

Flexibility of Space: Child-Friendly School Design

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Abstract— Curriculum transformation in elementary school has the consequence in a new teaching and learning method. The new method expect a flexibility in space using and arrangement. This research aims to create design concept of classroom flexibility in a Child-Friendly School (CFS). Applying a serial method of literature review and empirical survey on children character, as well as the requirement of learning method, criteria CFS is formulated in accordance with three categories of flexibility, which are expansibility, convertability, and versability. Transformation process in formal aspects is based on those three categories, which can be found as a hexagonal form connecting classroom which is easy to expand, to divide and to shift up respective to children safety, healthy and comfort.

Keywords: *Flexibility Of Space; Thematic Method; Elementary School Children's Behavior, Child Friendly School.*

I. INTRODUCTION

The change of era in the field of socio-culture, academics, or industry have the demand in developing knowledges, skills, or manner. The demand is being the basic of the curriculum chance that is used at the certain time and influencing the form of the school. School is a building or institution where the teaching and learning are held, and also a place to give and get the education. School is not only for the child studying, but also for exercising their physical activities. School is required by all children, so the school building must be friendly to all the users, from all age ranges and gender, or can be called as Child Friendly School (CFS) [1]. School building have to ensure the user safety, secure, healthy. respect to gender, accomodate any activities of the pupils, and allows the family and community to collaborate [1].

The curriculum that be used in the school is influencing the space requirement, especially the space for learning. The curriculum should accomodate efforts to influence learning whether in the classroom, on the playground, or out of school [2]. The topic of the research here concern on the curriculum changes from Teacher Centered Learning (TCL) to Student Centered Learning (SCL). They accomodate different approaches. Teacher Centered Learning (TCL) practice a one way communication from teacher to children. The teacher become the center of knowledge transfer in the learning process. This learning method may indicate the lack of enhancing children personality, interest, talent, and skill. By applying this method, the space for the classroom is based on

the number of students in the classroom. The classrooms are designed in permanent arrangement and orientation to the teacher. The classrooms accomodate only teaching activities.

Student Centered Learning (SCL) is introduce in the new curriculum. The pupils participate in group discussion, sharing their knowledges by each other. In the SCL method the teachers act as the facilitator, not only act the source of knowledge. In the new curriculum, the pupils, the teachers and even the parents have their role and responsibility to conduct the learning process. The learning material is composed in the form of thematic based subjects. Along with implementing the new curriculum, especially for Elementary School, the thematic based subjects have to include Four Pillar of Knowledge (UNESCO): learning to know, learning to do, learning to be, learning to live together, and learning to live sustainibilities [3]. Through the thematic based subjects, the school have to provide the chance of adapting the space requirement, such as quick moving to other place or quick expanding the space.

The objective of the research is to propose a design, which accomodate the space flexibility for CFS, by considering the flexibility categories: expansibility, convertability, and versability.

II. LITERATURE REVIEW

A. Child Friendly School

CFS has a wide spectrum. The concept of CFS differs country to country, by geographic condition, government, the environment condition, culture and society. CFS is not a strict model. CFS is having a flexible and adaptable principles, depend on the focus which taken into account. The design of the CFS have to be harmonious to the design of a normal child's growth phase. The normal child's growth phase are divided into four, that are relexetive movement phase, rudimentary movement phase, fundamental movement phase, and sport-related movement phase [4].

CFS is trying to ensure and fulfilling the right of the children in every aspects of life responsibly, so the school building must have the elements of safety, security, health, responsive gender, capable to accomodate the student's various activities, and allows the participation of their family and community.

Approach to the design of CFS consider the application of thematic method. Some design aspects has to be considered are flexibility to have group discussion inside or outside the classroom. The member of the group discussion are varies, depend on the theme of the subjects. Therefore, the classroom must have the right proportion, possibility to adjust various learning activities, and to be integrated between the indoor and outdoor. Aside the space organization, the the design has to consider the construction type, which is children friendly.

B. Flexibility of Space

Flexibility is an ability to adapted quickly and easily [5]. In architecture, the flexibility of space use is the space character that probably can change to various function according to the activities even without changing the order of the spaces. From the engineering point of view, flexibility has criteria, such as: the time needed in changing process, practicality, minimum risk of damage, adopting simple rule and ability to fulfil the space requirement. From economics, flexibility has criteria: low construction and maintenance cost. Flexibility in architecture can be achieved by: perform an adaptable structure, that is the mechanic structure with the capability to change the configuration, form, or characteristic in respond to the change of environment. [6]; Movable flexibility design or portable architecture is a flexible building which when it is collapsed and will be reinstalled on the other location, it will not ease the value of the materials that have been used [7]; universal design is the easiness to adapt for every user, with no exception for the disable [8]; transformable architecture or can be called as modular design (can add or delete the units or components). The structure in the transformable architecture is also can open, close, changing the form, or changing the color [9]; and responsive flexibility. The building with the responsive flexibility is adapting to the situation around, responding the change, and not refusing [10].

Flexibility that related to the space have three concepts [11], that are expansibility, convertibility, and versability. Expansibility is the concept of flexibility where the space and building can change according to the situation by expansion. Convertibility is the flexibility of space or building that allows the change of arrangement in a space. And versability is the flexibility of space or building that can change the function or multifunctional.

III. METHODOLOGY

In this designing of CFS, it is used two methods, that are research method to collect the data and design method to develop the design.

A. Research Method

The research method that be used is the qualitative method. The qualitative method is a research method that use the social phenomena from the view of the respondents as a cariable that focused on the full representation of a case or the complex reality. Generally, the qualitative research is used to researching the people's behaviour, social activities, the people's life, and anything that related to the other social phenomena. The qualitative method is used to produce the data that can not be achieved by the quantitative approach [12].

To producing data on the qualitative research, there are five technique that can be used, that are interview, focusing on group, survey, observation, and archive [13]. The technique that be used must be able to collecting the data from the research object that have been decided. The qualitative data source is a record of the observation result, interview result, and the documents that related in the form of text or pictures.

On the CFS design with a flexible space, the data collecting is did by using two methods, that are direct observation and doing interview with the research object.

- The observation is done by visiting the public and private Elementary School which have been using curriculum with SCL and applying thematic method. The data collected through monitoring the process of learning activities and observing the behaviour of children in the age range of elementary school children.

The observed aspects are:

1. Space; about the difference of space requirement and relationship between indoor and outdoor space on the application of TCL and SCL.
 2. Location; about aspects that must be fulfilled on CFS, including safety, health, security, and sustainability.
 3. Circulation; about the circulation of the classrom and school generally, to know the living space and the dead space in the school.
 4. Behaviour; about the children's behaviour at school, in and out the learning activities.
- Interviews are conducted by question and answer with students, faculty and principals, educators, and parents.

Interviews conducted with faculty, educators, and principals include:

1. The difference of the learning process in TCL and SCL, and its relation with the difference of student's activities on the learning activity.
2. Space requirements on the application of SCL with the thematic method.
3. The children's behaviour that occurs of SCL implementation, inside and outside the classroom

Interviews conducted with students include:

1. Learning process and the student activities on SCL learning activity.
2. Student activities during learning activity and break time.
3. The most visited space.
4. Extracurricular activities and their relation to space requirements.

Interviews conducted with students's parents include:

1. Parent involvement in learning activities.
2. Parent zone at the student creations exhibition.

IV. RESULT AND DISCUSSION

Table 1 demonstrates the results of observation in two different method applying in the school curriculum.

TABLE 1. THE RESULT OF THE OBSERVATION AND INTERVIEW

Teaching & Learning Activity	Circulation
<ul style="list-style-type: none"> Teaching and learning activities in TCL method are conducted individually. The seat arrangement do not need to be changed. In the SCL method, the teaching and learning activities are conducted both individually and in a group. The rearrangement of seat needs to be done. The SCL conducted theme of subject which might integrate the indoor and outdoor space. In SCL method, classroom can perform as workshop and partially fix class. The need of exhibition space, the classrooms has to be merged in order to obtain larger area to expose the pupils achievement at the end of theme 	<ul style="list-style-type: none"> The circulation of the classroom in a school with TCL method is simpler and fix, correspond to the seat arrangement. The circulation of the classroom in a school that use SCL method is more complex because of movable teaching and learning activities. The participants is more active because of practicing two-way communication system of teaching and learning In the thematic method, the teaching and learning activities can be held both inside and outside the classroom connected to the outside.

The result of observation and interviews that have been done is the different requirement of space between TCL and SCL learning activities.

The observation results is analyzed by discussing with the CFS criteria (Table 2) to define the relationship between CFS and space flexibility.

TABLE 2. THE ANALYSIS RESULT

Space Flexibility	CFS
<ul style="list-style-type: none"> Not every school have been practicing curriculum with SCL method have flexible classrooms. In the school which practicing curriculum with TCL and change to SCL method can the apply convertability because of the seats are relatively too heavy for the elementary school students. There is almost nothing any school that applied the versatility because every space have their own function. The circulation is dependant on space orientation. 	<ul style="list-style-type: none"> A school with the adequate land and owning their land is have a better quality of CFS. The ratio of the teacher and the student are inadequate, especially at the public school. The traffic jam that happened are the effect of they do not have any specific place to drop and pick up the students The activities inside the classroom can not be watched from the outside, especially from the teacher's room.

Table 3 discuss interrelationship of three element of word (flexibility, space, and CFS), which might develop design concepts. are as follows:

TABLE 3. THE SPACE FLEXIBILITY CRITERIA

Flexibility – space	Space Flexibility – CFS	CFS – Space
<ul style="list-style-type: none"> Expansibility: The use of wall panel that easy to be moved so the whole space can be connected to become a large space Convertibility: portable and light furniture are needed to make the pupils easier taking for moving by themselves. Versability: The use of the light structure on the walls for the easiness of the room function's change. 	<ul style="list-style-type: none"> Security: using two models of the panel with the same dimension, that are massive wall panel and the wall panel with the combination of glass. Safety: The wall panel can move on the line using the rail system that is placed on the ceiling. Sustainability: to make possible connection between indoor and outdoor space, selecting transparent material to allow that connection. 	<ul style="list-style-type: none"> Every classroom have to connect to the outdoor space for achieving better air movement. and to allow teaching and learning which integrate outdoor and indoor room. Space requirement accommodate ratio 1 teacher to 25-30 students. Area $\pm 3m^2$ space are needed to do the individual learning, and $\pm 5-6m^2$ to do the group learning.

The main criteria created for flexibility CFS are: possibility to create connection outward and inward, and movable partition is expected to enable enlarging the space. Considering the two main criteria, flexible geometry is selected. To choose the most flexible geometri, the geometry analysis is performed. The geometries analyzed are triangle, square, rectangle, pentagon, circle, and hexagon. Triangles, squares, and rectangles can make an optimal combination but has the least space orientation. Pentagon and circle produces waste spaces. Space with this basic shape requires the most raw materials but does not produce the optimal combination. Hexagon will produce the perfect combination of space eitouth useless spaces. The hexagon-shaped space requires the least amount of raw material and the greatest capacity than any geometry

Based on an analysis of the geometry that has been done, hexagon is the most appropriate shape of geometry for the maximum use in a space. The shape enable to perform six orientations with consists of six side with the same length.

In CFS, the ideal ratio of teachers and students is 1:30 and every student need $3m^2$ for learning actities in the class. Them, the required classroom is $90m^2$ [Fig.1]. The appropriate dimension will have 6m on each side. The arrangement of the hexagon inside the room can be assumed as the area of individual space. The floor pattern that eventually can be used as a space for the children on the individual learning.

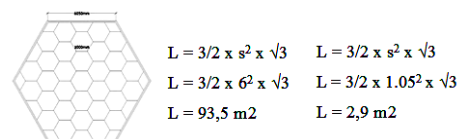


Fig. 1. Classroom model

The space flexibility can be applied is related to the space configuration. The classroom is divided into two moduls with the each modul is consist of 3 classrooms [Fig.2]. The modul with 3 classrooms is related to the division of small class and big class. The small class consist of the 1st, 2nd, and 3rd grade, whereas the big class consist of the 4th, 5th, and 6th grade.

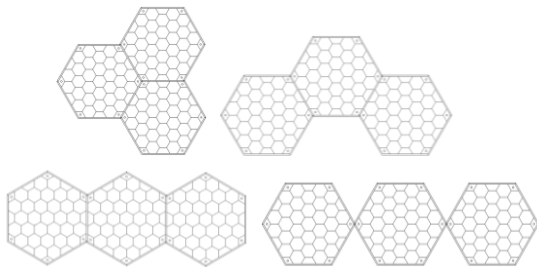


Fig. 2. The hexagon configuration alternative

Space flexibility and configuration that can change the extent and function of space is done by using the adaptive structure. It is done by separating the main structure from the wall. Adaptive structure is applied with using rotating panel so that wall can be shifted as needed. The panel wall used consists of two models, the massive panels and the glass combination panels [Fig.3]. The glass combination panel aims to allow sunlight to enter the room and student control in the classroom easily from the tacher room.

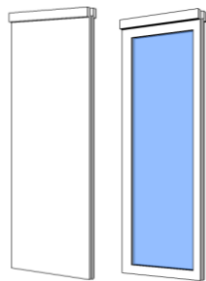


Fig. 3. Two types of wall panel are used

The use of wall panel is the preffered way to achieve the safety conditions in CFS. Children at elementary school age are the children who are developing in a motoric side, then the classroom must be able to avoid the accident in the classroom, such as tripping or pinched. The wall panel that is used move according to the lane by using the rail system that placed on the ceiling.

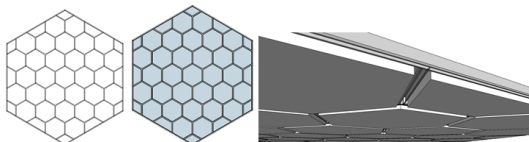


Fig. 4. Wall panel rails

The rail pattern follows the floor pattern of the classroom, so the panel can move freely and have an unlimited configuration. With unlimited configuration, changes to the classroom settings and classroom functions can be done easily. Some applicable panel configurations include:

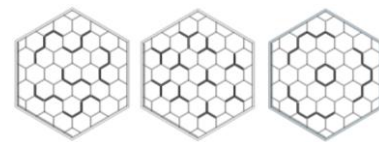


Fig. 5. Some alternative wall panel settings

The use of the wall panel material with the glass combination aims to achieve the security aspect of CFS and and let the sunlight entering the classroom. With this aims, so the wall panels are placed on two sides, on the side which directly related to the outdoor space and one side is placed in another room within the school building so that the students can be monitored by the teachers from the teacher room.

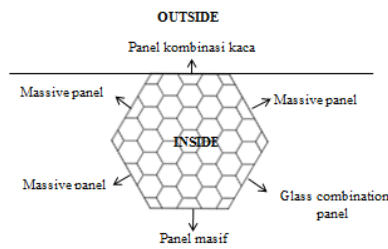


Fig. 6. The placement of the wall panel

With the concepts above, the flexibility of the classroom can fulfil the three concepts of space flexibility, while pay attention to the aspects of CFS.

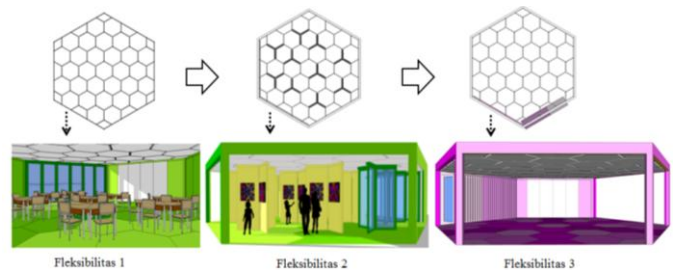


Fig. 7. Application of space flexibility in the classroom

- Flexibility 1, using rotating door on all side of the classroom with two types of panel, that are massive panels and the glass combination panels. The glass combination panels are used on the two side and the massive panels are used on the other four side.
- Flexibility 2, Wall panel rails are designed according to the pattern of the floor and placed on the ceiling to avoid the accidents. Every panel can move freely following the rail so the panel have an unlimited configurations.
- Flexibility 3, all of the wall panel can be collected on one side. Therefore, the space no longer has physical boundary and be able to connected directly with the spaces around.

V. CONCLUSION

The design answers to the space requirements of school which implementing SCL method. The result of design is a classroom that has the flexibility of space by considering aspects of CFS. The flexibility categories that applied are expansibility, convertibility, and versability, the shape main criteria created for the that have a space flexibility. The space flexibility is paying attention to the CFS aspects, that are safety, security and sustainability. That is because of the children in the age of Elementary School is in the phase of sport-related movement, where they have not be able to take responsibility about theirself, so the design must be able to minimalize the unwanted possibilities.

REFERENCES

- [1] UNICEF (2009), "*Child-Friendly School Manual*", New York: UNICEF
- [2] Saylor, Galen J. dan Alexander, William M. (1956), *Curriculum Planning for Better Teaching and Learning*, New York : Holt, Rinehart dan Winston.
- [3] Delors, Jaques (1996), *Learning: The Treasure Within*. Paris: UNESCO.
- [4] Gallahue, David L. dan Ozmun, John C (2002), "*Understanding Motor Development: Infants, Children, Adolescents, Adults*", New York: McGraw-Hill.
- [5] Alwi, Hasan (2007), "*Kamus Besar Bahasa Indonesia*". Jakarta: Balai Pustaka.
- [6] Schnädelbach, Holger (2010), *Adaptive Structure – A Conceptual Framework*, Proceedings of MediaCity: Interaction of Architecture, Media and Social Phenomena, Weimar, Germany, pp 523-555.
- [7] Kronenburg, R (2003), "*Portable Architecture*", Oxford: Elsevier/Architectural Press.
- [8] Mace, Ronald L. (1998), "*Designing for the 21st Century: An International Conference on Universal Design*", Hofstra University, Hempstead, New York. Edited by Jan Reagan for publication, August 1998.
- [9] Dermiesevic, E. (2006), *Transformable Building Structures: Design For Disassembly As A Way To Introduce Sustainable Engineering To Building Design And Construction*, Doctoral Thesis, Technische Universiteit Delft, Delft.
- [10] Kronenburg, R (2004), *Flexible Architecture: The Cultural Impact of Responsive Building*, Proceeding of Open Building and Sustainable Environment. The 10th Annual Conference of the CIB W104 Open Building Implementation, Ball State University.
- [11] Pena, M. William and Parshall A. Stephen (2012), *Problem Seeking: An Architectural Programming Primer*, New Jersey: John Wiley & Sons. Inc.
- [12] Narbuko, Cholid dan Achmadi, Abu (2007), *Metodologi Penelitian*, Jakarta: Bumi Akasara.
- [13] Groat, Linda N. and Wang, David (2002), "*Architectural Research Methods*", New Jersey: John Wiley & Sons.