's activities in the classroom were as follows:

**Table 1 Class Schedule for 2 Years Old**  
(source: Kindergarten's Principal)

| <b>Time</b>   | <b>Activities</b>                                                           |
|---------------|-----------------------------------------------------------------------------|
| 08.00 – 09.00 | Admission, health and emotion observation, and organize personal belongings |
| 09.00 – 09.30 | Sunshine energizing snacks                                                  |
| 09.30 – 10.20 | Motoric activity (running, jump, physical activity)                         |
| 10.20 – 11.30 | Learning activities and game time in study area                             |
| 11.30 – 12.00 | Lunch time                                                                  |
| 12.00 – 12.30 | Teeth cleaning/walking after meals, picture book reading, and bedding       |
| 12.30 – 14.30 | Nap time                                                                    |
| 14.30 – 15.00 | Wake up and stretching activities                                           |
| 15.00 – 15.30 | Outdoor activities or story appreciation                                    |
| 15.30 – 16.00 | Afternoon snack                                                             |
| 16.00         | Organize personal belongings and go home                                    |

**Table 2 Class Schedule for 3-6 Years Old**  
(source: Kindergarten's Principal)

| <b>Time</b>   | <b>Activities</b>                                                           |
|---------------|-----------------------------------------------------------------------------|
| 07.30 – 08.30 | Admission, health and emotion observation, and organize personal belongings |
| 08.30 – 09.20 | Warm up exercises, physical activity, and cool down activity                |
| 09.20 – 09.40 | Sunshine energizing snacks                                                  |
| 09.40 – 10.40 | Learning activities                                                         |
| 10.40 – 11.40 | Playing and games time                                                      |
| 11.40 – 12.10 | Lunch time                                                                  |

|               |                                                                       |
|---------------|-----------------------------------------------------------------------|
| 12.10 – 12.40 | Teeth cleaning/ walking after meals, book reading's time, and bedding |
| 12.40 – 14.10 | Nap time                                                              |
| 14.10 – 14.30 | Wake up and stretching activities                                     |
| 14.30 – 15.30 | Integrated activities                                                 |
| 15.30 – 16.00 | Afternoon snacks                                                      |
| 16.00         | Organize personal belongings and go home                              |

The class schedule for 2-year-olds and 3-6-year-olds had different start times but finished at the same time. The other difference was that the napping time for the 2-year-old class was longer than the 3-6-year-old class (Table 1 and Table 2).

#### 2.4.2 Kindergarten B (育 OOO 利幼兒園)

The kindergarten location is in the Yilan City, Yilan (figure 13). The age range of children who attended the school was 2 to 5 years old.



**Figure 13 育 OOO 利幼兒園**  
(<https://maps.app.goo.gl/6Fmgn9Jydab76Jv27>)

The classes in that kindergarten also depended on age. There was a class for 2-year-olds and a class for mixed ages from 3 to 5 years old. The activities for each class didn't have any differences, except the napping time for the 2-year-old children was longer. Here was the schedule for each class:

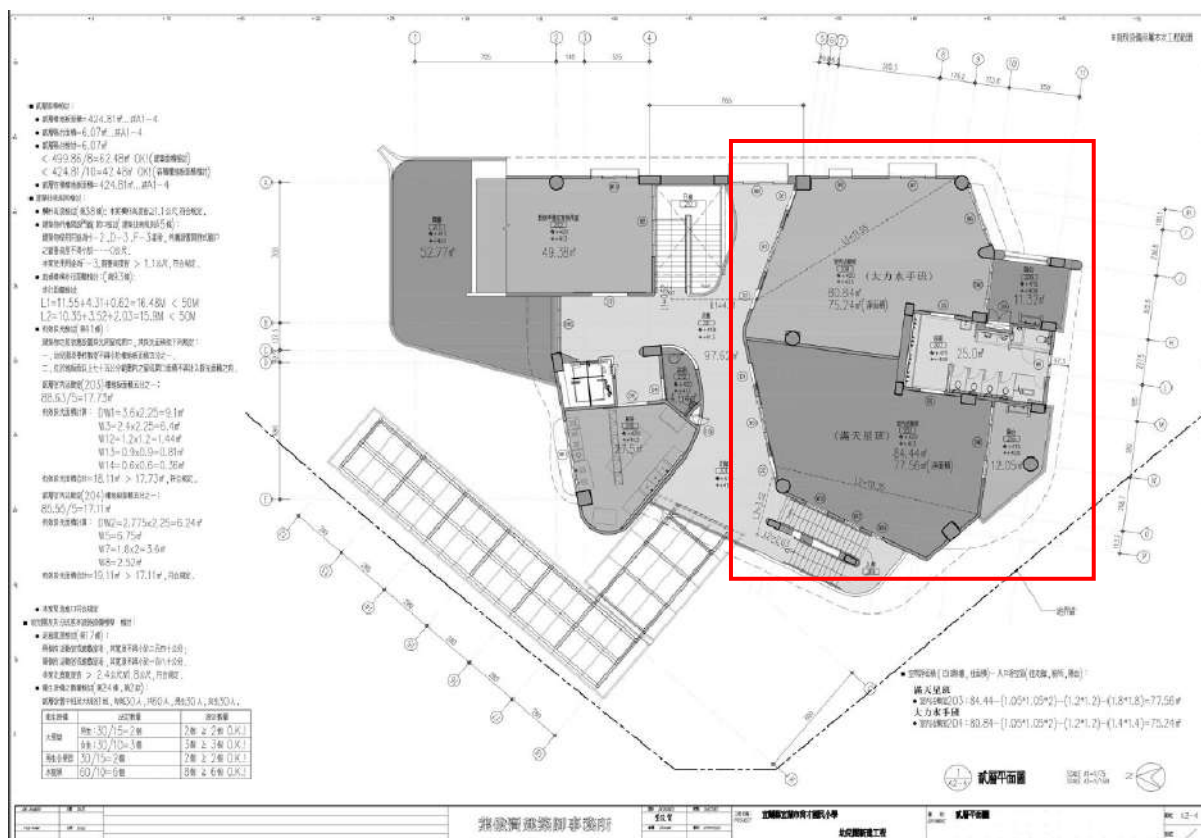
**Table 3 Class Schedule for 2 Years Old**  
(source: Kindergarten's Principal)

| <b>Time</b>   | <b>Activities</b>                                                                                                                                           |
|---------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 07.30 – 08.45 | Entry and study area exploration (health and emotional observation and personal belongings organization)                                                    |
| 08.45 – 09.15 | Snack time                                                                                                                                                  |
| 09.15 – 10.00 | Motoric activity (running, jump, physical activity)                                                                                                         |
| 10.00 – 11.30 | Learning activities (individual and group activities)                                                                                                       |
| 11.30 – 12.00 | Lunch time                                                                                                                                                  |
| 12.00 – 12.30 | After lunch activities (soothing activities and bed preparation)                                                                                            |
| 12.30 – 14.30 | Nap time                                                                                                                                                    |
| 14.30 – 15.00 | Wake up then clothing and grooming                                                                                                                          |
| 15.00 – 15.30 | Diverse activities (outdoor exploration, music rhythm, mother tongue day, picture book appreciation, holiday sharing, group games, experiential activities) |
| 15.30 – 16.00 | Snack time                                                                                                                                                  |
| 16.00 – 16.30 | Organize personal belongings                                                                                                                                |
| 16.30 – 17.00 | Circle time (activity review, sharing, preview of study area exploration)                                                                                   |

**Table 4 Class Schedule for 3-5 Years Old**  
(source: Kindergarten's Principal)

| <b>Time</b>   | <b>Activities</b>                                                                                        |
|---------------|----------------------------------------------------------------------------------------------------------|
| 07.30 – 08.45 | Entry and study area exploration (health and emotional observation and personal belongings organization) |
| 08.45 – 09.15 | Snack time                                                                                               |
| 09.15 – 10.00 | Motoric activity (running, jump, physical activity)                                                      |
| 10.00 – 12.00 | Learning activities (individual and group activities)                                                    |
| 12.00 – 12.30 | Lunch time                                                                                               |
| 12.30 – 13.00 | After lunch activities (soothing activities and bed preparation)                                         |
| 13.00 – 14.30 | Nap time                                                                                                 |
| 14.30 – 15.00 | Wake up then clothing and grooming                                                                       |





The classroom that was the object of the research was for children aged 4 and 5 years old (red box) (figure 15).

### 2.4.3 Kindergarten C (壯 000 小學)

The kindergarten location is in the Zhuangwei Township, Yilan (figure 16). The age range of children who attended the school was 2 to 5 years old.



The classes in that kindergarten also depended on age. There was a class for 2-year-olds and a class for mixed ages from 3 to 6 years old. The activities for each class didn't have any differences, except the napping time for the 2-year-old children was longer (Table 5). Here was the schedule for each class:

**Table 5 Class Schedule for 2 Years Old**  
(source: Kindergarten's Principal)

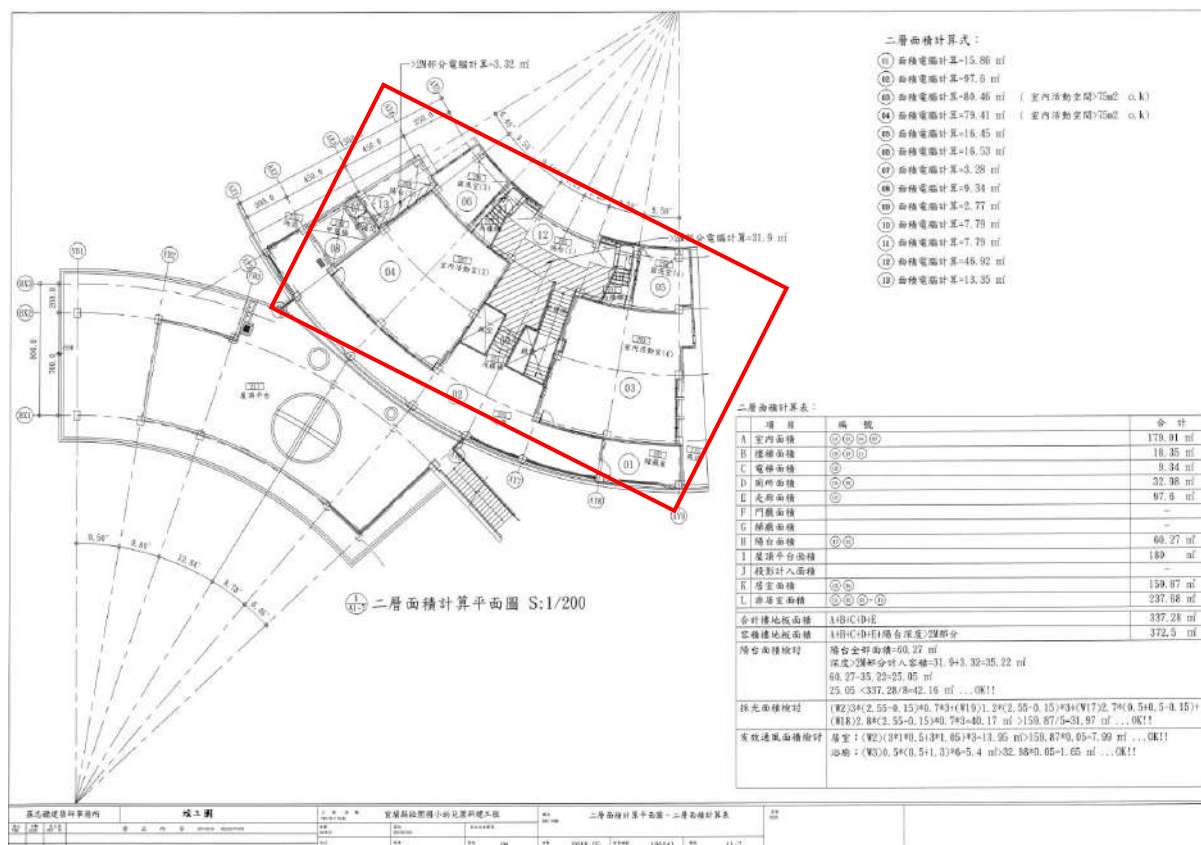
| <b>Time</b>   | <b>Activities</b>                                                                                        |
|---------------|----------------------------------------------------------------------------------------------------------|
| 07.30 – 08.50 | Entry and study area exploration (health and emotional observation and personal belongings organization) |
| 08.50 – 09.20 | Snack time                                                                                               |
| 09.20 – 10.20 | Motoric activity (running, jump, physical activity)                                                      |
| 10.20 – 11.30 | Learning activities and game time (individual and group activities)                                      |
| 11.30 – 12.00 | Lunch time                                                                                               |
| 12.00 – 12.30 | After lunch activities (soothing activities and bed preparation)                                         |
| 12.30 – 14.30 | Nap time                                                                                                 |
| 14.30 – 15.00 | Wake up and stretch activities                                                                           |
| 15.00 – 15.30 | Integrated activities (outdoor activities/story appreciation)                                            |
| 15.30 – 16.00 | Afternoon Snack time                                                                                     |
| 16.00 –       | Organize personal belongings                                                                             |

**Table 6 Class Schedule for 3-6 Years Old**  
(source: Kindergarten's Principal)

| <b>Time</b>   | <b>Activities</b>                                                                                        |
|---------------|----------------------------------------------------------------------------------------------------------|
| 07.30 – 08.30 | Entry and study area exploration (health and emotional observation and personal belongings organization) |
| 08.30 – 09.20 | Gross motor activity (warm-up exercises, running, balance physical activity, change of clothing)         |
| 09.20 – 09.40 | Sunshine energizing snacks                                                                               |
| 09.40 – 10.40 | Learning activities and experience the fun of peer activity                                              |
| 10.40 – 11.40 | Game in the study area, let children explore freely                                                      |







**Figure 19 Second Floor Plan**  
(source: Kindergarten's Principal)

The classroom that was the object of the research was for children aged 4 to 5 years old (red box) (figure 19).

## 2.4.4 Kindergarten D (中 O 幼兒園)

The kindergarten location is in the Zhuangwei Township, Yilan (figure 20). The age range of children who attended this school was 2 to 5 years old.



**Figure 20 中 O 幼兒園**

(<https://maps.app.goo.gl/vDjaJ8zikhK4QfoL8>)

The classes in this kindergarten also depended on age. There was class for mixed ages from 4 to 5 years old and class for younger children. This study only took one class, which was the class with a mixed age of 4 and 5 years old (Table 7). Here was the schedule for the class:

**Table 7 Class Schedule**  
(source: Kindergarten's Principal)

| <b>Time</b> | <b>Activities</b>                               |
|-------------|-------------------------------------------------|
| 08.00-08.45 | Playing interest things and collecting homework |
| 08.45-09.15 | Snack time                                      |
| 09.15-09.30 | Integrated activities                           |
| 09.30-10.30 | English class                                   |
| 10.30-10.45 | Break time                                      |
| 10.45-11.20 | Motoric class activity                          |
| 11.20-11.30 | Homework review                                 |
| 11.30-12.00 | Playing at the playground                       |
| 12.00-12.30 | Lunch time                                      |
| 12.30-13.00 | Bedding preparation                             |
| 13.00-15.00 | Nap time                                        |
| 15.00-15.30 | Learning activities                             |
| 15.30-16.00 | Snack time                                      |
| 16.00       | Organizing personal belongings and go home      |