American Journal of Engineering Research (AJER)
e-ISSN: 2320-0847 p-ISSN : 2320-0936
Volume-9, Issue-10, pp-144-148
www.ajer.org
Research Paper Open Access

The Design of a Natural Science Laboratory for Elementary School BasedAccessibility on Behavioral Architecture Concepts

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ABSTRACT :*The natural science laboratory is important place for teaching learning process. In thir place, students can interact and observe the livings things directly. This natural laboratory is supported with aquaponics technology that combines hydroponics and aquacultures. Aquaponics technology combines plants and aquatic animals. Furthermore, the design of this laboratory is based on behavioral architecture concept. This concepts depends on accessibility of elementary school students. This physical order of natural science laboratory emphasize environment quality and users effect. The location of this research in Nation Star Academy Elementary School, Surabaya. This school have not had a natural laboratory so the teaching and learning activities have not conducted completely. Because of that, the science teachers have difficulty to explain subjects clearly. The research method used are qualitative and analytical. The data used in these methods consist of literature studies, interviews, observations of similar objects, and documentation. The result conducted from this research is the physical order design with accessibility factors of a nature science laboratory based on behavioral architecture concept. Hopefully, it can provide convenience for teaching and learning activities in National Star Academy Elementary School, Surabaya.*
KEYWORDS *Laboratory, Aquaponic, Behavioral Architecture*

Date of Submission: 09-10-2020 Date of acceptance: 24-10-2020

I. INTRODUCTION

The natural science laboratory is important place for teaching learning process. Natural science laboratories in their development can use aquaponic technology as a combination of hydroponics and aquaculture. Aquaponics technology is directly related between animals and plants..

This research was carried out at SD Nation Star Academy Surabaya. The NSA School does not have a natural laboratory in supporting science and learning activities. Based on the Regulation of the Minister of National Education RI No. 24 of 2007, the Elementary School science laboratory can utilize classrooms that are equipped with science laboratory facilities. NSA schools meet regulatory standards, but teachers have difficulty to explain subjects clearly.

Natural laboratory design and planning approaches need to use environmental behavior architecture, in which the application is related to human (social) and environmental (physical) relationships, which cause humans to behave differently in one setting (space) [1]. Human activity as a form of behavior influences and is influenced by the physical setting contained in space as a container of activity. Therefore the relationship between settings and human behavior requires comfort, accessibility, legibility, control, territoriality, and security [2]. The application of behavioral architecture is needed because the users of this laboratory are elementary school students who have high activity and creativity. So the accessibility factor is important to create a physical order that is suitable for the needs of elementary school students.

Factors affecting accessibility in the physical order of the natural science laboratory consist of circulation, density, crowd, distance and step depth. Circulation is a movement from one place to another [3]. The design of a circulation, there are several requirements consisting of a clear sequence, both the size of the room, shape and direction; safe, avoiding crossing in circulation currents, and bottle necks (narrow inlets); avoid crossing [4]. The types of circulation are, linear is a straight path that can be the main organizing element in a row of space, Radial is a pattern that has a straight path that develops from a common center, Spiral is a single path originating from a central point, a Grid is a pattern that consists of two parallel lines that intersect

periodically and create a square plane of space, Network is a pattern consisting of lines connecting points in a space, and Composite is a combination of other circulation patterns [5].

Density and crowd can influence the movement of one's activities [6]. The relationship between density and crowd that is crowded is a perception of density which means the number of people in a place, and crowd is a perception that is subjective [7]. Density in two categories, namely spatial density and social density [8]. Spatial density (spatial density) if there is a change in space that is narrowed and the number of people in a fixed space so that the density increases. Social density occurs when an increase in the number of people without increasing the area. Relationship between Density and Crowd, crowd occurs starting from the density of a space, so that it affects the pattern of individual movements in space [9]. The step depth between spaces is measured by the extent to which access between spaces is limited by the surrounding space. The closer the other space, the smaller the distance or step depth [10].

II. METHODS

The research method used are qualitative and analytical. Data collection methods used are primary data and secondary data.The primary data used in these methods consist of literature studies, interviews, observations of similar objects, and documentation. Secondary data includes the study of literature and supporting documents. The result from this research is the physical order design with accessibility factors of a nature science laboratory based on behavioral architecture concept.The research variables used in this study consisted of several aspects in the aspects of Behavioral Architecture in the natural laboratory design (Table 1).

Behavioral Architecture	
Variable	***Sub Variable***
Accessibility	Circulation
	Density and crowd
	Distance and step depth

Table 1. Accessibility on Behavioral Architecture

III. RESULT AND DISCUSSIONS

Accessibility is an important factor in determining the physical order of natural science laboratory based on behavioral architecture. Accessibility regulates and facilitates the users of natural science laboratory in the teaching and learning process directly. The result of this research discuss comfort and easy accessibility in circulation, density, crowd, distance, and step depth.

3.1. Circulation

Arrangement of natural science laboratory circulation based on the condition and location site. Circulation outside the building shows the location of the natural laboratory's main entrance. The entrance to the natural laboratory is in the circulation path on a two meter wide road. The road is adjacent to the exit access of the Nation Star Academy building. The location of the entrance makes it easy for students and teachers to access the natural science laboratory. The three meter wide road is not used as the main access because the road is the main access to the field and swimming pool so it is less effective if the main door is on the side of the road.

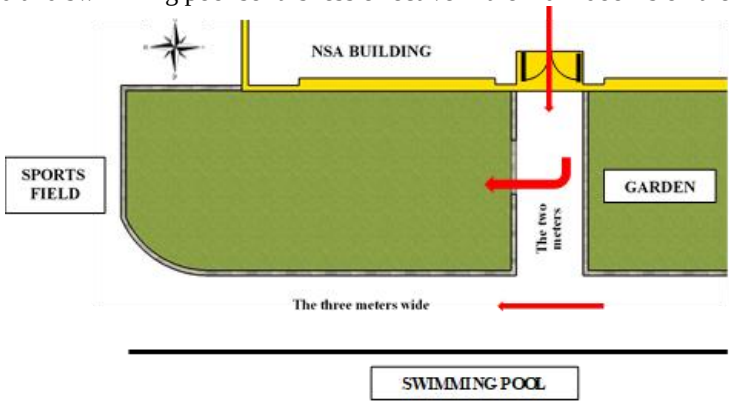

Fig.1. Natural Science Laboratory Entrance

Fig.2. Natural Science Laboratory Entrance

Circulation in buildings is designed with Grid circulation patterns. This pattern is used to construct a hierarchical system of activities through several stages, making it easier for teachers to explain to their students. The first stage starts with a variety of plants that are planted using hydroponics. The teacher can explain various plants, through the introduction of plant parts, plant development, flowering plants. The plants used are hydroponic cultivation plants such as chili, strawberry, mustard greens, spinach, kale, tomatoes, sprouts, and soybeans.

The second stage is aquaponic technology, which is a hydroponic system that integrates with aquaculture. In this aquaponic technology integrates aquaculture in the form of fish ponds with types of Tilapia and Goldfish. This type of fish is widely used in aquaponic technology because it is able to survive and has a harvest time of 3-6 months. Stools from these fish are pumped into the filter before being distributed to hydroponic plants, so that it becomes a natural fertilizer for plant development. The remaining water is channeled back to the pond. At this stage students can learn fish habitat. The third stage is an aquarium that is used to study animal habitats such as worms and frogs. The fourth stage is the space used by the teacher to evaluate learning to students.

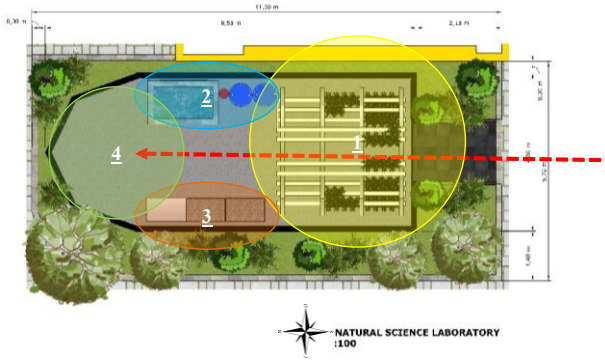

Fig.3. Natural Science Laboratory Circulation Pattern

3.2. Density and Crowd

Density and Crowd affect the accessibility of the comfort of human movement paths. Design the physical order of a natural science laboratory based on effective accessibility. The following are measurements and place requirements according to the normal size of the space user [11].

Fig.4. Measurement and Space Needs

Based on these standards, the design of this natural laboratory adjusts the comfort of the accessibility of human movements. Explained through the following picture:

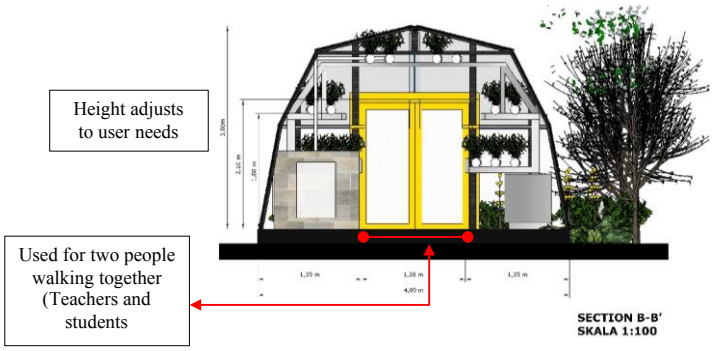

Fig.5. Accessibility of the Natural Science Laboratory Physical Order

The Aquaponic Rack Design consists of three racks, the first shelf is used by teachers and students in learning Science The second and third shelves are used for plants that are ready to be harvested / unproductive plants used in the learning process.

3.3. Distance, and Step Depth

This natural science laboratory consists of one room for several activities in it. So the distance and step deph makes it easier for teachers and students in the learning process. Relatively short distance and step depht makes it easy for teachers to supervise their students. Placing the learning evaluation area behind, so students are far from the reach of the entrance / exit. Supervision of students is needed because elementary students have active and creative behavior

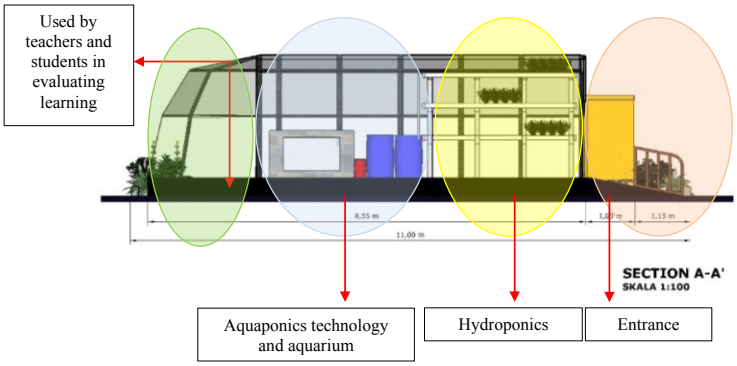

Fig.6. Comfort Accessibility Distance and Step Depth

Fig.6. Comfort Accessibility Distance and Step Depth

IV. CONCLUSION

The Science Laboratory of the Nation Star Academy Elementary School, Surabaya is designed based on behavioral architecture. One of the behavioral architectural factors used in this design is accessibility. Accessibility is used in determining the physical order of natural science laboratories, which includes circulation, density, crowd, distance and step depth. Circulation determines accessibility inside and outside the building, to locate the main entrance of the natural laboratory. Circulation pattern used in the form of Linear. this pattern is in the form of a herarchy in the learning process of Science subjects .

Density and Crowd are used to provide comfort in the accessibility of laboratory users. Measurement standards and space requirements are used for the effectiveness of the laboratory's order. The distance and step depth in the design of natural laboratories are made in one room making it easier for teachers to supervise and coordinate their students. The division of space is not limited by walls, but in the form of a space herarchy consisting of the entrance, hydroponic systems, aquaponic technology, aquariums, evaluation rooms for teachers and students. This Laboratory Design is expected to make it easier for teachers in the teaching and learning process of Elementary School Science subjects relating to living things directly.

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Hana Rosilawati, et. al. "The Design of a Natural Science Laboratory for Elementary School BasedAccessibility on Behavioral Architecture Concepts." *American Journal of Engineering Research (AJER)*, vol. 9(10), 2020, pp. 144-148.