Civil Engineering and Architecture 12(1): 252-268, 2024 http://www.hrpub.org
DOI: 10.13189/cea.2024.120120

Revealing Elementary Students' Architectural Spatial Image of Their School Through Visual Language Reading

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Received June 21, 2023; Revised August 30, 2023; Accepted October 12, 2023

Cite This Paper in the Following Citation Styles

(a): *[1] Astrid Austranti Yuwono, Purnama Salura, Karyadi Kusliansjah , "Revealing Elementary Students' Architectural Spatial Image of Their School Through Visual Language Reading," Civil Engineering and Architecture, Vol. 12, No. 1, pp. 252 - 268, 2024. DOI: 10.13189/cea.2024.120120.*

(b): *Astrid Austranti Yuwono, Purnama Salura, Karyadi Kusliansjah (2024). Revealing Elementary Students' Architectural Spatial Image of Their School Through Visual Language Reading. Civil Engineering and Architecture, 12(1), 252 - 268. DOI: 10.13189/cea.2024.120120.*

Abstract Children's point of view about places is different from adults', thus there is a need to examine their preferences of place according to their activities as the foundation to reveal the architectural spatial image of their school. Unfortunately, the research on architecture spatial image as the relation between preferred places and activities children have in their mind is scarcely being done, especially in the school environment. This research aims to reveal the spatial architecture image of the students about their school environment as the place for their learning activities. Therefore, the benefit of the research is the findings that have the potential to be developed into open design criteria of each learning activities category, as a concern to all stakeholders related to primary level education, namely school administrators, school building designers, and school building standard decision makers. This research discusses using visual language to read drawings of 9-11-year-old students from two primary schools to identify significant spatial qualities. The architectural properties and compositions of the significant elements will be read to reveal their spatial quality as the base for the interpretation of participants' architectural spatial image of the school concerning the activities. Participants respond to some instructions about preferred places by visualizing them freely through drawings, followed by semi-structured interviews as a confirmation and clarification process. The school's teachers are also being asked for the same instructions based on their observations of students' daily activities. The research analysis revealed that participants' preferred places based on learning activities have significant spatial qualities named insideness and centricity. Each of the learning activities types has different architectural spatial images, such as a place that has a definite space with specific arrangement, orientation, and closure; a place that has enough space to gather, and that has details as the identity of the place; a place that has the vocal point according to the activities; and a place that has a spacious area that allows one to move freely. The implications of these findings are open for the development of the standardization of primary school buildings.

Keywords Architecture, Children, Preliminary School, School Buildings, Spatial Image, Visual Language

1. Introduction

In Indonesia, as stated by the Minister of Education, Mr. Nadiem Anwar Makarim, B.A., M.B.A. in one of his speeches on November 25, 2022 [1], Indonesian elementary students have lower achievements than students at the same level in other countries. Therefore, he mentions that "A school should be fun" as a learning process and method. In an architectural context, the school's physical

environment has roles to support in providing a good environment.

Misalignment between what is facilitated from an adult's point of view and what children need is a finding in several architectural studies [2]. Adults consider the aesthetic aspect more important and sometimes forget the space's breadth and flexibility, which can motivate children. General standardization is a result of the manifestation of adults' point of view since it focuses on school buildings' efficiency in terms of manpower, costs, and construction time. The minimum criteria used as standards are more focused on technical aspects. This phenomenon shows a lack of attention to the perspective of children as the main users of school buildings. This also shows a lack of attention to buildings that are specifically intended for elementary school age, considering school buildings act as third teachers or silent teachers and are included as the hidden curriculum category in education [3] [4].

Piaget's stage of cognitive development [5] influences the images captured by children. Each stage has a range of abilities about how children capture and conceptualize something they find in their environment. Jean Piaget stated that there are differences in the way of thinking between children and adults in quantity and more fundamentally in terms of quality [6], where changes in age and intellectual development affect how a child observes and develops concepts of the world around them. The participant in this research is elementary students aged 9-11 years old, as they are already in the concrete operational phase and they can think logically and understand the aspects of function/usability related to activities [7].

Character education in elementary schools in Indonesia has four focuses, namely '*Olah Pikir*' (thought-literacy exercise), '*Olah Karsa*' (aesthetic-taste/sensitivity exercise), '*Olah Rasa*' (ethical-feel exercise), and '*Olah Raga*' (kinesthetics-physical exercise). Each domain has an activity concept that influences the success of its development in students, and each of it occurs in a space in school buildings.

The issue of architecture spatial images becomes significant for understanding children's concepts about buildings which are the result of the relationship between activities and the space of activities. Activities represent the function and elements of architecture represent the spatial of architecture.

This issue concerning the architecture spatial image of the students as the relation between spatial and activities is further formulated into the following research questions:

a. What kind of spatial qualities are significant for the learning activities based on participants' preferences of place in the research case studies?
b. What are the architectural spatial images concerning school activities according to the research case study participants?

Based on the significance, this research aims to:

a. Identify spatial qualities concerning learning activities in school by reading the visual language from the drawings.
b. Reveal the architectural spatial images the participants have about learning activities space in their school.

2. Materials and Methods

This research aligns with the structuralism paradigm since children of the participants' age are not yet capable of having a fully conscious understanding of their surrounding environment. Therefore, this research tried to reveal children's understanding from other media rather than only interviews.

This research was conducted using a qualitative method by collecting data from real case study conditions. Field data is regained from drawings, photos, and interviews with the students. Drawings are made based on some instructions that guide the students to draw a readable picture from concerning architectural point of view. Students were selected purposely by the teacher who has a good ability to communicate verbally and visually. As mentioned above, students of 9-11 years old were selected due to their cognitive ability to relate the function aspect of a place. Further, at the age of 9-10 years old, children's eyes get more detailed on observing objects; and by the age of 10-11 years old, they start to draw not just a creation from their imagination but also a note to an event [8, p. 14]. The discussion of this research describes the identification result of the architectural elements and their qualities using visual language reading of the students' drawings and thus is interpreted by the researcher to reveal the architectural spatial image students have about the school environment.

The child's images of the environment are divided into symbolic function and cognitive function, both of which are spatial representations. Representation as a symbol manifests itself in form, while as a concept, it is closely related to function. Both form and function have layers of external and internal representations, whereby internal representations can only be found through external representations [7]. The internal representation is ultimately a mental internalization of the entire interaction towards a particular spatial as spatial image. This understanding forms the basis for determining the appropriate data collection method and can be used as material for this research analysis. External representation based on the function of figurative cognition (imitation of reality) refers to the existence of a connection between the visual physical elements as a container for activity. Thus, the physical visual elements will lead to the use of visual methods through pictures and photos by the participants. External representation through the cognitive function of assimilation of reality which is operative will reveal the relationship between activities and the container of student

activities. Disclosure is done by a verbal method based on the data collection results of the visual method. Research by Woolner [9] shows that a series of visual methods used in research can produce complex but interconnected results to build appropriate understanding.

Visual language reading [10] is used to identify what is in the drawing '*Isi Wimba*', how it was drawn '*Cara Wimba*', and what it revealed '*Tata Ungkapan Dalam*'. Visual language can reveal how children see their environment due to their development and capabilities of integrating how they think [8, p. 11].

2.1. Architecture Spatial Image

Kevin Lynch suggests that there is a spatial image that is captured by residents of a city about the spaces in that city. Spatial imagery is captured based on the presence of spatial physical elements that are not limited to the city scale. These elements can appear in a variety of environmental types and scales [11], so they can also be used in the scope of this research.

Kevin Lynch [11] defines imagery as a mental map of users who regularly interact with a space for a long time. The legibility (readability) of architecture is influenced by several attributes including differences in appearance, visual access, and the complexity of the arrangement; in other words, the place has some identities that distinguish it from another place [12] [13]. These attributes allow humans to recognize, remember, understand, and have mastery over space [14]. This readability quality enables users to understand more accurately through symbolic physical features [15].

Lynch [11, p. 105] stated ten physical characteristics that describe qualities: singularity/figure-background, continuity, dominance, clarity of joint, directional differentiation, visual scope, motion awareness, time series, name & meanings. Those qualities facilitate the observers to figure out the space around them and shape their image of the environment.

A special understanding of space captured by children appears in the research of Memarian in Oloumi [16]. Memarian stated that children understand a place based on centricity & symmetry, a path based on continuity, and an intersection when it has surface differences. Therefore, the concept of space that is noticed by children is continuity, vicinity, symmetry, inside-ness, and separation. Those understandings and concepts are what in this research called architecture spatial qualities.

The interpretation process in this research was done through several steps to reveal the structure (Figure 1). The first is to identify from the drawings using visual language, what is important to the participants and how they see the space of activities. The second is to identify the properties and compositions in the drawings. And the third is to reveal the physical characteristics that form the integrated spatial qualities.

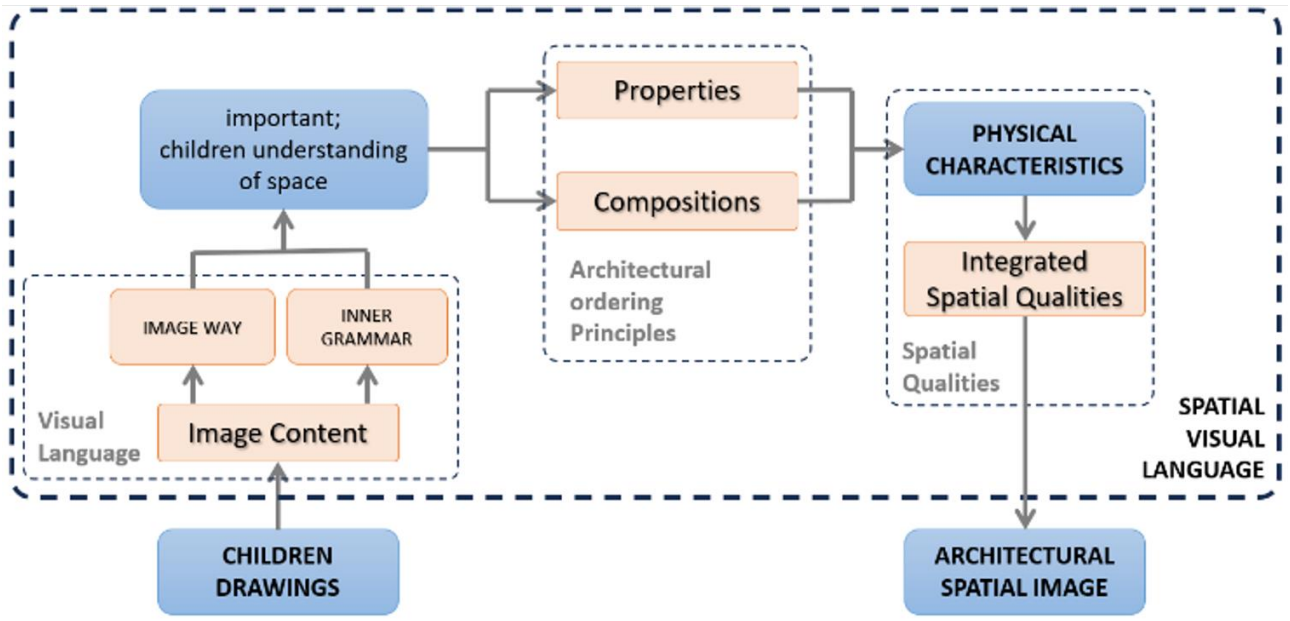


Figure 1. Interpretation Process

2.2. Properties and Compositions in Architecture

Architecture is inseparable between activities (functions) and their activity containers (forms), where the relations are formed by the properties and composition of objects. Property and composition theory [17] can be used to read architectural works. In this research, the theory is used to break down and identify the physical features of the architecture of the case studies.

The concept of property is separated into internal properties and external properties. Internal properties consist of axis-datum, symmetry-asymmetry, additive-subtractive-transformation, repetition-rhythm, scale-proportion, and organic-pure geometric. External properties consist of chromatic-analogous, textural-neat, massive-transparent, and ornamental-clear. In the identification process, those properties are applied to attributes, qualities, or physical characteristics [17]. The concept of composition identifies the positions and orientations/directions toward other objects. Position can be above-below, front-back, right-left, far-near, or center-periphery. Arrangements can be radial, linear, cluster, central, grid, or scattered.

2.3. Learning Activities in Elementary School

Education in Indonesia is heavily influenced by the thoughts of Ki Hajar Dewantara [18] and is a solid foundation [19] in its direction and development. Ki Hajar Dewantara's learning approach [20] emphasizes the process of character building through all human potential, namely '*Olah Pikir*' (thought-literacy exercise), '*Olah Karsa*' (aesthetic-taste/sensitivity exercise), '*Olah Rasa*' (ethical-feel exercise), and '*Olah Raga*' (kinesthetics-physical exercise), in harmony [21]. Based on Ki Hajar's thoughts, the Government of the Republic of Indonesia emphasizes that the implementation of character education has focused on '*Olah Pikir*' for intelligent aspect, '*Olah Karsa*' for sensitivity, '*Olah Rasa*' for honesty and '*Olah Raga*' for toughness [22].

This Research will discuss Architecture Spatial Images based on the four main learning activities (see Table 1.) mentioned above.

2.4. Visual Language

Children's drawings are a representation of what they capture, feel, and recall about their surroundings [8]. The ability to draw is closely related to the stages of development in children. Betty Edwards [23] in Pandanwangi [24] states that there is a similarity between the periodization of children's development and the development of children's drawings. It is stated that at the age of 10/11 years, children begin to enter the realist period by making realistic images and by incorporating elements of depth, space, and light in the images.

The visual language approach used in this research was chosen to analyze children's drawings and identify the spatial physical elements that indicated importance. There are four main aspects to analyzing drawings using the visual language that is [8]: Image Content '*Isi Wimba*' which means the objects drawn by the participants; Image Way '*Cara Wimba*' which means the way objects were drawn, it has four categories of basic shots, angle of shots, scale, a way to draw, and a way to see; Inner Grammar '*Tata Ungkapan Dalam*' which means how the objects were composed, it has four categories to describe space, to describe movements, to describe time & space, to describe importance; and Outer Grammar '*Tata Ungkapan Luar*' which mean how different inner grammars (multi picture drawings) connect. Architecture spatial image is interpreted from the physical elements that have some qualities, therefore visual language reading is used to identify important elements and their qualities.

Participants were asked to draw each place where they chose to do the four learning activities, so it is a one-picture drawing type. Therefore, from four aspects of visual language reading, this research focused on the Image Way and Inner Grammar (see Table 2.) to analyze participants' one-picture drawings. The Image Content is also used to point out objects chosen by the participants to be drawn, which can be read as important or interesting objects for them.

The Image Way has four categories basic shots, angle of shots, scale, way to draw, and the way to see; this research focused on basic shots and angle of shots analysis. 'Basic shots' reveal what is important to participants by magnifying some objects or the way around. The 'angle of shots' reveals how participants see the place of their activities, their position in the room, and or during the activities. The Inner Grammar in this research focused on two categories, 'to describe the space' aspect to reveal how participants see their space; and 'describing important' aspects to emphasize importance according to the participants.

3. Results & Discussion

The discussion below is the analysis of the readable aspect of the visual language of drawings made by the research participants. The explanation will be divided into places that participants mostly chose for each learning activity (see Table 3). Drawings result & photographs (see Table 4) for each preferred read using visual language (see Table 5) to identify what is important for the participants, to reveal the similar information they communicate. Drawings are also read by breaking them down to the architectural properties and compositions the participants show in the drawings, so they can be read in architectural aspects. In the next analysis process, properties and compositions determined the spatial qualities that become the base for spatial image interpretation by the researcher (see Table 6).

Table 1. Learning Activity Categories

Learning Activities	Elementary School Competencies	Activities in School
'olah pikir' thought-literacy exercise	knowledge by studying	reading, writing, counting **LEARNING**
'*olah hati'* ethical-feel exercise	attitude while interacting with others	Interaction, playing\ **PLAYING**
'olah rasa/karsa' aesthetic-taste/ sensitivity exercise	attitude while expressing themselves with awareness of their surroundings	drawing, music, dancing SELF **EXPRESSION**
'*olah raga*' kinesthetics-physical exercise	skills due to physical ability	sports game **ACTIVE SKILL**

Table 2. Visual Language used to read participants' drawings in this research

Image Content	Image Way	Inner Grammar
Objects chosen by the participants to be drawn, which can be read as important or interesting objects for them	**Basic Shots** reveal what is important to participants by magnifying some objects or the way around **Angle of Shots** reveal how participants see the place of their activities, their position in the room, and or during the activities	**Describe the Space** aspect to reveal how participants see their space **Describing Important** aspects to emphasize importance according to the participants

Table 3. Preferred Places in School mostly chosen for each learning activity

Learning Activities	Activities in School	Activities Categories	Preferred place in School
olah pikir thought-literacy exercise	reading, writing, counting	STUDYING	**classroom**
olah hati ethical-feel exercise	playing, interaction	PLAYING	**school corridors**
olah rasa/karsa aesthetic-taste/sensitivity exercise	drawing, music, dancing	SELF EXPRESSION	**garden; specialty classroom**
olah raga kinesthetics-physical exercise	sports game	SKILL EXERCISE	**sports field**

Table 4. Participants' Drawing and Photograph Results

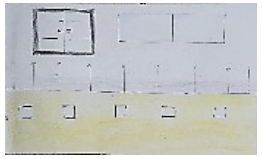
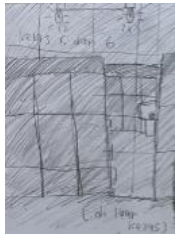
Learning Activities	**Existing Place Images SDN & PKBM**	**Participants' Drawing Results**
olah piker thought-literacy exercise STUDYING	 	  
classroom	 	  
olah hati ethical-feel exercise INTERACTION, PLAYING **school corridors**	 	  

Table 4 continued

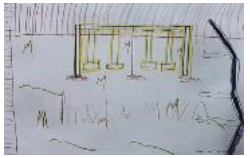
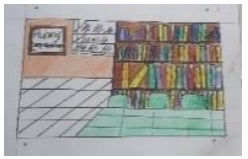
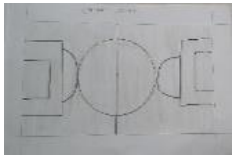
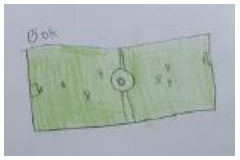
olah rasa/karsa aesthetic-taste/sensitivity exercise SELF EXPRESSION	 	  
garden	 	  
specialty classroom	 	 
	 	 

Table 4 continued

olah raga kinesthetics-physical exercise SKILL	 	  
school field	 	 

The drawing results show some similarities with the photograph results. Participants took photographs from the point of view which they also drew. The major difference is that photographs can only be taken from participants' eye level, meanwhile, in the drawings participants can explore more on how they try to communicate the place they chose with multi-points of view.

Table 5. Visual Language Readings of Participants' Drawings

Learning Activities	Drawings	Image Content	Image Way	Inner Grammar
olah piker thought-literacy exercise STUDYING		desk, chair, board, walls/windows	basic shots long shots angle of shots above/bird view, multi-view **~classroom as a whole~**	to describe the space framing & scale describing important specific views **~specific activities orientation~**
classroom		desk, chair, board, windows, walls,		
olah hati ethical-feel exercise PLAYING, INTERACTION		wall divider	basic shots medium close-up angle of shots normal view, multi-view **~detaild space of activities~**	to describe the space place identification describing important accent **~specific area~**
school corridors		floor path, wall divider		

Table 5 continued

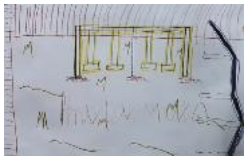
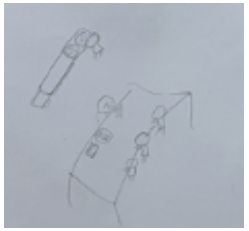
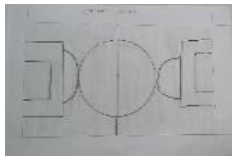
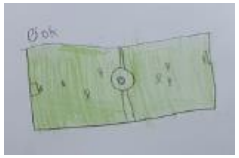
olah rasa/karsa aesthetic-taste/sensitivity exercise SELF EXPRESSION **garden**	  	plants, seating facilities	<u>basic shots</u> medium close-up, medium long shot <u>angle of shots</u> normal view, bird view **~emphasizing space/facilities for the activities~**	<u>to describe the space</u> no landline <u>describing important</u> accent **~specific area~**
	  	swing tool, grass		
specialty classroom	 	facilities according to activities	<u>basic shots</u> medium close-up, medium long-shot <u>angle of shots</u> bird view, normal view **~emphasizing space/facilities for the activities~**	<u>to describe the space</u> place identification <u>describing important</u> composition **~specific needs~**
	 	area/facilities according to activities		

Table 5 continued

olah raga kinesthetics-physical exercise SKILL	  	buildings, basketball ring, soccer field pattern, soccer goal	<u>basic shots</u> extra long shot <u>angle of shots</u> above/bird views **~spacious space~**	<u>to describe the space</u> place identification <u>describing important</u> specific views & details **~specific area~**
school field	 	land field, soccer field pattern		

The image way of classroom drawings is drawn from a sufficient distance to inform the overall content of the class. The shooting angle varies between a bird's eye or from human eye angle. Inner grammar is depicted with a strong tendency to display a typical classroom appearance, namely the front side of the class complete with a blackboard and teacher's desk, and depicts a row of desks and chairs. Whereas inner grammar which states space is described by emphasizing the integrity of space and its contents. So, from the four visual language readings it can be concluded that the child understands the classroom as a place of the classroom as a whole (described as completely as possible) and has a specific orientation (the part that is described as the main one) regarding the activities carried out in that place.

The contents of the wimba in the corridor area drawings show the corridor walls and floor paths. Wimba's ways used are 'medium close-up' and 'long shot' with a 'normal view' shooting angle. Medium close-ups and normal views show that participants feel they are inside the place, not looking at it from a distance. Inner grammar is expressed by describing an object that has a special identity as if it were a sign of that area. Thus, the conclusion that can be drawn is that participants understand the play space as a space that has a certain identity which indicates a special place to play.

Table 6. Properties & Compositions Identification to Reveal the Spatial Quality and Being Interpreted

Learning Activities	Drawings	Properties & Compositions	Spatial Qualities	Architecture Spatial Image
olah piker thought-literacy exercise STUDYING **classroom**		Properties symmetry, scale & proportion compositions front-back, left-right, grid	Symmetry-asymmetry --> centricity scale-proportion --> insideness front-back, left-right, grid --> separation	**a definite space with specific arrangement, orientation, and closure.**
olah hati ethical-feel exercise PLAYING, INTERACTION **school corridors**		Properties repetition, datum, ornamental compositions far-near, linear	Repetition/datum-axis --> continuity ornamental-clear --> surface intersection far-near, linear --> continuity	**a place that has a specific identity**

Table 6 continued

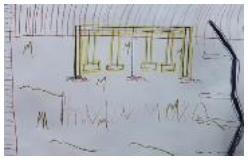
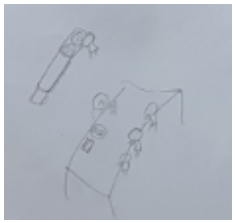
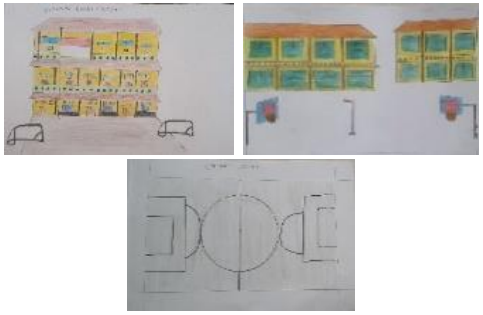
olah rasa/karsa aesthetic-taste/sensitivity exercise SELF EXPRESSION	  	Properties Datum Compositions center-periphery, central	Datum-axis--> insideness center-periphery --> insideness central --> centricity	**a place that has facilities according to the activities**
garden	  			
specialty classroom	 	Properties scale & proportion compositions center-periphery, central	Scale-proportion --> insideness center-periphery --> insideness central --> centricity	
	 			

Table 6 continued

olah raga kinesthetics-physical exercise SKILL **school field**		Properties scale & proportion compositions center-periphery, central	Scale-proportion --> insideness center-periphery, central --> centricity	**a spacious space for a specific activity**

The contents of Wimba described in place for self-expression activities show the room boundaries, room conditions (e.g. empty rooms), and activity-related facilities. Wimba way is described by taking a medium shot to be able to describe facilities related to activities, for example, a bookshelf for reading place, a large table for cooking together. Normal shooting angle and bird view show the whole room by depicting an empty room due to the need for dance practice. Inner grammar is described by specifically providing specific information regarding existing facilities to support activities. Thus, the conclusion for a place for self-expression activities is to prioritize facilities that support the specific needs of each activity.

The contents of the wimba generally show the pattern of a particular playing field and the attributes of the specific sport. Besides that, some describe objects around the sports game area. The wimba way is made with an extra long shot and from a bird's view angle. This emphasizes the scope of activity which is understood to be very broad so that it must be described from a great distance. Inner grammar looks typical, drawn to express the identity of the field as a field of play or by a particular sport. The conclusion that can be drawn is that participants understand the physical skills space as a place where they can move freely, and have a unique identity according to the game.

Drawing results for the classroom as the preferred place to do studying activity show that participants see the classroom as ‘a whole’ not just partially, as they draw almost all the elements in the classroom and represent it from a quite far angle of view. They also show a similar angle in the room that they drew, that is the board view. It shows a strong orientation as the main orientation of the activity. The properties and compositions in the drawings show a tendency for symmetrical drawings with scale & proportion; indicate front-back and left-right positions; and emphasize a grided arrangement of elements drawn. symmetrical drawings emphasize a central situation, strengthening the centricity. The scale & proportion they used to illustrate the size and what they feel is more important in a classroom. But composition, scale & proportion show space, and all the elements included in the drawings, show an insideness as they are inside the classroom most of the time. Positions to one another (front-back and left-right) show that they are aware of what is around them, while a grided arrangement that separates them tends to underline a strict relation to one another. Drawings analysis is interpreted into an architectural spatial image of a classroom that is a definite space with specific arrangement, orientation, and closure.

School corridors were chosen most by the participants as the place for learning activities related to interaction skills, in this research stated as playing activities. Drawings results show a close-up angle of view from participants’ eye level, which indicates that they perceived the place as more intimate compared to classroom drawing results. Since corridors in the school might not have the same physical elements, participants draw in as much detail as they can so that the place in the drawing can be recognized. They emphasize it using the repetition of ornaments that strengthen the datum. Repetition and datum show strong continuity since it is a corridor type of space, as they also draw strong linearity and far-near position. The surface intersection shown by the detailed ornaments emphasizes the presence of the specialty of the place. School corridors drawn by the participants can be interpreted as a place that does not need to be so big just enough to gather, that they can notice ‘all’ details as the identity of the gathering place.

Learning activities related to self-expression exercises preferred to take place in the school garden and specialty room. Self-expression in this research is explained as a place where the participants like to do their favorite activities. Drawing results of those places show specific elements based on the activities that took place in them. Desk and chair surrounded with plants to show that they did the drawing activities in the garden. A space in a room where desk-chair-etc put aside, shows a space for dancing activities that need a more spacious area. The same place is drawn with different details based on their story of preferred activities. Garden for participants who like to sing while playing with the swing tool, draw the swing tool as the main elements. While participants who like to do more physical activities, such as karate, draw only the spacious space of the garden without any other elements. They draw the place based on the scale & proportion with a centralized arrangement showing strong attention to a place that supports their needs for their favorite activities. Participants’ preferences for self-expression activities are interpreted as a place that has the vocal point according to the activities.

Physical skills in school learning are related most to sports activities, and the participants chose the school field as the place to do the activities. They drew it as if they saw it from far up above, so they could manage to show the entire space including the pattern of a soccer field as the place’s identity. Some drawings include the surroundings, i.e. mid-rise school buildings, with the scale & proportion that emphasize the size of the school field as well as define the field line. Centricity in the drawing results is strongly related to the sports field pattern that has a center and the goals or the basketball rings. Since the skill exercise mostly relates to sports in school, the spatial image of it is a place that has a spacious area where they can run around while playing the game.

4. Conclusions

This research primarily addresses ensuring inclusive and equitable quality education and promoting lifelong learning opportunities for all. By ‘listening’ to the children, we can make a more suitable place for them and support their activities.

Drawing results in this research show some spatial qualities that are significant for several students as participants. Insideness is the highest quality revealed through the drawing analysis, followed by centricity as the second highest quality that appears. Participants seem to see places in the case studies as a space that need to be clear regarding the function and the boundary of the space.

The researchers interpret drawings based on layered readings. Firstly, visual language readings identify what is important and its position to the participants. Secondly, break it down to identify the properties & compositions in the drawings. Thirdly, juxtapose them into spatial qualities concepts. All those layered readings were used as information to interpret the architectural spatial image of the participants about places of learning activities. Architecture spatial images revealed in this research are:

a. Studying activities occur in a place that has a definite space with specific arrangement, orientation, and closure.
b. Interaction through playing activities occurs in a place that has enough space to gather, and that has details as the identity of the gathering place.
c. Self-expression activities occur in a place that has the vocal point according to the activities.
d. Physical skill activities occur in a place that has a spacious area that allows one to move freely.

Another finding of this research is about the influence of buildings organization on the preference of place in school by the students. In one of the case studies, it is confirmed that it does have the influence, and further the influence to the place preferences in school areas that can form pleasure and interest, and ultimately produce student achievement in certain areas related to activities at school. So, this method can lead to some suggestions of how the school plan should be planned. Applying the proposed method will make the starting point in the design processes since the method can reveal the unconscious children's understanding of their surroundings. A short training course might be needed since some theories and definitions need to be understood first before analyzing and interpreting the data.

The proposed method can be used to reveal children's opinions -through drawings- about spatial in the architectural context. The result of using this method can lead to the formulation of design indicators. Therefore, it will be very useful as the base of consideration for designing schools, or other facilities involving children as the users.

Acknowledgements

This research is part of the dissertation research. Thanks to the Doctoral Study Program, Faculty of Engineering, Parahyangan Catholic University for permission to publish part of the research process carried out by the candidate. Thanks to Maranatha Christian University for awarding a scholarship to pursue my doctoral degree. I would also like to extend my gratitude to my promotors at Parahyangan Catholic University, whom I intensely discussed with to complete this research and paper writing.

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