

Evaluating Affordances of Streams and Rivers Pertaining to Children Functioning in Natural Environments

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Abstract. This study evaluates the affordances of natural water bodies pertaining to the functioning of children. Ten children, aged 4-12, were observed experiencing three streams and two rivers in tropical environment. A phenomenological approach yielded a dataset of the children behavioral responses derived from a behavioral mapping and an open-ended interview. The responses are physical movement and words and phrases of the children suggesting their preferences or dislikes toward the water settings. The data was analyzed in three stages, firstly, positive or negative affordances, secondly, a taxonomy affordance of children outdoor environment, and thirdly, the level of affordances. The children experienced 78 positive affordances and only five negative ones. From the taxonomy, the water afforded 11 categories of environmental qualities in which the categories are graspable/detached objects and water offered the most number of affordances, 16 and 15, respectively. Most of the children's activities were performatory and exploratory types. The results suggest that children perceived the affordances of streams and rivers through physical, cognitive and social interactions. The children, therefore, perceived the water bodies as playscapes affording varieties of functional meanings.

Introduction

A vast body of literature on children experiencing natural environment suggests that children are naturally curious and fascinated to explore the natural environment. Exploring nature is a phenomenal process for children (Hart, 1997) involving active engagement with the environment in terms of their spatial behavior and landuse (Hart, 1997). The engagement means a play involving both the sensorial and motoric activities. The play is an ecological experience in which children perceive to move around, and the movement reveals a lot of significant information about the environment (Kytta, 2003). Perception and movement are essential, critical and irreplaceable dimension of children healthy maturation and development (Kellert, 2002).

Nature is diverse and complex. It is dynamic and it comes in ever changing variety of shape, texture, color and smell that allows children to perceive it as

timeless (Prescott, 1987). Inasmuch, the natural world is the most information-rich environment, and thus affording a child nearly limitless contexts and opportunities for developing his physical and cognitive faculties (Wilson, 1993). For example, Fjortoft (2004) finds that playing in forest influences physical activity play and motor fitness of kindergarten children. Direct contact with the natural environment helps the children to the discovery of knowledge (Hart, 1997) by three modes of learning: cognitive, affective and evaluative (Kellert, 2002). These learning modes permit the children to develop affiliation, affection and attachment to the playspace (Chawla, 1992), which is relevant in both intellectual and emotional developments (Kellert, 2002).

The complexity of nature can be seen in the following example. There are no two streams alike; each meandered on the landscape according to the properties of the land. A stream in a hill forest flows ruggedly along steep slopes and between rock

outcrops with rapids and waterfalls. On the other hand, a river in a low-lying plain meanders gracefully with slow current. Likewise, no two profiles of a stream are alike; a hill stream in a tropical forest is narrow with steep banks vegetated by overarching riparian trees. The trees permit little sunlight to reach the water which results into a cool milieu. In contrast, a profile of a floodplain river is wide and its low banks are covered by ferns, herbaceous plants, bamboos and palms. Hence, its setting is more open than the hill stream allowing distant views. And, its convex bends are deposited with sandbars, whereas its concave bends are steeply eroded by the water. Children will perceive the variations of the two profiles when they locomote in them which involve visual and tactile contacts. As such, the children may perceive them as dynamic entity that is changing in forms through time by the forces of nature.

Dynamism of natural streams and rivers is easily felt when the children directly experience the water. For example, swimming across the stream permits a child to feel the current and coolness of water by his whole body. The activity enables the child to construct a perception that the water body is a structure that affords swimming, drifting and cooling. However, when the stream level rises after heavy rain in its upper course, the child will experience stronger current that demands more effort to cross it. Hence, natural features enable children to see differences in sameness (Olds, 1989) which is a mental construction essential for the intellectual and emotional development of children (Khan, 2002). Another example of mental construction may occur when a child touches or grasps boulders, stones, pebbles, sand or clay. No two streams have the similar composition, but these materials are ubiquitous elements with varied sizes, textures and colors. A large boulder affords a child to stand or sit on, whereas sand affords him to hold it in his hands and to throw away. As such the experience enables the child to differentiate the functional meanings, the former is large and heavy affording stand-on-able and sit-on-able and the latter affording grasp-with-able and throw-away-able. In other words, play, either brief or long, permits children to recognize the textures and structures of the environment (Christensen, 2003). Inasmuch, studies on children experiencing the outdoor environment reveal that children perceived the value of the environmental features not on the appearance or aesthetic, but rather on their functional properties (Fjortoft, 2004; Whitehouse *et al.*, 2001).

Affordances of Natural Environment for Children

J.J. Gibson's Theory of Affordances has been used to examine the relationship between functional properties of the environment and how environments are used (Clark and Uzzell, 2002). "The affordances of the environment are what it offers the animal, what it provides or furnishes, either for good or ill" (Gibson, 1979: p. 127). According to Kyttä (2003), affordances are the "functionally significant properties of the environment that are perceived through active detection of information" (p. 45). That the properties are recognized when the children encounter, traverse, construct and perceive places (Christensen, 2003). Kyttä (2003) further posits that affordances include properties from both the environment and the acting individual. As such the affordances are always unique and different for each individual and each specific group of people (Kyttä, 2002).

All affordances involve perception and movement that the division between sensory and motoric activity disappears (Kyttä, 2003). Inasmuch, Gibson (1979) notes "We must perceive to be able to move around, and we must move around to be able to perceive" (p. 223). It seems that children's fascination to the natural attributes involves sensory and motoric activities. Sensory activity is perception, and motoric activity is movement that affords the children the possibility to make physical contacts with the natural elements. And, movement means play for children (Gallahue, 1993). It involves perceiving the landscape elements and forces through the children senses: sight, audio, touch, smell and taste. Play is an informal participation that permits the children to perceive plenty of information according to their own terms and control. And, play is the right of a child as promoted by Article 31 of the Convention on the Rights of the Child (United Nations, 1989).

Affordance of an environment is defined by the individual qualities, such as children physical skills or bodily proportions (Kyttä, 2003). As such, Heft (1999) posits an object that smaller than the hand-span of a child, for example, a twig, is perceived by the child to be graspable, that is it affords grasping. The twig also affords the child to throw it away, to scratch the ground, to dig dirt, and so on. Thus, the twig, as an environmental feature, has multiple functional significances understood by the child through experiencing the environment. Therefore, the concept of affordance is well suited for describing the

psychologically essential qualities of children environment (Kytta, 2002). It seems that children take particular delight and continue to engage those affordances that give clear evidence of their efforts.

Taxonomy of affordances

According to Heft (1999), the affordances of natural environment for children activities can be categorized into a taxonomy consisting of 10 categories of environmental quality: flat, relatively smooth surfaces, relatively rough slopes, greenery and wildlife, graspable/detached objects, attached objects, non-rigid attached objects, climbable features, aperture, microclimate, moldable material and water. A study on children outdoor environments by Kytta (2002) improves the taxonomy by adding a category affordances for sociality and play, and subtracting the category of aperture. In this study, which concerns on affordances of streams and rivers for children functioning, extends the taxonomy with environmental affordances that support vegetation and wildlife. The taxonomy tells what categories afforded the most or fewest functional properties to the children during their play and social activities.

Types of affordances

Interaction of children with the environment involved two types of affordances: positive and negative (Kytta, 2003). Positive affordances offer physical and social benefits that generate fascination and satisfaction to the children, whereas negative ones afford adversities which result into fear and avoidance (Heft, 1999; Kytta, 2003). Let's look at two forms of water, a waterfall and a stream. A two-meter high waterfall of a forest stream is perceived as a fascinating natural element due to its sense of coolness and inviting sound. These properties may trigger curiosity to children to come close to it and feel its movement with their body, positive affordances. But, a torrential stream flowing in between boulders is a fearful element. Its property is negative that children would evaluate the stream as an element that they must avoid to play, a negative affordance. The former encounter shows a bonding and attachment of the children toward the natural elements. Environmental psychologists called this relationship as *topophilia* (Tuan, 1974). The latter encounter may be called *topophobia* suggesting children avoid to experience with a fearful and potentially dangerous natural element. Hence, the children will not see an opportunity to fish or bath in it.

Levels of affordances

In the view of children perception and movement, Kytta (2003) further categorized the affordances into three levels: perceived, utilized and shaped. Perceived affordance is the functional property of a feature viewed by a child and offering him an activity. For example, an overarching tree over a stream possesses the property allowing a child to jump from it into the water. Utilized affordance is the property of a feature being used by a child in an activity. When a child dives into deep water, for example, he is acting on a utilized property of the water for a play activity. Shaped affordance is the property of the feature being changed by the activity of a child, for example, moulding a sand mound on a sandbar.

Chawla and Heft (2002) categorize the affordances of children experiencing the environment into three types of activities: performatory, exploratory and productive. The first are those actions directed toward some object or other individual within some setting for an intended purpose. The second are actions directed toward discovering new properties in the environment. When a child jumps into a river, for example, it is a performatory activity. His action will let him to discover the depth of the water — an exploratory activity. Both of the activities offer at least two utilized affordances, jump-into-able and dive-into-able. Finally, the productive activities are actions transforming a feature into a desired and new object. The aforementioned example of moulding sand on the sandbar of a river is a productive activity because the child manipulates the sand into a mound. The shaped affordance is mould-into-able. The sand mound becomes a new play tool offering more affordances which may include smash-on-able.

Study Aims

The aim of this paper is to present an analysis of the affordances of streams and rivers as children outdoor playspaces. The specific research questions dealt with here are:

1. What are the functional properties that streams and rivers extend to a child?
2. What are the functional significances that social plays in the riverine environments extend to a child?
3. Do the streams and rivers offer rich and varied information about the character of an individual efforts of engagement?

Method

Subjects

The study is based on behavioral mapping and open-ended interview with 4-12-year-old children (n=10) in three villages in Peninsular Malaysia. There were five girls and five boys. The girls comprised of a 4-year-old, two 5-year-old, a 6-year-old, and an 11-year-old. And, the boys were a 7-year-old, two 8-year-old, a 10-year-old and a 12-year-old. All of them lived in urban areas, and they often visited the village streams or rivers during their school holidays. The survey was done during five school holiday periods, consecutively. Each holiday periods lapsed about 12-14 weeks allowing the children to long for the outdoor experience.

The surveys were conducted during the midday to late afternoon at five water bodies: a 7-foot wide stream, two 15- and 25-foot wide hill streams, and two 30- and 40-foot wide rivers. Nomenclature and physical characteristics of the water bodies and children length of play are clarified in Table 1. All the water bodies were within 4 to 57 km from the residences of the children. The length of play ranged from 12 minutes to 98 minutes that is solely up to the children demand. Inasmuch, fatigue and shivering due to the cold water particularly at the hill streams were the two major factors that ended their play.

Measures and procedures

A phenomenological approach was applied to elicit the behavioral response of the children with the water bodies. It explores and describes the situation or experience of the children (Seamon, 2000) with the stream or river environment. It seeks to grasp and elucidate the meaning, structure and essence of the lived experience of a child phenomenon (Patton, 2002) with the water features and with his peers. It identifies and describes the subjective experiences of the respondents. Hence, the approach was a qualitative inquiry examining the responses of children in their situated actions (Graue and Walsh, 1995). That is, the stream or river was their lifeworld (Seamon, 2000) or context of action (Graue and Walsh, 1995). The approach focuses on the functional meaning or significance of the physical setting as perceived by the children through their actions (Graumann, 2002). In other words, the approach elicited the affordances of the water bodies according to the perception of the children through their movements. The affordances not only restrictive to the physical meaning of the features especially water, but also considering the social interaction that the children gain through play.

Upon reaching the streams or rivers, the boys took off their shirts and wore shorts and straight went into the water, whereas the girls bathed with their clothes

Table 1. Nomenclature and physical characteristics of the water bodies, and children length of play

Type of water body and length of play in minutes	Physical characteristics
7-foot-wide stream <i>Paddy field stream</i> 12 minutes	A narrow stream feeding water to abandoned paddy fields with steep, clayey banks and soft clay and sandy bed. A very narrow footbridge made from two bamboo poles run across it. Small trees and thick bushes covered much of the bank except at the footbridge. Slow current and water up to 1.3 m deep. Much of the stream is exposed to the sun.
15-foot-wide hill stream <i>Bukit Pulai stream</i> 57 minutes	It originates from a tropical rain forested hill with fast current rushing among large and small sandstone boulders. Hence, it has a series of short, rapid and low waterfalls and sandy bed. There are several catchments built by previous visitors by damming across the stream with the small boulders. Its banks are densely vegetated by tall and small trees, and creepers and climbers.
25-foot-wide hill stream <i>Bukit Tinggi stream</i> 45 minutes	It is located in a different hill from the above stream and at higher altitude. Hence, its water is more rapid and much cooler. The boulders are larger and generally covered with mosses because it is densely shaded by the trees. Its depth ranged from 0.6 to 1.4 m with sandy bed. Many riparian trees overhang their branches into the stream.
30-foot-wide river <i>Teris river</i> 98 minutes	It is located at a foot of tropical rain forested hill. During the survey, its water is low enabling most of the children to wade across the sandy river bed to get from one bank to another. It is generally shaded with tall trees and the most distinctive is a riparian tree, <i>Dipterocarpus oblongifolia</i> , that cantilevers its trunk halfway across the river. There are three fallen logs in the water and stuck into the riverbed which apparently become play equipment for the children of the village. Its low banks are steep and composed of clay and silt on which villagers carved steps for them to reach the water. Plenty of wildlife such as birds (bulbuls, magpie robins and flycatchers) and insects (butterflies and waterstriders) are found at the river landscape.
40-foot-wide river <i>Gondah river</i> 38 minutes	Almost similar to the above river but is located on another side of the hill. It runs through a wildlife sanctuary where wild and abandoned elephants are kept. The river is the place where wildlife wardens washed their elephants once per day. During the survey, the children were allowed by the wardens to take bath in the river. It is a fast flowing river with sandy bed and tall trees on its banks. Its bank is gentle with sand and tall grasses. Much of the river is shaded but the portion where the children play is exposed to the sun.

on. In addition, each child brought along a towel and a pair of clothes for change after playing in the water setting. The researcher only assisted the children when they requested for help including where to place their dry clothes and towels and assisted the young children to step down or up on steep riverbank. The researcher also participated in the children play, and upon the children request he helped them to cross deep waters. No instructions to direct the children experience were given. The parents of the children introduced the researcher to the children to initiate rapport and sense of trust between the children and researcher, and thus minimizing any sense of apprehension.

Two types of data, overt and covert responses, were elicited from a purposeful sampling. The former was the movement of the children which was elicited by the behavioral mapping. The latter was the words and phrases mentioned by the children, and were elicited by the open-ended interview. In the behavioral mapping, the position of a child was observed and later noted in a sketch map for each stream or river. Words and phrases of the children communicating with peers were noted in a pocket journal at the site.

Out of the water, the researcher interviewed the children in a group of two to four children, and recorded their conversation in a tape recorder. Each interview session was brief, 4-5 minutes long, letting the children to continue their play when their attentions have deviated to the water activities. At times, the recorder was handed over to the children when their attentions were diverting from the interview. Occasionally, they were offered to hear their recorded voices and usually ended with lots of laughter upon hearing it. Four to six sessions were conducted at each stream or river with a total of 27 sessions for 130 minutes at the five water bodies. The interview spots include at a sandbar, on large boulders, on an overhanging tree trunk, and on the riverbanks. After experiencing the water, the interview continued in the van during the journey back to the children residence for 20 to 100 minutes. The purpose was to examine the feeling of attachment or bonding of the children to the water bodies pertaining to the their affordances. Examples of the interview questions were:

1. How many activities have you participated at this stream or river?
2. What are the features with which you have played most?

3. Why did you play with it?
4. Do you play alone or with a peer?
5. What are the things that you talked about when you played with your peers?

Two examples of the recorded conversations were as follows:

Example 1: A conversation with three boys, aged 8, 11 and 12, at the Teris river was:

Researcher: Tell me what do you like about this river.

8-year-old: The water is cool. It is a place for me to run on sand, jump from the bank, feel the sand with my feet, and swimming.

11-year-old: It is a fun place. I can move all around. I find a flat stone and throw it on the water and fun to see it skips over the water surface.

12-year-old: I help a few of them to cross the deep water. We play at the fallen log. We ride on the log, and hanging from it. This place is 'best'.

Example 2: A conversation with two girls, aged 5 and 6, at the same river where they were collecting flowers was:

Researcher: What do you do with the flowers?

5-year-old: The flowers are beautiful. We collect them and arrange them like this on this sand (sand bar). We have never seen these flowers before.

Researcher: Do you like to play here?

6-year-old: Yes, the water is cool and not deep. There are many stones to collect and sand to scoop with our hands. The stream is very long and we are free to move around.

Analysis

The data from the sketch maps and tape recorder were interpreted and categorized into three stages of analysis. Firstly, the data was categorized into positive and negative affordances to differentiate the preferences and dislikes (avoidances) of the children to the water features. When the positive affordances were more than the negative ones, the result suggests that the properties of the water bodies afforded the children with play activities, and indicates the water features as playspace. In contrast, when the negative exceed the positive, the water bodies were perceived by the children as places where they should avoid playing.

Secondly, the data was categorized in taxonomy of affordance which was developed from the taxonomies by Heft (1999) and Kytta (2003). The affordances are classified into two types, positive and negative according to 11 environmental qualities: flat, relatively smooth surfaces, relatively rough slopes, greenery and wildlife, graspable/detached objects, attached objects, non-rigid attached objects, climbable features, microclimate, moldable material, water and affordances for sociality. The categorization explains the types of activities of the children with the water features either performatory, exploratory or productive. The results will suggest the children's physical, cognitive and social performances.

And, thirdly, the data was categorized into three levels of affordances, namely, perceived, utilized and shaped. This analysis further differentiates the perception and dexterity of the children with the elements of water features and climatic factors, and with each other.

Results

Positive and negative affordances

As can be seen in Fig. 1, the natural water bodies offered 15 times more positive affordances ($n=78$) than negative ones ($n=5$) to the children. The positive affordances overwhelmed the negative ones suggesting that the functional properties of the streams and rivers were effectively perceived and utilized by the children. In other words, the children

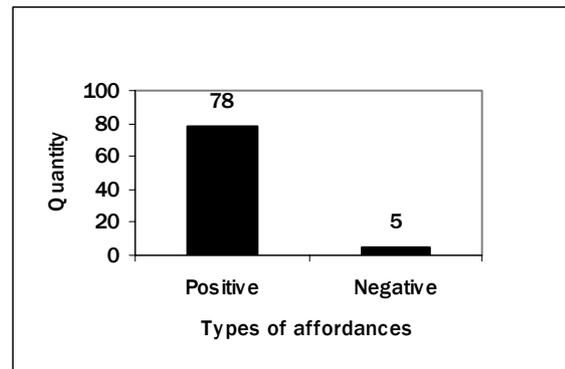


Fig. 1. Affordances of streams and rivers experienced by the children.

perceived the water bodies and their features as functional properties affording many play activities. The length of play varied from 12 to 98 minutes which was directly influenced by the properties of the water features. As such the children spent short time at the paddy field stream because their play was abruptly interrupted by a negative affordance which was fear of leeches. A longer length of play at the Teris and Gondah rivers suggests that they offered more variety of affordances than the streams permitting diversity of performatory, exploratory and productive activities.

Categories of environmental qualities

The aggregate data on the categories of environmental qualities afforded by the riverine environment is shown in Fig. 2. In the positive term,

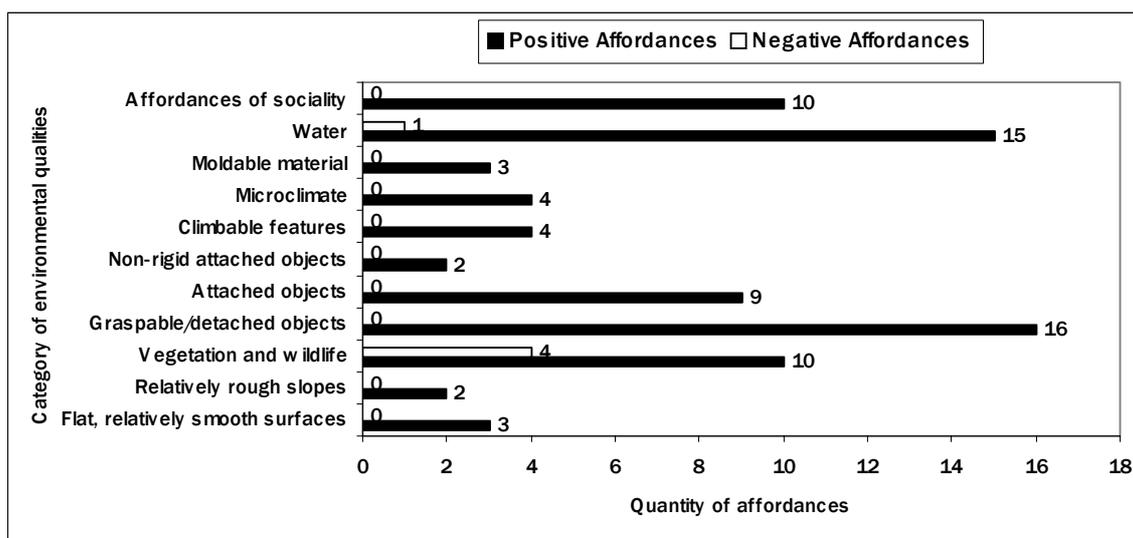


Fig. 2. Taxonomy of affordances of streams and rivers experienced by the children.

all the categories offered the children with as few as two affordances and as many as 16. On the other hand, only two categories, water (n=1) and vegetation and wildlife (n=6) afforded negative affordances. As can be seen, it is clear that two categories, graspable/detached objects and water, afforded the highest number of functional meanings to the children, 16 and 15, respectively.

Level of affordances

A distribution of the levels of affordance is illustrated in Fig. 3. As expected, in positive terms, utilized affordances (n=52) dominated the children’s activities followed by perceived (n=19) and shaped ones (n=7). The result suggests that most of the activities of the children were performatory and exploratory types. The least are the productive activities as suggested in the shaped affordances. Therefore, the phenomenon indicates that the children were active playing that is physical interactions with the features of the streams and rivers. As will be discussed later, these activities involved physical interaction with the water features as well as social transaction with peers. Hence, the phenomenon indicates the affordances of the riverine environment have affectively generated the functioning of the children, cognitive, physical and social.

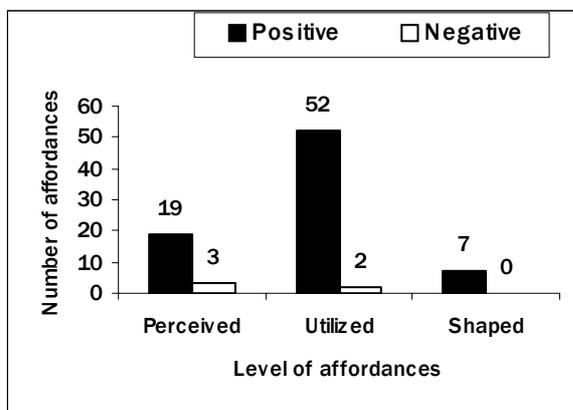


Fig. 3. Levels of affordances of the streams and rivers.

Discussion

Category graspable or detached objects

The graspable or detached objects were elements of the water bodies such as stones including flat pebbles, sand, sticks and driftwood as well as man-made elements, rubber slippers. The children utilized the elements for performatory, exploratory and

productive activities. Some of the performatory and exploratory activities were throwing flat pebbles on water surface, scooping sand with hands, floating on driftwood, and picking stones to make a dam. Each element offered several affordances. To give an example, at the rivers Gondah and Teris, the flat pebbles permitted three affordances to the children: searching them with hands on the riverbed, throwing them horizontally on the water surface and seeing them skipping on water surface. They were both performatory and exploratory activities. The first action was a sensory activity; the children scanned the riverbed with their hands for the appropriate pebbles. The second was a motoric activity which was directly dependent upon to the physical ability and skill of throwing the pebble. And, finally, the third was a sensory activity; a perceptual action that fascinated the children. Furthermore, it permitted a peer to assimilate the action of other, and later accommodate it. The phenomenon began when a 10-year-old boy, whom already knew how to throw the pebble, picked a pebble and threw it in a spinning and horizontal motion on the water surface. His action was quickly assimilated by his two peers that is they searched for similar pebbles and threw them on the water surface. They succeeded after several failed attempts. The social play and skill were possible because the river environment afforded open space for free play with plenty of graspable and detachable objects. Therefore, “perception and action mix; action reveals new affordances, and the perception of new affordances creates new action” (Kyttä, 2003: p. 31).

Likewise, the abundance of stones at the Bukit Pulai stream permitted an exploratory phenomenon: constructing a dam. Four boys, aged 7, 8, 10 and 12 and a girl aged 5, collected stones from the stream banks and bed to make a dam across shallow water which was half-completed by previous visitors. The 10-year-old boy led the team by communicating to four peers to collect different sizes of stones. Some of the verbal instructions included “Take a small stone,” “A bigger one than this,” “A round stone,” “A flat one to fit here,” and “This (stone) is heavy.” His peers selected, picked and carried the stones and passed the stones to him. He arranged the stones in relation to the size of crevices that he saw. Thus, the perceptual interaction with the stones generated judgment to use appropriate words and phrases allowing him to communicate with his fellow peers in order to pick the correct sized stones to complete the dam. On the other hand, his peers who picked the

stones made perceptual judgment to select the appropriate size and shape. During the play, the hot afternoon sun did not deter their play. It seems clear that the stones as movable materials afforded rich social transaction. According to Hartle and Johnson (1993), the transaction is social ability: the ability to understand the rules of play. The constructive play with the stones afforded at least seven performatory and exploratory activities: selecting, picking, carrying, arranging, judging, communicating and cooperating. And, finally, the play afforded a productive activity that is creating a dam as a new feature in the stream setting. The performances of the children is consistent with the concept stating that children preferred action-oriented and movable materials over static materials (Hartle and Johnson, 1993).

Interesting enough was an activity of two boys, aged 8, with a driftwood which they had found stranded on a sandbar at the Teris river. They pulled the wood together and then one of them floated and drifted downstream. Upon reaching a distance far away from his peer, he pushed the driftwood upstream for his peer's turn. The waiting peer shouted, "Let me try it." Their overt actions triggered the rest of the boys to take turn to utilize the driftwood. The phenomenon was a social interaction involving performatory and exploratory activities (Ladd, 1999). Finally, the boys placed the driftwood on the sandbar and carved the sand underneath it in which they called the creation of a house. Hence, the sand permitted a shaped affordance to the children. In other words, the children experienced a productive activity; shaping a new structure in the riverine setting. In sum, the driftwood afforded five activities: pulling, floating, drifting, turn-taking and making a feature.

Sand is a graspable as well as moldable features available in abundant in all the five water bodies. Its affordances to the children were scoop-from-riverbed-able, scoop-to-make-channel, throw-on-peer-back-able, mould-to-make-mound-able, break-mound-able materials, and stand-on-able, walk-on-able and run-on-able surfaces. These were performatory and exploratory activities (n=8) such as scooping and throwing, and productive activities (n=2) including molding and breaking mound. In relation to the sand, two boys, 10- and 12-year old, planted a fallen branch onto the riverbed. They curiously observed the stick and communicated on how strong the stick could stand against the river

current. When the stick fell, they grasped it and stuck it back to the riverbed in a firmer position. Therefore, the affordances of the stick included pick-up-able, stick-into-riverbed-able, and watch-on-able materials. That is performatory and exploratory activities.

Category water

Clearly, the children's activities with the graspable and detached objects were directly associated with water. Insofar, the objective of the children coming to the streams and rivers was to be in the water. The water afforded 15 functional properties. The obvious performatory activities were bathing in the rain or sun, swimming, submerging, splashing, walking and running in shallow water.

In the water, the children felt the moving water all over their bodies. And, the cooler waters of the hill streams afforded feeling cold and shivering after a while in the water, the only negative affordance. Moreover, utilizing the driftwood, the children gained two more affordances, floating and drifting. Crossing the river afforded them with an exploratory experience: judging the depth of water. Such functional meaning was afforded by the profile of the riverbed in relation to the height and strength of the children. Inasmuch, in the shallow section of the river permitted a child to run and resulting to splash water onto his peers. The children also hit the surface of the water with their hands and felt the water splashed onto their bodies and faces. Notwithstanding, the rushing water of the hill streams produced a sound of rapids and waterfalls that delighted them to play. And, in the calmer water of the rivers, they saw ripples when a stone was thrown into the water. In sum, the water of the streams and rivers afforded splashing, floating, drifting, crossing the water bodies, running in shallow water, producing cold water, hitting water surface, and producing sounds of rushing and falling water.

Category vegetations and wildlife

Referring to Fig. 2, the vegetation and wildlife afforded 10 positive and four negative affordances. The former afforded viewing greenery, climbing overhanging branch, jumping from cantilevered branch, shading from afternoon sun, picking leaves and flowers and many more. These were perceived and utilized affordances allowing the children to participate in performatory and exploratory activities.

For example, at the Teris river, the 10-year-old and 12-year-old boys climbed the branch of a matured tree, *Dipterocarpus oblongifolia*, and jumped into the water. It is a performatory activity.

At the same river, three girls, aged 4-6, picked leaves drifted by the river current and collected flowers from climbers growing on its bank. They placed and arranged the plant materials in a pattern on a sand bar. In sum, the affordances of the riverine vegetation are view-greenery-able, climb-on-branch-able, jump-from-branch-able, shade-from-sun-able, and pick-leaves and flower-able.

Likewise, the wildlife also permitted at least four positive affordances: watch-crab-able, watch-birds-able, watch-butterflies-able, and pick-snail-and-clam-able. These were performatory and exploratory activities. Inasmuch, the activity of picking snails and clams from the Teris river was new to the children. As such, the children had the longest period of play at the river which generated much curiosity and fascination.

The vegetation afforded no negative affordances. However, the wildlife afforded four negative ones; seeing leeches in water, seeing leeches on body, swimming away from leeches, and removing leeches from body. Notwithstanding, the children's activity at the paddy field stream was abruptly terminated due to the leeches. Therefore, the vegetation and wildlife of the riverine landscape afforded a mixture of positive and negative functioning properties to the children.

Category attached objects and climbable features

As can be seen from Fig. 2, attached objects like fallen logs and poles afforded nine activities. And, climbable features such as large boulders afforded four activities: scaling, sitting, looking-out-from and hiding.

Interestingly, the logs afforded the children jumping from, somersaulting, balancing, ducking in water under the log, hanging with legs and arms, rocking on the end of a log, and basking. Additionally, the poles, firstly, allowed a boy to align them over paddy-field stream, and then to cross the stream on these poles. These activities are all performatory and exploratory activities, except the aligning of poles over the stream as productive activity. An activity worth mentioning was the aligning of two poles by an 11-year-old boy to cross the 7-foot-wide stream. With his own strength he aligned the poles over the stream with both ends securely stuck in the soft ground of the stream banks. He shaped the crossing by placing the poles side by

side to allow him to ride rather than walk, and to get across the water. Thus, he explored and understood the functional meaning of the poles: aligning and crossing the stream. Thus, the pole was a utility as well as a play tool.

In sum, through perception and movement, it seems clear that the children recognized a variety of affordances from the attached and climbable features of the riverine settings.

Category affordances of sociality

The streams and rivers offered 10 affordances of sociality involving shouting, directing, splashing water to peers, holding hands to cross deep water or to avoid drifting, playing driftwood, throwing sand on back of peer, chasing, seeing peers jumping from log, and acquaintance with new peers. The size of social group varied from as many as seven individuals (Fig. 4) to as few as two at the activity of picking snails and clams from the water or picking flowers from the climbers. According to the literature on social interaction of young children, it suggests that social interactions help a child to become aware of peers' feelings and characteristics (McDevitt and Ormrod, 2002). The literature also suggests that children gain friendship and acquaintanceship from the social play (Ladd, 1999), which are essential for the mental and emotional development (West, 1992). One of the most interesting social interactions was playing with the driftwood which was earlier explained. The social affordances offered by the driftwood and water were directing-peer-able and turn-taking-able.



Fig. 4. A social play in shallow water at the Teris river.

Conclusion

It seems clear that the children experienced the affordances of the stream and river mostly in a positive mode more than in a negative one. Their interactions with the physical features involved simple uses of materials such as scooping sand, picking and arranging stones, throwing flat pebbles, climbing tree branch and drifting on driftwood. The findings suggest that the children perceived the stream and river as settings with the abundance of graspable and detached elements as well as attached and climbable features which they readily utilized in relation to the water as the major element of the riverine landscape. In other words, their interactions with the water features were so complex that they sustained their curiosity and fascination. The finding suggests that the children perceived clearly that streams and rivers are their place for play through participation. This finding is consistent with the views of Christensen (2003) and Graue and Walsh (1995) that children construct and construe their place through physical activities and social relations which may result into emotional bonds to the place including place attachment (Chawla, 1992) and favorite place (Korpela *et al.*, 2001).

As preferred by the children, the interactions with the features of the riverine landscape were almost all in groups, except for an 11-year-old girl whom hide herself behind a large boulder while dipping her body in the water. Thus, lots of social play and social skills such as communication, assimilation and accommodation were generated during their play. The stream and river, therefore, are playscapes for the young children that afforded interactions with the physical features as well as transactions with peers playing with these features.

In sum, the diversity of the materials in the stream and rivers afforded the children with the opportunity to express themselves in a wide variety of play forms (Hartle and Johnson, 1993). The streams and rivers were multi-sensory playscapes that affectively stimulate the children's senses. The findings implicate that stream and river are natural water bodies that are useful for the cognitive, physical and social functioning of children. Thus, conserving them for the children is an important step in planning of children play environment.

Directions for Further Research

The value of stream and river as children playscape requires more research. More children behavioral studies are needed to expand our understanding on the significance of natural water settings for children physical, cognitive and social developments. Firstly, the affordances of the stream or river change when its water fluctuates and thus the children will perceive the water setting differently. As such, high water level after heavy rainfall especially during rainy season will submerge sandbar and large boulders, and the river water overflows its banks in strong current. Thus, lesser features are available to play means less number affordances. And, fast flowing water may be a negative affordance to many children that is the fear to be swept away by the current. However, high water level opens an opportunity for the non-fearful children to jump from higher elevation, such as from the banks and overarching trees, as positive affordance. Village children whom use the stream and river as their play spaces may be much fascinated when the water rises. That is, the children assess the environment properties in relation to themselves (Fjortoft, 2004).

Secondly, in the perspective of childhood cognitive development, it will be interesting to investigate the language use by an ethnic relating to the physical properties of the water settings. For example, rural ethnic children would have specific words to describe the shallowness of river water or the shadiness of the river setting. These words are full of functional meanings in which children learned from adults and peers. Hence, the children would understand the word that describes high water level, and thus they know what affordances the river would offer. Such study demands a phenomenological approach in which children words are obtained from their situated actions and context of play.

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: الإمكانيات، المسطحات المائية الكبيعية، البيئة الاستوائية.

. تُقيم هذه الدراسة إمكانيات المسطحات المائية فيما يتعلق بأداء الأطفال. لقد تم مراقبة ١٠ أطفال من عمر ٤-١٢ سنة، وهم يلهون في ثلاثة جداول مائية ونهرين في بيئة استوائية باستخدام طريقة تسجيل الظواهر المشاهدة، ثم القيام بجمع بيانات الأطفال ومدى تجاوبهم من خلال رسم خرائط السلوك وإجراء مقابلات غير محددة النهاية. لقد كانت الاستجابات عبارة عن حركات محسوسة وكلمات وتعابير صادرة من الأطفال ومعبرة عن تفضيلاتهم أو عدمها فيما يتعلق بوضعية المادة الموجودة في البيئة. لقد تم تحليل النتائج على ثلاثة مراحل: أولاً، مدى توفر الإمكانيات الإيجابية أو السلبية. ثانياً، مدى توفر تصنيف بيئة الأطفال الخارجية. ثالثاً، مستوى توفر الإمكانيات. لقد واجه الأطفال ٧٨ إيجابية وخمس سلبية فقط. ومن التصنيف وجدنا أن المياه وفرت ١١ صنفاً من تصنيفات جودة البيئة التي كانت مجموعها ١٦ و١٥ صنفاً. لقد اتخذت معظم أنشطة الأطفال أشكال العروض والاكتشافات، حيث أظهرت النتائج أن الأطفال يدركون ما توفره جداول المياه والأنهار من إمكانيات عبر تفاعلات حسية وذهنية واجتماعية. لقد أدرم الأطفال المسطحات المائية كمكان للعب يوفر قدرًا من التنوع في المعاني الوظيفية.