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Design and Evaluation of an eco-literacy project: Floating Wetlands at West Coast Park

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Abstract

This Research Technical Note (RTN) provides a qualitative assessment of an environmental education project which involved the construction of floating wetlands at a pond in West Coast Park. The project aimed to understand how and why specific aspects of workshop programming affected the learning outcomes of the participants, so as to provide useful information for educators to optimise the design and implementation of environmental education programmes. Participants' learning outcomes and feedback were collated through surveys, videos and one-on-one interviews. A key finding was that participants found it meaningful to be given opportunities to take ownership of the project through decision-making and the hands-on experience. Two features which supported this process of participant ownership in the workshop are hypothesised to be small group size, and the provision of multiple niches for learning. In addition, real-world significance, opportunities for long-term commitment, and outdoor location are also suggested to be important to produce positive and lasting learning outcomes. Future engagement of the same social group at the same site could further substantiate the findings reported here.

1 Introduction

The 17 participants and their teacher, Annie Lim, from Commonwealth Secondary School.

Urban green spaces often serve as venues for environmental education. Many forms of environmental education are recognised, ranging from more passive approaches such as the development of educational signage and self-guided tours, to active programmes such as litter collection, community gardening and ecological restoration efforts. There is much evidence to suggest that environmental education programmes, particularly those which incorporate hands-on activities, can positively affect participants' knowledge, attitudes and actions in relation to the environment. However, what is less clear is specifically how or why such initiatives contribute to individual learning (Rickinson, 2001). Such information could help educators and landscape managers optimise the design and implementation of environmental education programmes to be more impactful and produce positive, lasting learning outcomes.

The specific model of environmental education documented in this Research Technical Note is known as 'ecological literacy' (eco-literacy). This approach focuses on developing in people the capacity to discern how human and natural systems function, both individually and in relation to each other (Orr, 2005). In this context, the purpose of this study was to explore how a hands-on eco-literacy project could affect participant awareness of natural systems within the urban context of Singapore.

2 Methods

a. Project design

The project was designed based on a participatory model of embodied learning as described by Barab and Dodge (2007), and the concept of tactile space (Carolan, 2007), and was structured to include the following:

- **Situated context** - the learning must take place within the context in which it will be applied
- **Real-world significance** - the project must produce genuine, real-world value to the community and its biophysical environment, rather than being a simulation to teach a concept
- **Ownership** - the project must provide opportunities for participants to feel a sense of ownership in the project through decision-making and tactile involvement
- **Expert involvement** - the project should provide opportunities for relationships to form between established practitioners (experts) and participants
- **Social bonding** - the participants should be socially connected so that a social network can develop around the project
- **Long-term commitment** - the project should provide opportunities to continue, such that the same social network can interact with the place over an extended period of time

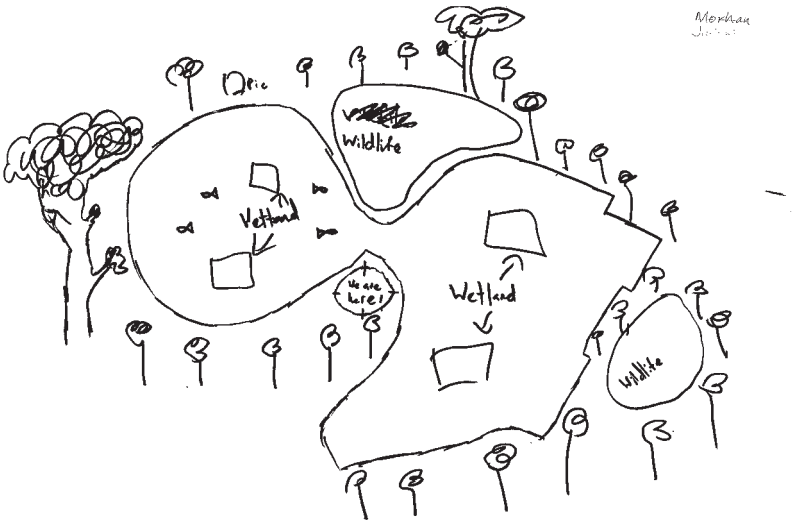
The site selected for the project was the pond in West Coast Park on its eastern end. Each of the 17 participants were members of the Green Club from Commonwealth Secondary School and were between 12 and 14 years of age. They were invited to take part in this study based on their school's proximity to the site, and the availability and support of a sponsoring school and teacher.

The project was designed in two parts. Phase 1 consisted of three separate 4-hour workshops, during which groups of 5-6 students were guided to create a series of floating wetlands based on a design by Dr. Wilson Wong (HortPark, NParks). Phase 2 was a reunion event in which participants were gathered back to the site 3 weeks after the workshops to observe their completed work, share their experiences, and decide on the final anchoring locations for the floating wetlands.

Phase 1 (Workshop, comprising seven activities):

1) **Survey and Discussion** - This was a written survey of 16 questions distributed to each participant, followed by a group discussion based on questions asked. This portion of the project served two purposes: to prompt participants to start thinking about human and natural systems, and to help the researchers gauge the participants' existing attitudes and interactions in relation to their built and natural components of their environment.

2) **Site Study** - Participants were guided to create a base map of the pond, and explore individually or in pairs the perimeter in a mapping exercise to discover "What is Here?", followed by discussion on "What can nature help us do here?" using Wendell Berry's key questions for design (1987). The mapping exercise was followed by giving each student an opportunity to present and discuss his/her findings in a group setting, and a guided discussion towards selecting an ideal location for the floating wetlands in the pond based on their observations.



Morhan's map of the pond environment showing potential locations for the wetlands in relation to trees and wildlife areas.

3) **Base Construction** - Participants were split into groups of three. Groups were presented with the unassembled materials needed for the construction of the base platform, and given the opportunity to discuss their own ideas for how the materials might be used. They were then guided by a researcher to complete the construction of two 1 m^2 modular base units.

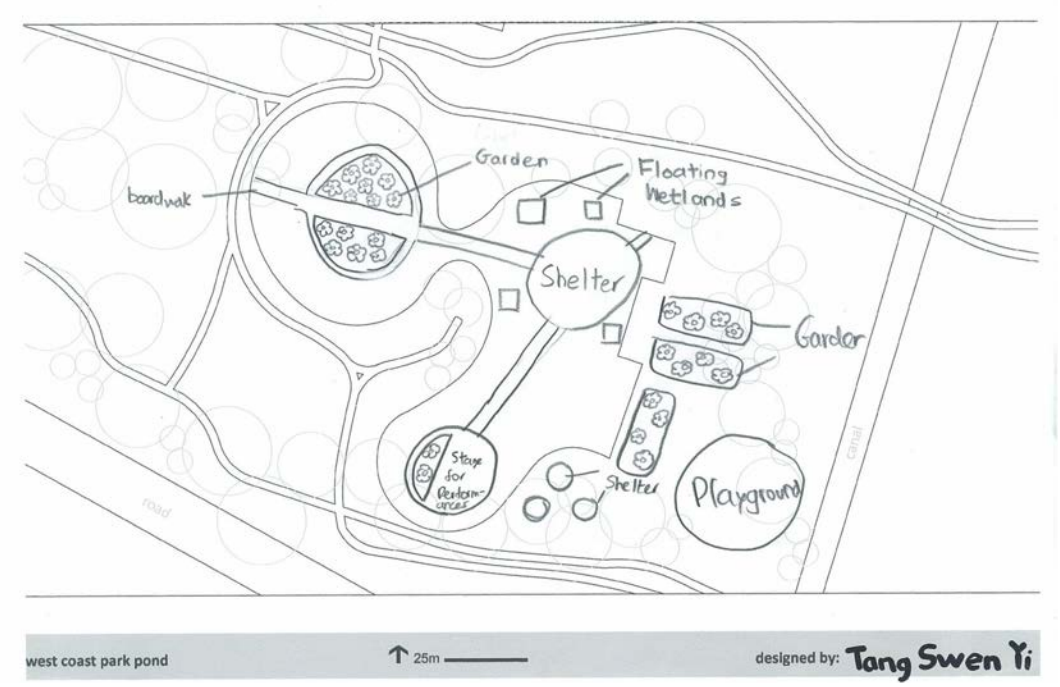
4) **Modular design** - Modular design options were presented to the whole group. Together, the participants were given the opportunity to decide which options they preferred and give rationales based on previous discussions of the wider site context, biodiversity, aesthetics and opportunities for human-nature connections.

5) **Wetland planting** - Researchers and experts engaged participants in an interactive discussion on why particular species had been selected, and how they should be planted in spatial relation to each other. The participants then worked with the researchers, experts and volunteers at a 2:1 or 1:1 ratio to plant the various species selected onto the completed base units.

6) **Launch** - The wetlands were launched into the water with participants, experts and volunteers working together to lift each of four modules to the pond edge and lowering it to

the researchers working in the water, who fastened the modules together in the modular design composition chosen by the participants.

7) **Take-home activity** - Each participant was given a site map and color pencils, invited to draw their ideas and designs for West Coast Park Pond and bring it back to the Reunion Event (three weeks later) share their ideas. Completed designs were used to gauge the participants' interest in this type of work and their understanding of the interconnections of human and natural systems.



Swen Yi's completed site design, showing a boardwalk, a garden and a playground at the site

Phase 2 (Reunion Event) was planned to provide opportunities for students to reflect personally and communicate with one another about the project, and to provide the researchers with impressions of how participating in the workshop affected their understanding of natural systems in the urban context of Singapore. There were four main components:

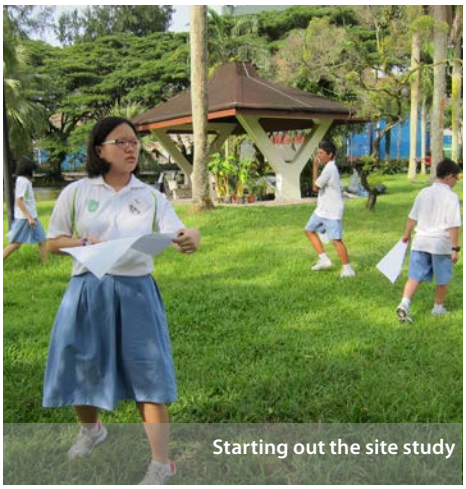
1) Participants and other members of the Green Club were shown a slide show of the three workshops prepared by the researchers, to refresh the memories of the participants and share the experience with the others.

2) Participants were invited to express their thoughts about the project using these means: a short survey, writing and drawing in response to written prompts, writing down ideas for future workshops at the site on a future ideas board, and informal interviews with researchers. Snacks were provided to facilitate social bonding and sharing, whilst all the students were encouraged to walk around the site to explore.

3) Participants were guided to reach a collective decision as to where each of the wetland modules should be located in the pond. The researchers then went into the pond to move the modules to these locations, while the participants stood on the bank and directed the researchers based on their advantage of perspective.

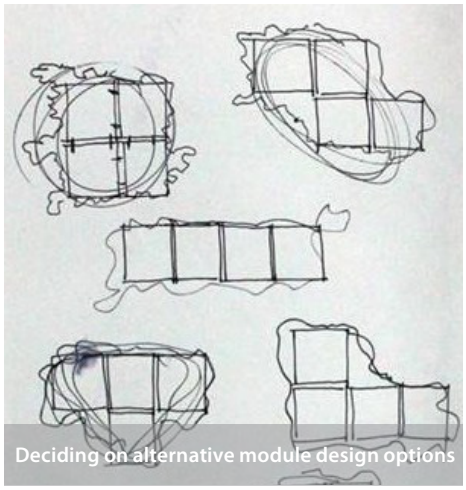
4) Participants were encouraged to bring their families and friends to visit the site, and to contribute ideas for future involvement at the site to their teacher-in-charge, as well as directly to the park manager.


Completing the survey


Starting out the site study


Discussing how the broad context relates to the site in terms of human and natural systems


Constructing the wetland module base


Deciding on alternative module design options


Planting the wetlands


Launching the wetlands

Participants watching a slide show of the workshop activities

Megan and Jing Han discussing ideas for future workshops at the site

James interviewing Darryl

James and Tracy pulling the wetlands to their anchoring positions, guided by the participants

WARM-UP QUESTIONS (pick 1):
What was your favorite part of the workshop? OR What do you think about this project?

PURPOSE: Searching for meaningfulness of this project.

- ➔ You're in the Green Club … and you've done environmental community service projects before. What did this one teach you? < LISTEN > Was there anything about the project that made you understand something better than you had before? What? <LISTEN> What do you think about the work you did? <LISTEN>
- ➔ What part of the workshop had the most meaning for you? <LISTEN> Tell why. <LISTEN> What part did you learn the most from? <LISTEN>
- ➔ How have you been more observant about natural or human systems around you since this activity? <OR> What other natural systems have you noticed since this activity? Have you noticed how humans interact with these systems?
- ➔ Anything else you'd like to tell us about?

Guiding questions used for one-on-one interviews during Phase 2 (Reunion Event)

b. Data collection and analysis

During both Phase 1 and Phase 2 of the project, qualitative data were collected in the form of observations, field notes, a survey, drawings and written responses from the participants, photographs and videos. A significant portion of the data came from voice-recorded one-on-one interviews with the participants during the reunion event (Phase 2), which were conducted in a semi-structured fashion using questions aimed at evaluating how meaningful participants found their involvement in the project to be. The transcribed interviews, together with the other forms of data, were analysed for recurring patterns or themes in an iterative manner.

3 Findings

a) Survey

The survey revealed general patterns of relationships which participants had with natural systems in their daily lives, as well as their knowledge of several environmental issues concerning human interactions with natural systems. It should be noted that participants were all members of the school Green Club, so their responses may not be representative of those of the larger population. These are summarised in the paragraphs below.

- Interactions with natural systems

  Most participants stayed in high-rise apartments, and spent more time outdoors commuting than playing or working. During their commutes, they were more aware of plants, trees, wildlife and people whilst walking or cycling compared to when they used vehicular transport. At home, most participants had direct access to a community open space, a playground, and a community garden. Few had access to a private balcony or a private garden.

- Attitudes towards natural systems

  Most participants listed East Coast Park as their favourite outdoor place in Singapore. Parks, followed by playgrounds, were the favourite outdoor places in their neighbourhoods (Fig 1). Cycling, jogging, football and organised camps were the most popular outdoor activities, in descending order. Most participants preferred to spend a free afternoon at indoor places, such as in shopping malls, going to the movies or staying at home. Among natural landscapes, there was an overall preference for natural forested areas, followed by beaches and urban parks or rivers.

Q8. What is your favorite outdoor place in Singapore? Why or what do you like about it ?

Response	Count	%	
East Coast Park	7	47%	Why? Many outdoor activities can be done; Family enjoys time there; Cycling [2]; Hangout with friends; beach; Clean open space, cycling track, big trees
West Coast Park	2	13%	Why? It's playgrounds. scenery and McDonald's; Adventure Playgrounds
Sungei Buloh Wetland Reserve	2	13%	Why? Bird watching
Singapore Zoo	2	13%	Why? Diversity of Plants/ Animals; So many cute animals
Pandan Reservoir	1	7%	Why? Scenery, Calming effect
Chinese Garden	1	7%	Why? Wildlife, plants, air quality;
Total Respondents	15		

Q9. What is your favorite outdoor place in your neighborhood? why or what do you like about it?

Response	Count	%	
Nearby Park	4	25%	Why? Playground & exercise facilities; scenery; Kite flying and running; Bird watching
Playground	3	19%	Why? Play [2]; Meet friends and play games
Shopping Mall	2	13%	Why? Many things that I need can be bought. and my family and I can spend qaulity time there; Friends and dining
Community Centre	2	13%	Why? I love swimming; badminton and friends

Fig 1. Extract from results of open-ended survey questions which asked participants about their favourite outdoor places in Singapore and in their neighbourhood.

- Knowledge of environmental issues

Out of six topics tested, participants rated themselves least aware of algal blooms in urban ponds, followed by habitat fragmentation and invasive exotic plants. When asked to rate the effects of six human behaviours on the environment on a scale of helpful to harmful (Fig 2), participants appeared to be the most knowledgeable about the environmental benefits of not releasing unwanted pets into the wild, planting native plants, and not feeding the wildlife at a park. They were less aware of the potential environmental impacts of fertilising lawns, planting exotic plants, and feeding the fish at an urban pond.

Q14. How would you rate the impact of the following human behaviors (from helpful to harmful) on the ecosystem?

Rating Scale: 5=Very helpful to ecosystem 4=Somewhat helpful to ecosystem 3=Has no impact to ecosystem 2=Somewhat harmful to ecosystem 1=Very harmful to ecosystem

	Feeding the fish at an urban pond		Fertilizing Lawns		Planting Exotic Plants		Releasing Unwanted Pets into the Wild		Feeding Wildlife at a Park		Planting Native Plants	
Response	Count	%	count	%	count	%	count	%	count	%	count	%
5	1	6%		0%	1	6%	1	6%		0%	8	50%
4	5	31%	8	50%	8	50%	1	6%	2	13%	7	44%
3	1	6%	3	19%	3	19%		0%	1	6%		0%
2	8	50%	4	25%	3	19%	5	31%	6	38%		0%
1	1	6%	1	6%	1	6%	9	56%	7	44%	1	6%
Total Respondents	16		16		16		16		16		16	

Fig 2. Results of survey questions which asked participants about how they understood the effects which specific human behaviours in urban green spaces affected the ecosystem.

b. Learning outcomes

One key objective of the workshop was to impart to participants a general awareness of natural systems in the urban context. In general, based on the interviews, the participants indicated that they felt more aware of their surroundings. However, each individual perceived this in a slightly different way. For example, Ethan expressed it as the understanding that park systems need to be managed sensitively, in terms of sharing with others that animals should not be released indiscriminately. Kai Siang generally felt more knowledgeable about the surroundings, whereas Safiqah shared that she gained a specific awareness that the plants in parks and along roadsides are actively managed, rather than just left to grow.

These responses were corroborated by the participants' responses to the same survey questions before and after the workshop, which revealed that they generally viewed themselves as more knowledgeable after the workshop regarding human and natural systems and environmental issues specific to Singapore (Fig 3).

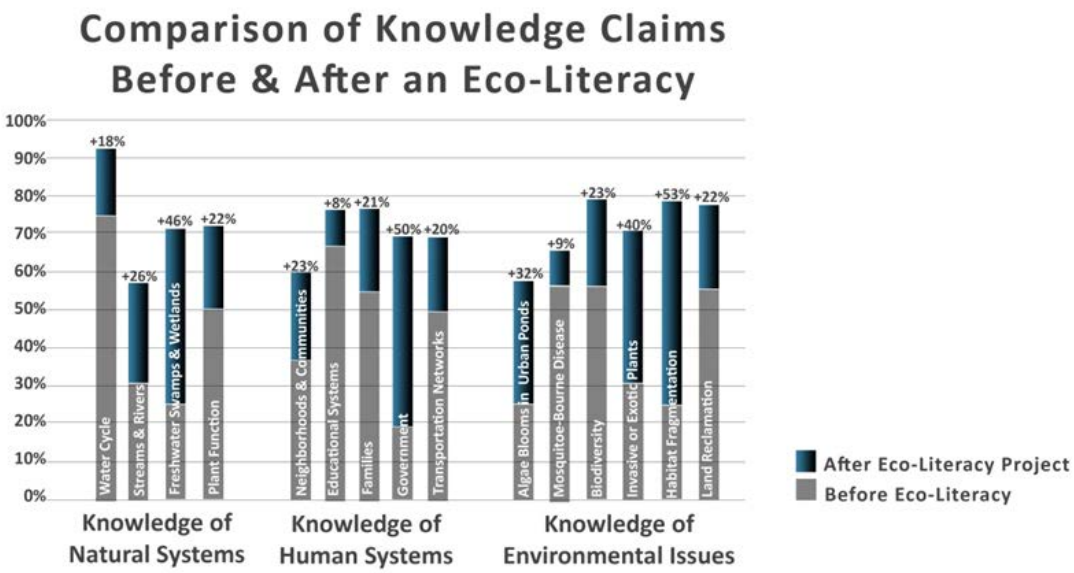


Fig 3. Comparison of participants' answers to survey questions which asked them about their self-perceived level of awareness of natural systems, human systems and local environmental issues before and after the workshop.

Percentages show the proportion of respondents who rated themselves as very knowledgeable or knowledgeable about each topic on a five point scale. Plus signs indicate perceived knowledge gain after the workshop

c. Programming

Out of the six key features of the model of embodied learning applied in this project, three were identified as being particularly significant for the participants: ownership, real-world significance and long term commitment. Participants also emphasised that they found working in an outdoor environment an enjoyable change from classroom activities.

- Ownership

The provision of opportunities for students to feel ownership of the project was observed to be a key component of the learning process. Several aspects of the programme are hypothesised to have contributed to the students feeling a sense of ownership over the project:

- **Decision-making.** Giving participants a real voice regarding the form of the project outcome was a critical aspect of providing them ownership. Whilst it was not feasible to open all aspects of the project to group consensus, time was set aside specifically to glean ideas from the participants directly in terms of deciding on the modular design of the wetlands, as well as the final decision on where the wetlands should be placed. Participants contributed particularly actively during these sections when they sensed that their decisions really did affect the project outcomes.

- **The hands-on experience.** The act of physically building the wetland through base construction and wetland planting was clearly something which the participants found challenging and meaningful. The opportunity to invest physical labour into the construction of an entity, whilst time-intensive, afforded each individual a personal stake in its completion.

- **Small group size.** Participants worked on the project in a small group (maximum size of six), which meant that each person needed to play an essential role in creating the wetlands. There was no redundancy in manpower which would have resulted in the less proactive students taking a back seat and not being involved.

- **Learning niches.** Individual participants were observed to excel in different types of tasks. For example, Swen Yi, who expressed a sense of accomplishment with drawing up the site survey, said that he found the base construction difficult. Jing Han, who appeared less engaged in the base construction, clearly excelled at the modular design. In contrast, Kai Jun clearly found the base construction very interesting, but the wetland planting less so. Nevertheless, through the interviews, it did seem that as long as a student was able to engage fully in a single part of the workshop, that brought him or her sufficient satisfaction to take ownership of the project. Thus, where possible, building in different types of activities within the workshop to allow participants to express their different strengths and abilities could contribute positively to ownership.

In the context of this study, ownership was not viewed as a target outcome per se. Rather, it was through the giving and taking of ownership that students developed personal interest in the activity, and in this process, the work became personally meaningful to them. One episode in particular illustrates this point well. During the modular design component of the first workshop, participants were shown an array of design options prepared prior to the event by the researchers. Initial discussion produced an apparent consensus on the form of a square. Subsequently, participants were asked individually what their preferences were. One student, Jing Han, seemed hesitant to go along with the estab-

"[My favourite part of the workshop was] when we were planting the plants into the floating wetlands, because then I can choose where to put this one and that is in fact more interesting. If I want to put this one here or there and in fact you can design your own floating wetland"

— Megan

"I enjoyed planning how the wetlands would be placed in the pond. I was able to think creatively and freely and design as I wished."

— Ethan

"Seeing the floating wetlands being successfully created showed us that our efforts finally paid off after the exhausting construction of the floating wetlands."

— Jing Han

"Most other projects are not hands-on, and if they are it's like massive groups. So this is different, it's much smaller also. Everybody actually gets to do something."

— Nicholas Ian

"I like the planning of the wetland design and the launching of the created wetland. The planning was easier for me as I am quite creative"

— Swen Yi

"I think the construction of the base is quite fun. It's quite a puzzle by trying to find all the right sides to match each other"

— Kai Jun

lished consensus. When prompted to share her idea, she opted to draw the outline of a new shape (an open square), which had not been considered by the researchers, before explaining: "this allows the plants to spread out more evenly in all directions". The entire group responded with enthusiasm, and further discussion quickly ensued. Ethan offered a suggestion for placing a wildlife perch in the midst of the design, and Jia Hui wanted the group to stop and think about how the new design would hold together. The consensus almost immediately shifted to the new design created by Jing Han, and no further thought was given to the square suggested earlier.

During each workshop, this pattern was repeated many times. The theme which emerged from this observation was the value of ownership during the participatory process and how ownership taken, whether through decision making, or the physical making of the project, repeatedly generated more interest among either that individual, another individual or the group. As interest increased, the intervals at which new ownership was taken became more frequent, thus leading to a very meaningful experience as the participants engaged their minds and bodies within a real-world context. The pattern of this phenomenon was graphed (Fig 4) by observations made of video recordings of one event, noting on a timeline where each opportunity for ownership was taken, and the resulting increase in interest. Strictly speaking, there are a multitude of human expressions, both verbal and non-verbal which could be considered indicators of heightened interest. For the sake of simplicity, the only indicators graphed are comments, questions or contributions by participants and overall enthusiasm of the group as a whole. The graph is a conceptual representation of these observations. The noteworthy point is that the occurrences of this phenomenon began happening at closer intervals. Increased ownership led to increased interest which then led to a more meaningful experience.

"We're not just doing it for the sake of doing it. This project was different. It was like doing something more-- like this floating wetland will really impact this place."

— Samuel

"It's really quite fun la, because we get to like put it in a real pond (gestures with wide open arms to the pond in front), instead of just like in the school".

— Safiqa

"This is different. This is interesting. It has the opportunity to keep going.. Now that we have done this, we can show younger students how to build floating wetlands at other places."

— Ethan

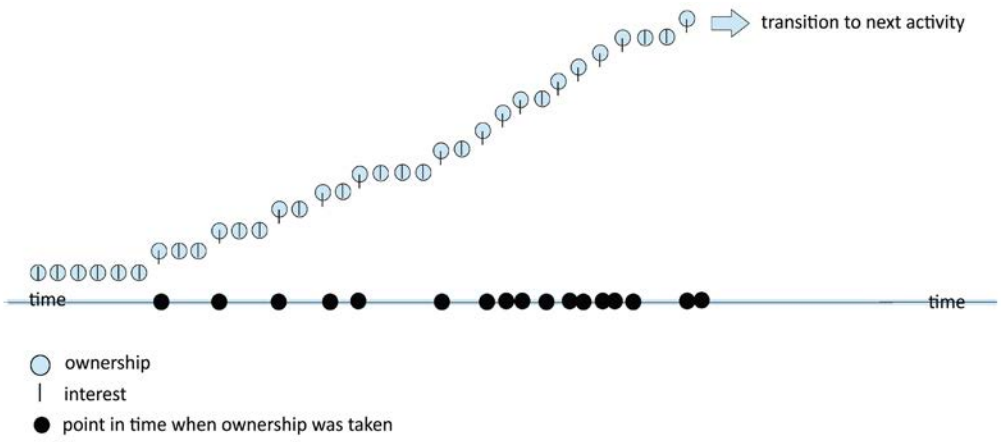


Fig 4. Graphed observations of the phenomenon of increased ownership leading to increased interest leading to increased meaningfulness.

- Real-world significance

  Participants appreciated that the floating wetlands they constructed were being placed in a real pond, with the potential to directly benefit society and the environment. They found it personally satisfying that what they had done was not a simulation, but directly benefited the wider community and wildlife.

- Long-term commitment

  The participants were chosen such that the physical proximity of their established social network (the school) would make it convenient for the group to sustain a long-term interest in the site. During the workshop and the reunion events, the participants did express an interest to continue working at the site. This could help to ensure that the engagement

with natural systems begun at this site does not stop with the project, but continues and develops as the participants build on their newly acquired skills and knowledge.

"I think it's quite different..get more close to nature"

— Chen Hui

- Outdoor location

"I really liked this project because it is more nearer to nature than others"

— Jing Han

During interviews, participants consistently indicated that they enjoyed learning in an environment which was outdoors and 'close to nature'. Both researchers noted that the part of the workshop when students appeared to be the most engaged and interested was when they were each asked to share their observations from the site study with the group. The teacher-in-charge of the Green Club, Mrs. Annie Lim, commented: 'this is how learning should be- outdoors and with such stations for exploring'.

Tracy exaplaining the original design options

Participants initially agreeing on a square design

Jing Han drawing out the open square design

Ethan suggesting that the wildlife perch could be placed in the centre of the new design

The group voting unanimously for Jing Han's new design

4 Discussion

The purpose of this study was to explore how a hands-on eco-literacy project could affect participant awareness of natural systems within the urban context of Singapore. There were two components to this question: firstly, to assess if indeed participant awareness was affected in some way, and secondly, if it was, to observe which aspects of the project could have contributed to this.

Based on the interviews, survey results and informal dialogue, it did appear that most participants gained some form of awareness. The form of this awareness varies for each individual (section 3b). This diversity in self-reported learning outcomes could be attributed to the deliberately open-ended and learner-centred teaching style employed in the workshop. This was desirable

in the sense that the lessons internalised by the participants were likely to have been more personally meaningful to them, and therefore more impactful. Preliminary evidence as presented in section 3c does suggest that the aim of making the workshop personally meaningful to participants was largely achieved.

Four aspects of the programme in particular are thought to have contributed to personal meaningfulness for the participants: (i) Ownership, (ii) Real-world significance, (iii) Opportunity for long-term commitment, and (iv) Outdoor location. Of these, ownership is hypothesised to have played a dominant role in generating meaningfulness for the participants, and the particular aspects of the programme which could have enabled participants to take ownership are suggested to be the ability of participants to make real decisions affecting the project outcomes, the hands-on experience, the small group size, and the provision of multiple niches for learning.

The general approach exemplified as part of this study was to engage a local community in a series of projects which directly address the specific environmental needs of that community, through long-term engagement of the same social group at the same site. To develop this model further, future possibilities for building on the learning experience of the group at this site at West Coast Park pond were identified (Fig 5), based on knowledge gaps identified, ideas contributed by the participants for future involvement, and practical constraints. Discussions are presently ongoing to assess how the learning community brought together for this project could build on their involvement at the site to further strengthen their learning outcomes.

Concept	Knowledge gap	Participant idea	Potential real application
Pond water quality	• Algal blooms • Fertiliser use	• Rain gardens	• Study effect of floating wetlands on water quality • Study possible pollutant sources
Biodiversity	• Native vs. exotic species • Wildlife attraction vs. introduction • Habitat fragmentation	• Plant more native plants • Construct a wildlife perch • Plant more bushes around the pond for wildlife refuge	• Bird, fish, dragonfly surveys • Construct wildlife perch • Riparian plantings
Human-nature interacton		• Build a bridge across the pond for people to have closer access to the water	• Design signages telling about the community involvement at the pond • Design signages advising the public how to interact with the pond in environmentally friendly ways

Fig 5. Table schematic of how ideas to maintain participant involvement at the same site were generated, through an identification of knowledge gaps, participant-generated ideas, and real potential applications.

One caveat to the overall approach to environmental education adopted in this study was that the responses to re-survey questions which assessed changes in their awareness of the impacts of specific human activities on natural systems, whilst not strictly conclusive, suggested that a greater emphasis on imparting a knowledge background detailed enough to inform personal action in specific contexts could have been helpful. For example, one function of the floating wetlands which participants were exposed to during the workshop was their value as wildlife habitat. Whilst it appeared that participants understood the motivation of enhancing wildlife in the pond, it was not clear that they perceived the differences between 'wildlife attraction', 'wildlife release' and 'wildlife feeding'; the latter two generally being detrimental to the pond ecosystem. It thus seems important to directly address specific aspects of human-environment relationships to ensure accurate understanding.

One of the themes which emerged from this exploratory study was that of personal meaningfulness. Personal meaningfulness is hypothesized to be a key element of the environmental education programmes- numerous other studies have suggested that environmentally responsible behaviours are essentially motivated by emotional connections with nature, whether established through positive childhood experiences, family role models, or attachment to place (Chawla 2006, Scannell and Gifford 2010). The observations documented in this study corroborate several programming principles through which environmental educators may be able to design and implement programmes which are personally meaningful for participants, foremost of which is an emphasis on creating opportunities for participants to express ownership of the programme outcomes.

In summary, this study analysed qualitatively some aspects of a hands-on eco-literacy approach to environmental education which seemed to work well in the local context of Singapore. Besides potentially optimising learning outcomes for the individuals from an educational perspective, this approach could contribute much in terms of direct environmental benefits for urban green space management in general, and would also foster greater rootedness and attachment to place amongst the participating community. Future work with the same group at the same site could further validate the preliminary findings presented here.

Further reading:

For readers interested in exploring the theoretical context of the learning approach described in this study in greater detail, several related concepts in education theory include experiential education, service learning, free-choice learning, place-based education and social learning. More specifically, when applied in the service of natural resource management in urban areas, the approach used in this study is closely aligned with the concepts of 'ecological place-based learning' (Gruenewald, 2003), 'tactile space' (Carolan, 2007) and 'civic ecology' (Krasny and Tidball, 2009).

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