LITERACY OF CHILDREN ON ECOLOGICAL SYSTEM OF HOME GARDEN IN MALAYSIA

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Abstract

A key part of ecological literacy is reconnecting children to living systems that is children's good knowledge on relationship with nature. In Malaysian school curriculum, children are taught on connections between plants and animals and their environmental factors including water, sunlight and soil. However, little is known on how much school children practice the in-class knowledge when they are experiencing their everyday landscape, the home garden. We predict there is a gap on children practical knowledge of home garden ecosystem in Malaysia. This study aims to explore the depth of knowledge of school children on ecological system in home garden environment in Malaysia. The quest to understand children's ecological literacy begins with searching of references from journals on ecosystem, children functioning and education. The journals include Journal of Adventure Education and Outdoor Learning, Children's Geographies, Landscape and Urban Planning, Childhood Today, Children's Cognitive Psychology, Journal of Ecology, and Nature Learning. In addition, textbooks of fundamental of ecology are reviewed to understand the basic knowledge of ecosystem for children. The knowledge of ecological system is categorized in a thematic map under the heading of (1) nature learning, (2) interspecific relationship of plant and animal, (3) ecosystem science, (4) school curriculum, and (5) species identification. Therefore, participation observation and open-ended interview were used to conduct the study. Further study will develop into an assessment model for ecological literacy for children on learning to know, learning to be, learning to do and learning to live together. The meta-analysis study will provide evidence on importance of children engagement with outdoor environment leading to nature learning.

Keywords: children, ecological literacy, outdoor learning, adventure education

INTRODUCTION

Reconnecting children to interact with the living systems in the natural environment allow them to enrich their thinking and learning as well as a belief that ecology in science may be a particular important domain in early childhood (Worth, 2010). Children have their own uniques learning style (e.g. White and Stoecklin, 2008) and experiential way of knowing (e.g. Leach *et al.*, 2007) the natural environment. In order to constantly restructure the children's ways of knowing and develop inquisitive minds, they need to be given opportunities to think, to construct, to make observations, to inquiry, to explore the surroundings, to read the nature, to test hypothesis, to create relationships and to reflect their actions (de Brito Miranda, Jófili and dos Anjos Carneiro-Leão, 2016). This situation certainly built important skills and attitudes for learning to their physical, cognitive and social (Chawla and Heft, 2002), thus leads to greater degree of competence (Gordon, A. & Browne, 2015; Duerden and Witt, 2010; Chawla and Heft, 2002). Literacy of children on ecological systems are when children's ability to know and understand the basic knowledge of ecology. Basic ecology, is the study of organismal diversity that deal with the relations of living organisms to one another and its

surroundings including water, soil and sunlight (Courchamp *et al.*, 2015). Example, children are engaging to the orchard for playing, at the same time, they naturally learn about plants and animals in particular locations such as knowing spiders are predator that feed on insects such as butterflies and mosquitoes that trapped on its web, and able to know the red ixora flowers have nectars compared to pink ixora flowers (Yusof, 2015). Through direct experience, this understanding of ecosystem will fostering children interaction, autonomy, exploration, curiosity and sense of responsibility (Ferreira, Cruz and Pitarma, 2016; Courchamp *et al.*, 2015; Murtaza, 2011), thus it representing children's good ecological literacy on relationship with nature. In other words, although children learn from conventional instructional technologies, e.g. textbooks and videos, it is important to highlight the importance of contextual, direct, and unmediated experiences used in problem-based learning situations. Hence, children are able to use a variety of senses in exploring the content to maximize active learning (Miranda *et al.*, 2017).

Home setting is a place where children spend most of their time in playing, enjoying and resting (Said, 2007). Children begin their everyday life from home to the outdoor contexts including garden, ditch, orchard, street, schoolyard, and stream. Without children realized, they are engaging with their surroundings and naturally become part of their nature learning. Their surroundings are rich diversity, open-ended learning laboratory (*Children and Nature*, 2013) and easily accessible where children able to go beyond their homeground in order to interact with plants and animals. The availability of home garden and nearby nature may afford young children to learn and play a variety of activities without parental concerns (Skar, Gundersen and O'Brien, 2016; Moore, 1986).

In recent years, children engagement and accessibility to natural environment has been decreasing. Previous studies on children's environment found that nature is the most significant place to develop children's learning (e.g. Skar, Gundersen and O'Brien, 2016; Smith, 2010; White and Stoecklin, 2008). In Malaysian school curriculum, children are taught in ecological systems for most of their considerable time at school and extra tuition in which isolating their everyday life experiences (Rivet and Krajcik, 2008). From this viewpoint, the phenomenon is often decontextualized (Metz, 2004) and considered construction of contemporary thinking (de Brito Miranda, Jófili and dos Anjos Carneiro-Leão, 2016) that will be understood as school tasks. Hence, children nowadays, they learn to see things as separate and without connection (Loureiro, 2006) to the environment in which they live. As a result, children related environmental literacy is rarely utilized, missing a key opportunity to intergrate children's everyday forms of perception and action that are knowing, seeing and doing. Thus, children's understanding of ecology has been a comparatively neglected field of study (Wood-Robinson, 1991).

Therefore, this study is to explore the depth of knowledge of primary school children on ecological system in home garden environment in Malaysia. This dominance is significant to consider children's literacy or idea in ecology in order to reveal the children's understanding on relationship between plants and animals as well as their habitats.

METHODS

The literacy of children on ecological systems were explored among 37 primary school children from standard four to six, aged 10-12, who are living at Kampung Ulu Jawa, Pontian in Johor, Malaysia. The group was led by the instructor on the ecological trail session in a nearby home garden. To conduct the data collection, permissions were obtained from the school's principle and chief of the village. The data was collected through instructional method and participatory observation to obtain a broad understanding of children's responses on relationships between plants and plants as well as plants and animals. Their responses were taken using photographs (Askerlund and Almers, 2016; Dowdell, Gray and Malone, 2011). From the photographs, children's responses were analyzed according to their responses on the activity during their ecological trail and capture what was spontaneously expressed by the children in the situations (Askerlund and Almers, 2016; Cobb and Mead, 1977) in the home garden.

The ecological trail included orchard, home yard, ditches along the street shoulder, and oil-palm farm setting at the village. An instruction based on ecological learning within their home garden included exploration, articulation and reflection. When the children were carrying out the activity, the researcher observed the children and their responses in engagement. The discussion was

used to encourage children to explore, articulate and reflect their understanding of the connection (Ünal and Nan, 2010) between plants and plants, plants and animals as well as their habitats and environmental factors including water, sunlight and soil. For example, basic ecological knowledge needed in order to understand the nature elements on ecology (Draft Global Issues Pilot August, 2011) that is through interspecific relationships such as mutualism, commensalism, explotative, and competition. The instructor used to describe and explained the ecological through networks of relationships to children. Example of mutualism relationship is that, an acacia tree is a home to a colony of stinging ants and provide them foods, while ants protect the tree from being attack by other organisms. Through their interaction, therefore, this session enables the children to have their opportunity to reflect on their ideas (e.g. Nordström, 2010; Ünal and Nan, 2010; Tunstall *et al.*, 2007; Malone and Tranter, 2003) on ecological literacy in perceptions and actions (de Brito Miranda, Jófili and dos Anjos Carneiro-Leão, 2016).

On the other hand, the study applied a phenomenological based-approach to explore children's literacy in ecology (Leach *et al.*, 2007), by asking them to make prediction and give explanation for the way things happen. Examples, children were asked to tell their understanding such as what kind of flowers that attracted bees and what is the creatures that live in the ditch. Moreover, other phenomenological has been conceived 'curious-observe-inquiry-explore-explain-reflect-evaluate' techniques (de Brito Miranda, Jófili and dos Anjos Carneiro-Leão, 2016; Worth, 2010) that is to test their literacy on ecology.

RESULTS AND DISCUSSION

The analysis of data gathered from field observation and photographs, the children expressed enthusiastic and excited about their assigned activity. Therefore, the results presented children's responses in perception and action during the activity based on the thematic analysis.

Participation in ecological trail

Figure 1: Children were explained by the instructor about ecology

Participation in ecological trail in home garden was based on children's engagement and interaction in the activity. At the beginning, children were briefing on the purpose of the activity. Children were looking and listening to the instructor, however, not all of them paid much attention during the activity. The result suggest that there is a need to conducting focus group with children (e.g. Gibson, 2012) to provide rich understanding of children thoughts, feelings and experiences. Hence, this will also increase the number of curious, observations, questions and lead to exploration, articulation and reflection. From Figure 1, instructor was starting with warm-up scenarios and questions to children and favor them to response freely. Moreover, this session contributes children's cognitive level including their concentration, attention abilities, performances and thinking skills (Mustapa, Maliki and Hamzah, 2014).

Therefore, the experience was rich and challenging. However, the process of children's engagement in inquiry-based-science (Worth, 2010) on ecology is still weak. This process will be increased when children are given the opportunity to be active in learning life science. It means that through direct experience, learning the home garden ecology can generates knowledge to the children as well as their perceptual-action (Cosco *et al.*, 2010; Chawla and Heft, 2002). Although, children did not asked many questions, children were able to hand over informations when instructor posted questions. An excerpt illustrated the children's idea of knowledge on the subject.

> *Instructor: How do water striders communicate to each other?*
> *Child 1: Wave! [ripple]*

It means through cognition, children recognized the water striders live and walk on water. The child's response is more towards his common sense but it was considered right. This shows the understanding on the relationship between water strider and water is existing. When the water strider moves, it create and detect ripple. Using the surface tension of the water, water striders stand up on their long, skinny legs and send out vibrations that travel along the surface. Each leg has nerve sensors that can detect slight waves, water striders are able to communicate with one another in this way. Therefore, this phenomenon will gradually establish the literacy of children between ideas which develop to become more complex and structured ideas (Ferreira, Cruz and Pitarma, 2016).

From the beginning of this observation, children's showed their interested in seeing and doing, rather than knowing, in which implies their willingness (Corsino, 2006) and sensibility to observe, develop responses and articulate what the children know (de Brito Miranda, Jófili and dos Anjos Carneiro-Leão, 2016). For instance, children begin to be involved into the oil palm farm with peers to get hand-on experience (Figure 2). Despite of their aged differences, they appeared to be participative and interest in the ecological trail. However, from the field observation, it was found that children were formed into rows; (i) first row - children that closed with the instructor, (ii), second row - children that stand in the middle row and (iii) third row - children that stand at the back which are not that closed to the instructor. As shown in the Figure 1, the children who were standing at the back which hardly to get an eye contact on what was happening, so they began to become interested in different kinds of things other than joining the discussion, like starting to play with peers such as collect stones on the ground and talking with each other during the activity. They seemed to lose their concentration because they were unable to see it clearly and directly eventhough they were closed interact in the nature. Further study can be recommended that the activity should be conducting into focus group and interviews, so that children are being able to be curious, observe, inquiry, explore, explain, reflect and evaluate (Ferreira, Cruz and Pitarma, 2016).

Spaces experience for ecological learning

The results were captured based on what was spontaneously expressed by the children in the situations in the home garden. From field observation, children participated in ecological trail for engagement and interaction. The spaces visited were categorized into four; 1) oil palm farm, 2) homeyard, 3) ditches and 4) informal green space. The findings discussed on the children experience these places through exploration, articulation and reflection influenced their perceptual and action performances. A farm is a place where oil palm trees are located mixed with secondary forest and inhabited by wild animals. The homeyard is edible plants and fruit trees planted within their neighbourhood home garden. The ditches are located along the street shoulder with the existence of insects and plants. The informal green space with wild plants are also found at the street shoulder. Contextualizing science instruction (Rivet and Krajcik, 2008) are used as a catalyst for children to perform the tasks and utilize their prior knowledge in everyday experiences in home garden.

At the oil palm farm, children were given an exposure on how the ecological systems took place. The instructor began to describe on oil palm (host) and pteridophyte (epiphytic fern). Children identified that the tree was oil palm when they were asked by the instructor. Through their perception, this can be defined that children have high sensibility of knowing the type of plants that found at their village. This is because they have the prior knowledge of the elements bcause they engage and interact everyday. This has intenses the children to be able to describe the information in the situated context.

Therefore, children were also exposed to the ecological learning on pteridophyte that grows on the oil palm. This plant-plant relationship known as commensalism. The pteridophyte used oil palm tree for their support system but it does not obtain nutrients from oil palm and therefore does not harm or affect the oil palm. Besides, another example is the relationship between pteridophyte and ants on the oil palm tree, known as mutualism. The ants inhabitants gain housing in root-masses of pteridophyte while ants protect the pteridophyte against other animals (Fayle *et al.*, 2015). These relationships are called ecological systems. From the field observation, children seem unable to describe these process of relationships on ecology. As such, it indicates that their ecological literacy is existing but not in a complex knowledge. This

suggested that children ways of perception were more to judgement of elements which firmly established as part of common knowledge rather than science point of view. Therefore, children were able to immerse themselves in the natural surrounding (Ord and Leather, 2011; Kellert, 2005a, 2005b) allowing them to be active in movements and actions. As shown in the Figure 2, this can be visible when interaction, autonomy and exploration (Ferreira, Cruz and Pitarma, 2016; Courchamp *et al.*, 2015; Murtaza, 2011) take place. This demonstrate that experiencing the home garden affords the children to be active learners.

Figure 2: Children began to show their interaction towards the living elements

At their neighbourhood homeyard, the children were observe two living elements, that are *Dedalu* plants and *Garcinia mangostana*. This relationship between *dedalu* plants (parasite) and *Garcinia mangostana* (mangosteen tree) is known as parasitism. According to Oxford Dictionary, parasitism is an organism that live on another organism called host and gained nutrients from the host. First, children were able to see how these two plants looks like. While listening to the explanation, children began to get closedr to the mangosteen tree and touch the *dedalu* plants. As can be seen in Figure 3, Bullock (1994) posits experiences with nature can help children to stimulate their senses in seeing, touching and intense movement to learn about environment. The finding shows that children perform in actions when they were able to explore during outdoor participation. This phenomenon happened due to diverse in living elements, that are relationship of plant and plant. In parallel to a study by Chawla (2004) that children have their sense of curious and eager to learn in outdoors which lead to sensorial actions.

Figure 3: Children were gathered in front of the neighbourhood homeyard

Figure 4: Children were conquered the ditch area in order to perceive, understand and interpret clearly.

During the ecological trail, children also visited the ditches that located at the street shoulder near their home garden with the existence of animals (insects) and plants. Children were briefing on how the water striders live and how it maintain its habitat. Children need to learn when there is inhabit surfaces of calm waters, there will be water striders. Therefore, the aquatic plants become a place for water striders to lay eggs for its habitat. Water striders are predators that eat mosquito larvae and land insects trapped on the water's surface. Nevertheless, this life cycle is known as ecological systems. Figure 4 shows that children were making physical contact with animal-habitat in which stimulating their senses. The result showed that children's enthusiasm to the physical living elements were effectively perceived by the children through their sensorial actions and responses. This interactions involved perception and action such as they surrounded the ditch to see the water striders closely. However, in performing the tasks, children been asked questions to find out their independent in relation to think and the acquiring of know-how (Ferreira, Cruz and Pitarma, 2016). Ogborn (2008) posits it is important for children in practical know-how as it is essential input into the doing of science. The

following excerpts captured the children's understanding of water striders.

Instructor: What is it?
Child 1: It is spiders!
Instructor: Then, how it walks on the water?

No answer were given.

Instructor: How can it floating?
Child 1: …because it is light!
Child 2:…because their legs act as lifebuoy!

Although the children are seeing it almost really often in their home garden, the result showed that their accuracy on understanding of the subjects are still low. From this feedbacks, the result showed that the literacy of children on ecology are most intense their own common ideas and senses rather than using ecological terminology. Children have develop their own answer to problems (Ferreira, Cruz and Pitarma, 2016). This finding is parallel with Pereira (2009a:12), children build their concept ideas and explanations, which may not correspond to current scientific knowledge, but are logical for them. Needless to say, this reveals that children learn ecological system in homegarden using their own terminologies based on common sense idea which often differs from scientific language.

Figure 5: Children have been explained by the instructor on the life cycle of how yellow flower (*Allamanda cathartica*) can be attracted to bees

Another interaction was the informal green space with wild plants found at the edges of secondary forest. The instructor told to children on how do the activities of the insect affect plant growth and development. The example was between bees (insect) and *Allamanda cathartica* (yellow flower) undergo the life cycle. Bees are attracted to bright color of flowers where it fly from flower to flower gathering nectar. During pollination, bee moved within a flower to obtain nectar may transfer pollen either within that flower or among other flowers on that plant.. In other words, bees get their food (nectar) to eat, and the flowering plants get pollination and reproduce. The bees collected the pollen to take back to their hives. This relationship known as mutualism. The process is needed to be mentioned by the instructor in order for the children to be more understandable. As can be seen in Figure 5, the instructor began to ask questions to children to describe the ideas of the subject. The excerpts are as follow:

Instructor: Then, how the bees oriented?

No responses from the children.

Instructor: How the bee communicate the direction of the food to the other bees?
Child 1: The bees hit their sesungut to each other

Although, the response on second question was more in a children's logical senses. Throughout the field observation, some of the children plucked *Allamanda cathartica* (yellow flower) and some of them looked the flower tree more closer and smell the scent of the flower. This phenomenon reveals that children explored the living elements and the event by making observations and engage in simple investigations (Worth, 2010). However, during the ecological trail, children were unable to see the bees in real on how the bees take place. This situation also has stimulate the children's use of imagination (de Brito Miranda, Jófili and dos Anjos Carneiro-Leão, 2016). The imaginings get their meaning, not from definitions or terminologies but from actions that is from the practical active know-how which underlies them. For example, when instructor mentioned that bee performs waggle dance to other bee, children began to dance with peers. They illustrated how bees take place to communicate. Nevertheless, children showed a great deal of wondering and curiosity about the subjects discussed. The result presented that children learned ecological systems (bees with yellow flower) in a meaningful context seems to fascinating children and catch their inquisitiveness

(Pramling, 2011).

Table 1: Children's responses on relationships of ecological systems based on spaces in home garden

Theme	Number of elements observed			
	Oil Palm Farm	Home yard	Ditch	Informal green space
Exploration	4	2	2	1
Reflection	2	2	1	3
Articulation	1	0	3	1

Table 1 shows the result analyzed from the data obtained according to the spaces experience by the children during the ecological trail in the home garden. It has been catagorized into three; exploration, reflection and articulation. These categorization is based on physical, cognitive and social participation with the elements that children observed. The result indicates that the highest frequency of elements observed by children is through exploration followed by reflection. Each of the spaces visited by children has involve exploration and reflection because they are full of wonder and curious in which compelled them to explore and react to their immediate environment. In parallel to Gibson (1988) that environments invite and challenge the children to engage and interact through exploration and give reflection. This suggested that children continual search for new affordances that enable them to discover and create new knowledge of themselves and the environment they inhabit (Gurholt and Sanderud, 2016). Therefore, the home garden experiences help to illustrate how to turn the children's curiosity about how water striders lives and survive on water, or bees get nectars from flowers with bright color, into problem-solving activities. This exploration arises because the children have sense of control and familiarity when the engage with the environment they are in and the elements they use to interact. Nevertheless, it means through exploration, children know how to fit themselves in the environment, latter develop the children's performances.

From the Table 1, articulation is the least influenced the children when they observed the living elements in their home garden. It suggests that the articulation of the children's ecological literacy conveyed in school has not fully integrated. From the observation, it seen that most of the children were observed by teachers which stimulate them to be worry to respond the questions asked by the instructor. This finding is related to Anderson (2000) posits that children are afraid of giving a wrong answer when a teacher asked them questions. In contrast to Selly (2017) posits that engaging children with nature gives rise to questions and feedbacks. This finding suggests that children able to be more flexible and freely active when they have sense of control in which parallel to Olds (1989).

In other words, children find affordances for learning and play. The finding reveals that the children have shown how the living elements of the home garden supporting children's perceptions and actions. Table 2 shows the performances of children in perceptions and actions in order to perceive their depth in ecology.

Table 2: Children's performances of ecological literacy based on spaces in home garden

Relationship	**Performances**	
	Perception	Action
Plant And Plant	Low	High
Animal And Habitat	Low	High
Animal And Plant	Low	Low

Table 2 shows the performances on children's ecological literacy based on categorization of spaces in home garden. The results suggested that children were expressing their curiousity and eagerness to learn in outdoor environment through engagement which correspond with Laaksoharju *et al.* (2012), claimed that the possibilities for learning to nature is dramatically increased if children are taken outdoors.

In order to accomplish it, the children's literacy of learning ecology were explored through their perception and action when they experienced in home garden. Table 2 shows the findings derived from the ecological trail activity. It was found that children's ecological literacy in perceptual in understanding of relationships of plant-plant and plant-animal as well as animal-habitat are still low. Literacy of children on ecological system depends on children's ability to know and understand the knowledge on relationship of ecology. Children were able to give their responses on the questions given, however, the understanding of children on ecological literacy did not exceed to the complex phase. Children seem to hardly describe the relation between organism and another. This finding is accord with study by (de Brito Miranda, Jófili and dos Anjos Carneiro-Leão, 2016) that complex thinking phase occurs when children undergo the process of interaction that is make

observation, ask question, create relationship, thest hypothesis and reflect on their action.

In contrast, Table 2 shows that the children's performances in action is high because of the dynamism and diverse of the context. The children love to explore and discover with new things that challenge their movement (Azlina and Zulkiflee, 2012). For example, the children spontaneously get into the bushes to have physical contact with the oil palm tree (Figure 2). Children experience their environment as a stimulator and experiential component of their activities (White and Stoecklin, 2008). It suggests that high degree of affordability where they engage and interact with the living elements do affected the perception-action of the children triggered them in stimulating senses and generate feedbacks (Said and Bakar, 2012).

When children were brought outside to the place they lived and play on, and they had access to orchard, green spaces or homeyards, they were able to see things in a real form and more practical. Therefore, children perform better when being engaged in practical activities that developing their confidence on performing tasks. This is important part of process of interaction where children have a chance to reflect what they are taught, developing ability to question, give reason, make hypotheses and debate with peers and teachers.

In summary, reconnecting children to interact with the living systems in the natural environment allow them to enrich their thinking and learning as well as a belief that ecology in science may be a particular important domain in early childhood (Worth, 2010). The findings also supported that the children should not learn about the ecological systems just from the book or video screen when they could learn and see it in their home garden environment.

CONCLUSION

The findings suggest that the home garden setting in the rural area become as an extension for children to develop their literacy on ecological systems and support their actions; physically, cognitively and socially. The children perceived the home garden as an open-ended laboratory because there are no boundaries for exploration. This indicates that home garden setting is affording the natural elements including plants and animals towards children's sensory stimulation and responses through exploratory and discovery to understand more about the world they live in. Thus, children perceived their home garden as a place for them to have sense of control to discover their own knowledge. This interaction inspired the children to extend their knowledge about their world including noticing, wondering, finding challenges and taking risks. It means that the home garden setting is directly influencing the children's perceptions and actions. Nevertheless, home garden elucidate the importance of ideational resources for the initiation of learning activities.

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