Expanding and Enhancing the East London Waterworks Park Learning Circle

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Abstract

The East London Waterworks Park (ELWP) is a community-driven organisation focused on the redevelopment of an ex-Thames water depot into a community accessible green space. The Learning Circle is one part of this larger organisation and focuses on creating learning experiences throughout the park. Our project was designed to help the ELWP Learning Circle expand their outreach to schools through sets of educational materials that can be used in conjunction with a sitewalk of the ELWP's land. After collecting data through interviews, document review, field observations, and examining existing forest school activities, we identified key aspects of environmental education. We found that it is important to emphasise appreciating nature and to consider modifications for increasing accessibility. We also found that it is important to create hands-on activities, incorporate a dialogic learning style, and maximise group learning. Our findings then influenced the creation and revision of our educational materials intended for Key Stage 1 students. Through these deliverables, our project will help the ELWP expand their work by giving students hands-on opportunities to explore and appreciate the natural world around them.

The ELWP team: Daniel Boutin, Sarah Kogan, Elion Sholla, and Serena Tura

Introduction

The East London Waterworks Park (ELWP) is a community-led initiative in the Hackney neighbourhood of London to transform a brownfield site into a vibrant, publicly accessible greenspace. This park will feature arts and science project areas, swimming ponds, and wildflower meadows. Set to be complete by 2029, the park will be a space for community connection and environmental education.

The governance of the ELWP is structured into six circles, each focused on different aspects of the park. Our project extended the work of the Learning Circle, which focuses on designing learning experiences in line with community and conservation principles.

The main goal of the project was to develop a set of educational materials to facilitate collaboration between the ELWP and schools in the Hackney and Waltham Forest area. By working closely with members of the Learning Circle, we developed a finalized set of educational materials, structured in accordance with the National Curriculum, which were designed to integrate smoothly into the existing course curricula. We covered a variety of skills through these plans, including literacy, science, social skills, and environmental awareness, exposing students to the wide variety of benefits that come from forest learning.

To achieve our project goal, we conducted a series of interviews with educators and members of the Learning Circle. The interview questions were developed through existing research into effective interviewing methods, and were refined continuously to align our objectives. To develop our lesson plans, we conducted site walks with our sponsor and observed workshops with ecoACTIVE. We also examined data from the UK National Curriculum and existing forest schools, including Suntrap, Learning Through Landscapes, and Park Primary School, which provided valuable insights about our program design. Through our project deliverables, we aim to bring a unique and engaging educational experience for Key Stage One students (aged 5 to 7), providing them with the chance to explore and learn in nature.

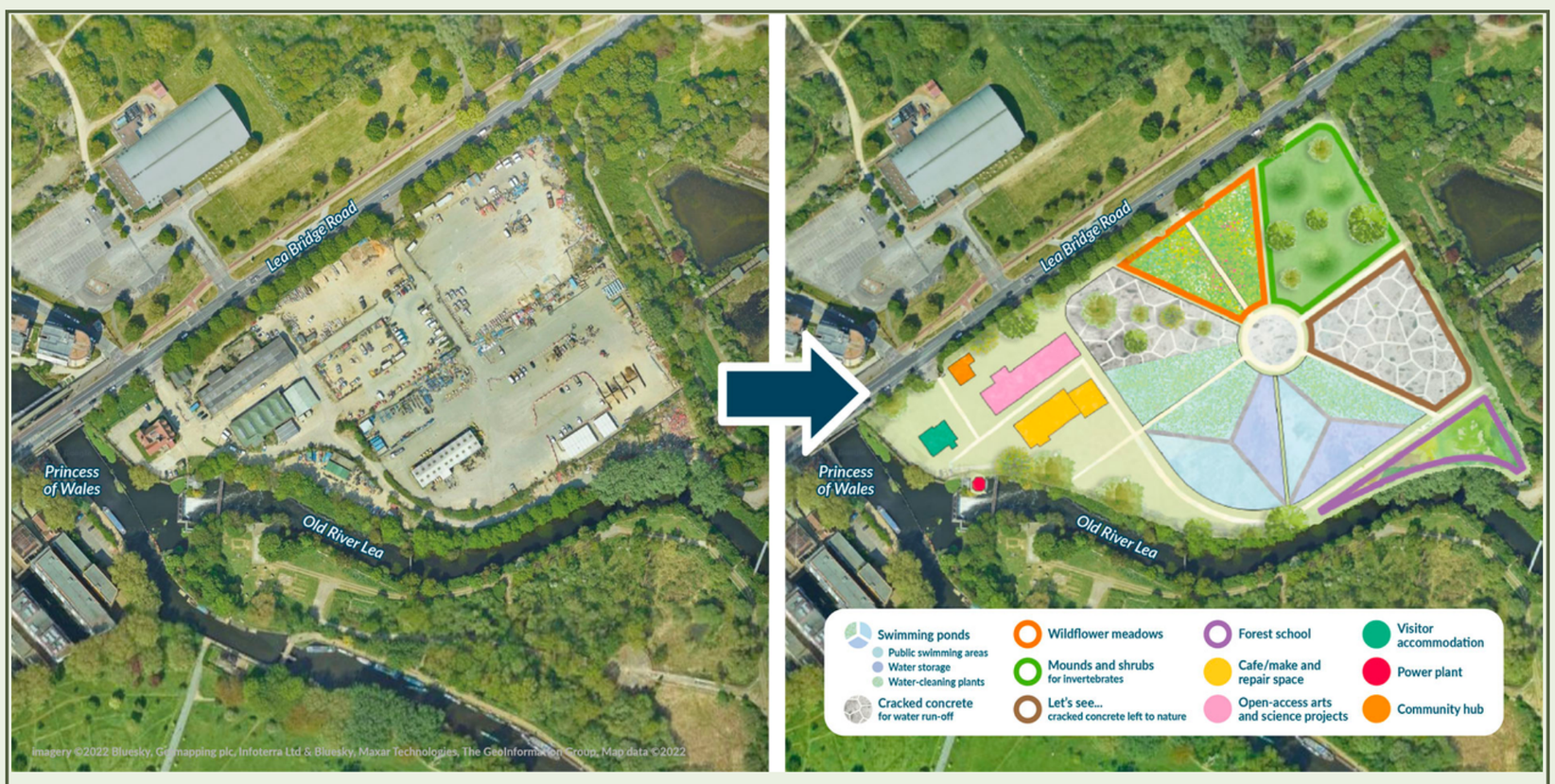

Fig 1. Proposed renovations to the East London Waterworks Park brownfield site

Background

Brownfield Land in the United Kingdom

The US Environmental Protection Agency defines a brownfield as "a property, the expansion, redevelopment, or reuse of which may be complicated by the presence or potential presence of a hazardous substance, pollutant, or contaminant." In the UK, the terms "brownfield land" and "previously developed land" are synonymous, with some examples of these sites including previous manufacturing sites, old gas stations, and otherwise abandoned lots [1]. These types of spaces tend to have a negative public perception and are seen as eyesores to the people who reside near them [2]. Brownfield sites are commonly found in urban areas or in places that were once industrial hubs, and the sites are abandoned because it is easier for people to find new land to develop rather than try to clean up the previously used land.

Fig 2. Map of the brownfields surrounding the park

Recently in the United Kingdom, there has been a push to redevelop brownfields instead of disturbing untouched lands further from urban centers. While there are drawbacks to redeveloping these potentially contaminated sites, the positive social and economical benefits seem to outweigh the negatives. Drawbacks to brownfield redevelopment are limited, with the majority of concerns being the health risks to workers from site decontamination and potential harm to the biodiversity of the area as brownfield sites can be home to sophisticated ecosystems [2]. Some community benefits from brownfield redevelopment include reduced health risks to the community because sites are decontaminated, reduced development pressure on current greenfields, better public perception of the site, and increased property values near the redeveloped site [3]. Brownfield redevelopment looks different at each particular site as the known contaminants and pre-existing infrastructure play a role in determining what the redeveloped land can be used for. With recent social emphasis on the importance of interacting with nature, many cities are opting for brownfields to be redeveloped into greenspaces.

Fig 3. Diagram of wildlife in a section of the park

Background

Importance of Green Spaces in Urban Areas

Greenspaces are an important part of urban living because they provide an accessible space for all to connect with nature, which has both physical and mental health benefits. Physical health benefits associated with greenspaces can be directly linked to the increased exercise that people engage in when they have access to greenspace, but some health benefits such as increased vitamin D absorption and decreased blood pressure arise from just visiting a greenspace and interacting with nature [4]. Mental health benefits tend to arise from the existence of a space for community interaction which can help foster a sense of belonging. Greenspaces that are in residential areas have also been proven to be associated with lower levels of burnout and depression and an increase in overall life satisfaction [5]. There are clear physical and mental health benefits to having greenspaces in urban environments which furthers the importance of redeveloping brownfields located in urban environments into greenspaces.

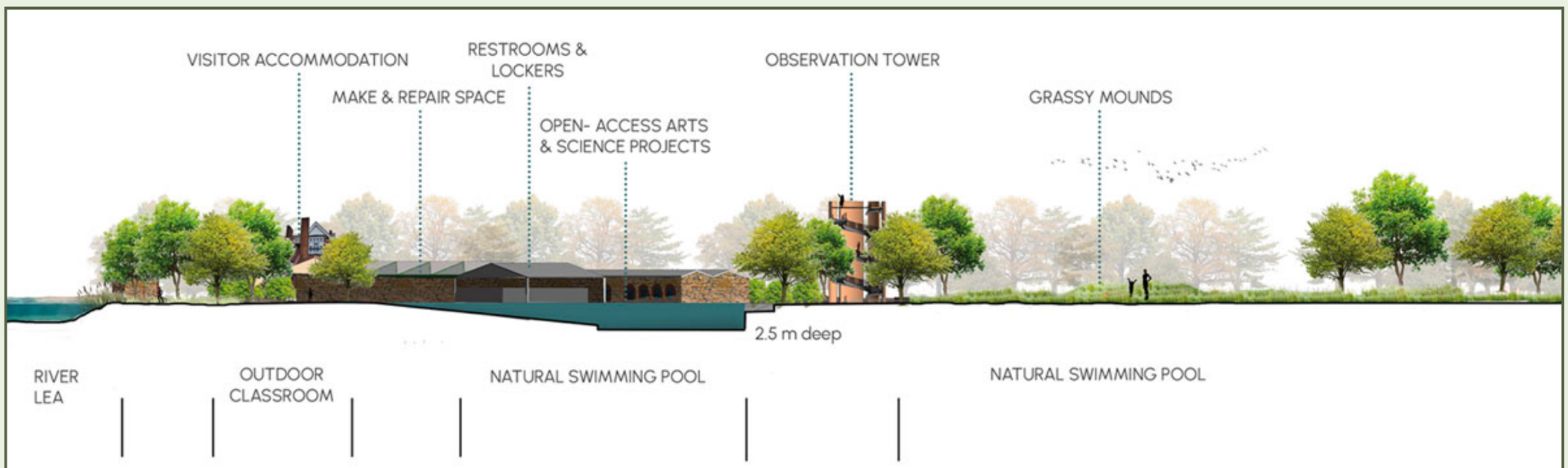

Fig 4. Layout of the proposed hydrobotanical system that would be used for natural swimming pools

Education About, For, and In the Environment

As part of the Learning Circle, our main focus was to develop a lesson plan that the East London Waterworks Park could use to educate local students on a wide range of topics from the National Curriculum, primarily in the departments of science and the environment. The educational aspect of this program contained two folds, each benefiting students in distinct ways. The first "fold" for these materials was to provide a comprehensive lesson plan which consists of interactive activities that will be completed inside the classroom as well as on the ELWP site. These activities will align with the National Curriculum, specifically its topic requirements for Key Stage 1 (Years 1 and 2). Several activities were prepared on different sections of the National Curriculum to provide educators with flexibility on which lesson should be taught at a given time. The focus of these activities was to provide students with a hands-on opportunity to connect with the facilities of ELWP. Each one has an emphasis on exploration and independent discovery, giving space for students' self-discovery and exploration of their environment. In our research on successful educational principles, one point that was consistent across sources was the relevance of the "locus-of-control", referring to a student's belief that

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they have the ability to directly impact the health of their local and global environment with their actions. Students with a high locus-of-control were more receptive to new information regarding environmental issues as well as other positive benefits [6]. In providing students with as much freedom as possible to explore their environment, our educational materials aimed to reap some of these benefits.

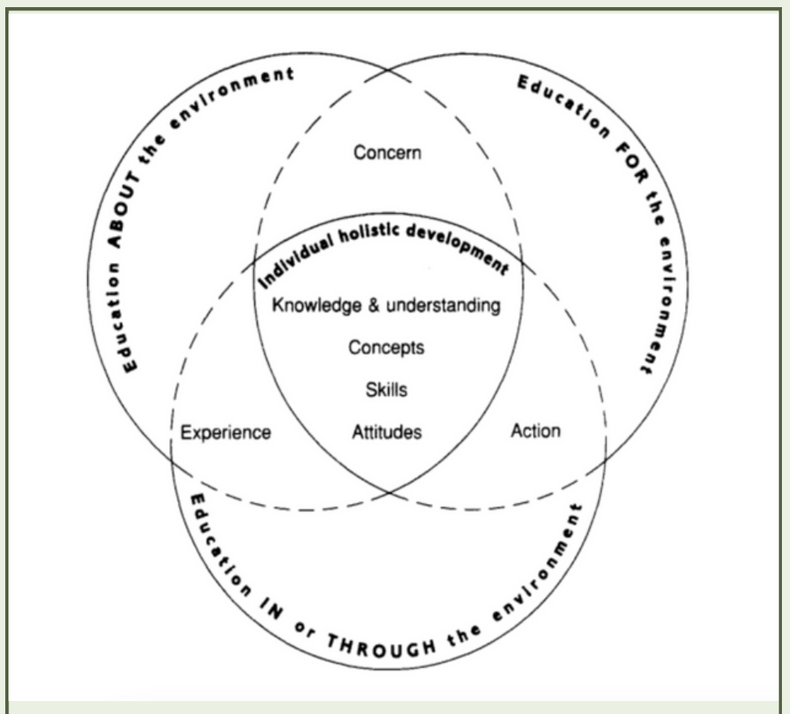

Fig 5. Interactions between types of environmental education

The second "fold" of this idea is to provide students a natural environment to learn in, which can improve their learning capabilities in a number of different ways over a traditional environment. Several studies conducted on various populations around the world found a correlation between the presence and accessibility of greenspaces and improved results when tested for working memory, attentiveness, and spatial working memory [7]. Additionally, one study found that a connectedness to the natural environment during education can have a strong positive influence on ecological behaviors in children, and deduced that the factor which influences ecological behaviors is more likely the connectedness to nature, rather than the teaching itself [8]. For the above reasons, it is imperative to be intentional with how ELWP gives students first-hand environmental experience, and link it directly to the ecological principles the National Curriculum dictates for primary school education. The following diagram from the National Curriculum inspired the structure and principles of our education materials, with its tripedal pillars of education ABOUT, FOR, and IN the environment serving as a framework for the activities produced for the ELWP educational program.

Taking inspiration from this model, as well as forest schools such as Turn Back Time in Paxton, MA, was important to optimizing the program and ensuring it embodied effective teaching methods. Turn Back Time recognizes the healing and teaching ability of nature and allows children to explore and grow in nature, through the use of workshops and interactive activities such as the student-built playplace, as shown in the figure below.

Fig 6. Student-designed learning and play area at Turn Back Time in Paxton, MA

Background

The outdoor spaces that Turn Back Time were a strong point of interest for the educational materials that were generated for the ELWP. They exemplify a self-paced learning and an emphasis on exploration that served as an inspiration for the aspects of the materials that concerned discovery and exploration. They also inspired our educational materials to allow students to explore and feel nature in a manner that is safe but still permits students a high degree of freedom. Additionally, Turn Back Time's pre-existing success in educating children in a forest school environment lends confidence that our lesson plan will be similarly helpful.

Demographics of East London & Hackney

One of the most impoverished boroughs in London is Hackney, where education has historically been viewed as a concern. As we have seen, this is not typical of the rest of the East London area. Hackney has a significant school enrollment deficit relative to the number of residents [9]. Hackney deals with a number of educational and social challenges—there is a noticeable gap in student enrollment compared to the local population, revealing distinct preferences for certain schools over others. Revealing these issues sets the stage for a comprehensive understanding of the borough's educational state and allows us to further explore Hackney's strength and unique attributes.

Hackney's strength lies in its remarkably rich cultural mix and its housing estate policy, serving as one of the best examples of mixed-income housing estates in the country. The ethnocultural diversity within Hackney is shaped by numerous groups without a strong dominance. This diversity fosters an incredible opportunity for contact between people and groups who, feeling comfortable with their own identities, are then open to engaging with others [10]. In Hackney, the folks stand together, united in solidarity that is not contingent on ethnicity. Hackney is not just a borough, but a community where locals live together with a shared sense of belonging.

Current Park-School Collaborations in London

London schools have shown considerable interest in integrating outdoor learning experiences into their program. Many organizations such as the London Wildlife Trust and Urban Outdoors London already offer hands-on nature lessons that directly link to the UK National Curriculum, with key focuses on observing plants and animals, understanding habitats, exploring the history of the site, and practicing principles of wellbeing in nature [11]. For older students there are programs available that focus on classification of species, explorations of life cycles, and creating maps of the nature reserve.

Fig 7. School session at the London Wildlife Trust

Background

With many previously established organizations that implement successful outdoor learning experiences there is clearly demonstrated interest within London schools to be able to offer outdoor learning experiences to their students.

Teaching Method Optimization

There are several frameworks we considered when developing our activities about the environment, which were pulled from a variety of existing models. The first is backward design, a widely used practice to develop lesson plans. It begins with identifying desired outcomes, ideas, and skills. Then, the lesson planner decides on resources to test this knowledge, typically taking the form of worksheets, practice problems, or labs. Finally, the rest of the lesson plan is filled in with key facts and strategies, which convey a complete knowledge of the given topic [12].

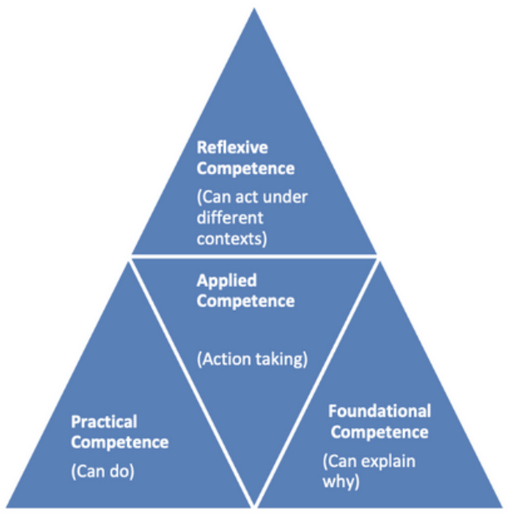

Fig 8. Diagram of competencies for education

We also used several pedagogy models, including the idea of competencies for education. Key findings were gathered, combining practical competence (hands-on action), foundational competence (explaining the why), and reflexive competence (applications in different situations). These allowed us to build toward applied competence, or applying knowledge for different contexts [13]. We also deeply researched forest schools and outdoor learning methods that were already in practice.

Combining these methods, and considering learning styles and accepted UK classroom practices, we determined a structure for our activities. Each activity begins with an in-class presentation and associated activity in the guided learning style, so that students can begin to build a foundation of skills and vocabulary. On-site, students carry out the activity with a worksheet. Each activity is designed to teach a different skillset, and encourage observation of a different part of the natural world. Finally, there are questions to debrief and review the knowledge the students have learned, and their applications in real-life environmental topics [14].

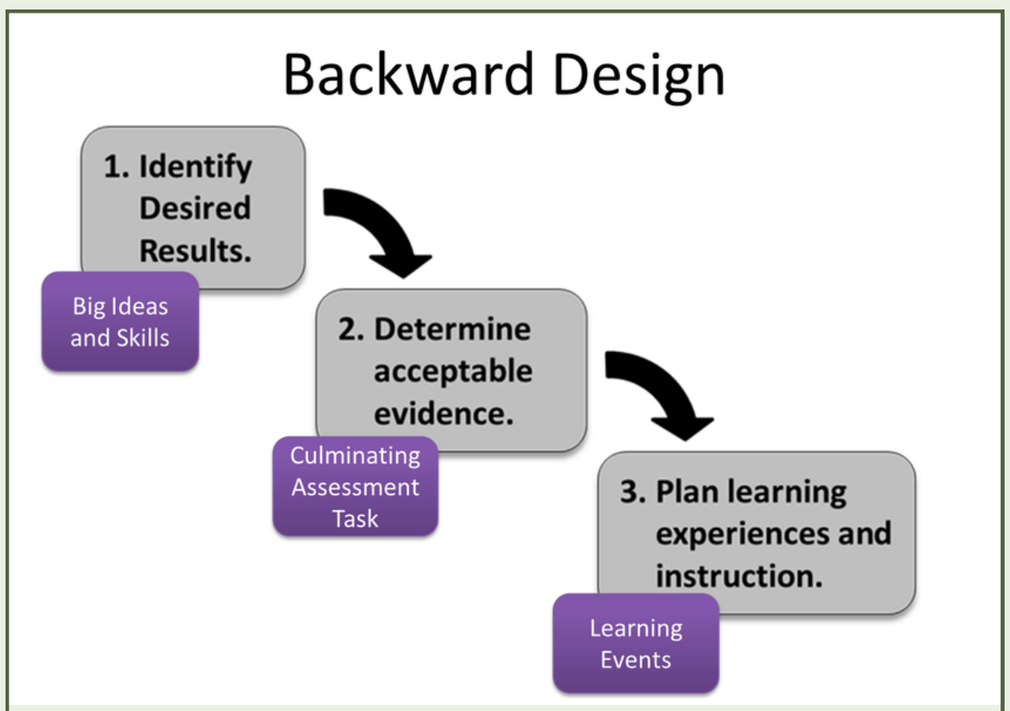

Fig 9. Diagram of backwards design process

A combination of methods allowed for a robust, adaptable curriculum that centers on hands-on learning. This approach makes lessons more memorable and easier to process, and the accompanying worksheets provide a physical reminder of the learning objectives from that lesson. The combination of styles cater to a variety of learners and ensure higher retention.

Methodology

Introduction

The main goal of our project was to facilitate collaboration between the East London Waterworks Park (ELWP) and schools in the Hackney and Waltham Forest area by creating educational materials for outdoor learning experiences in line with community and conservation principles.

The research questions guiding the project are as follows:

> How can the East London Waterworks Park collaborate with schools to drive environmental appreciation and bring awareness to their greater mission?

> What types of educational materials are effective for teaching primary school students?

> What features make a set of nature-based educational materials accessible and easy for Key Stage 1 educators to implement into their classrooms?

From these research questions, we developed a set of project objectives and a research design process to meet these objectives. Figure 10 below illustrates our research process.

OBJECTIVE 1

Understand how nature-based education fits in the National Curriculum

Our first objective was to understand the topics covered in the National Curriculum. Initially we deployed a survey through Qualtrics (questions in Appendix A) with the intention of collecting information from primary school teachers about the topics they teach and the methods they use to teach in their classrooms. These surveys were distributed to existing ELWP contacts, as well as over 60 primary schools in Hackney and Waltham Forest. However, due to low response rates, we shifted our data collection focus to observational methods, including document analysis, qualitative interviews, sitewalks with our sponsor and workshop observation with another environmentally-focused charity.

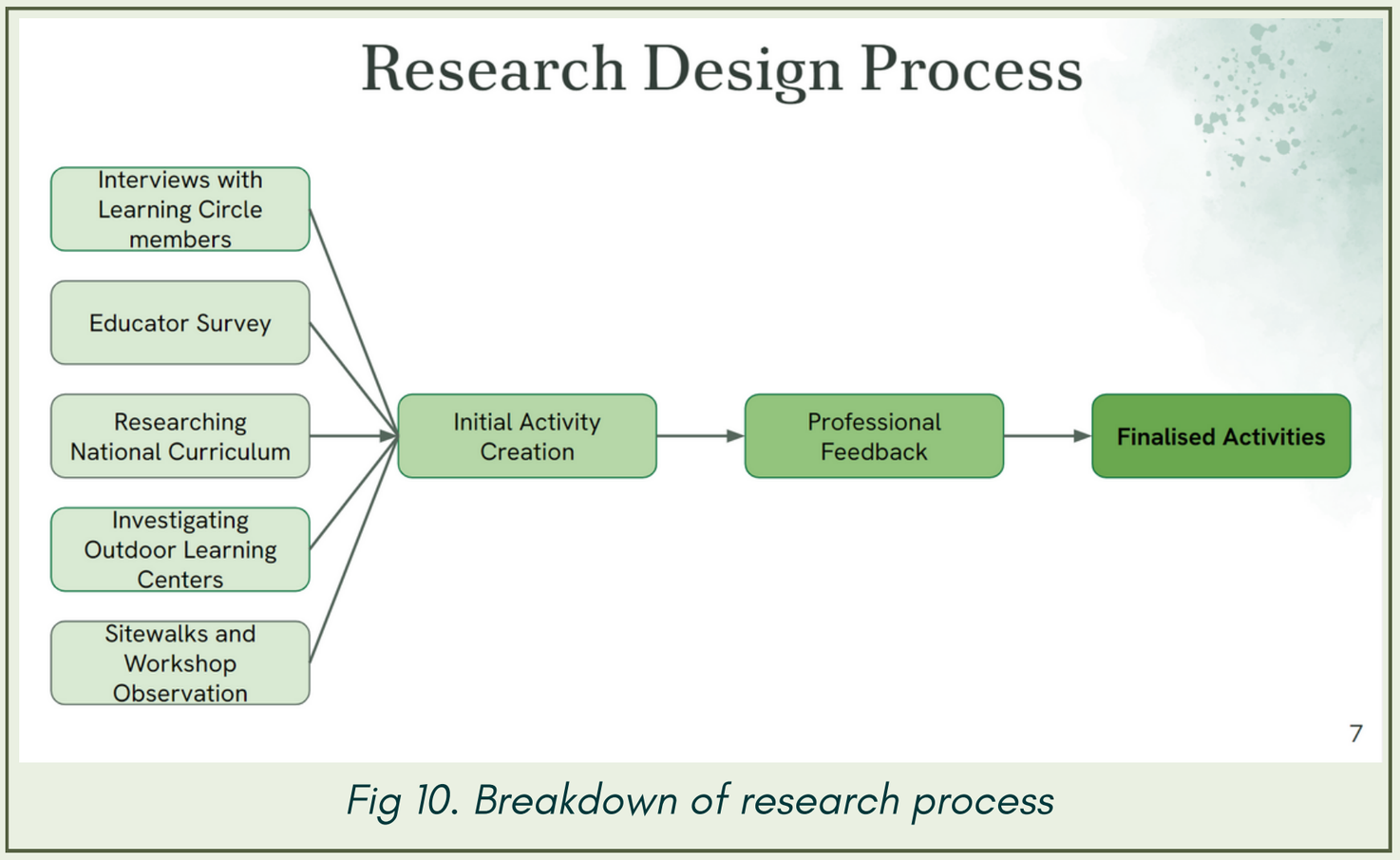

Fig 10. Breakdown of research process

Methodology

We analysed the Key Stages 1 and 2 Framework Document from the UK Department for Education. This document describes the topics that are required to be taught for the following subjects: English, Mathematics, Science, Art and Design, Computing, Design and Technology, Geography, History, Languages, Music, and Physical Education. We read through this document and made a list of any of the requirements for Years 1 and 2 that were relevant to environmental education. Most of these requirements were in the science section, as that is where most environmental education takes place; however, some requirements from the Art and Design and the Design and Technology sections were also relevant to our project.

Fig 11. Environmental workshop at ecoACTIVE

To further our knowledge base on the National Curriculum and nature-based education, we conducted interviews with three Learning Circle Members, including current and former educators. We chose to interview Learning Circle members as many of them have some level of experience teaching in a classroom, and they have a deep understanding of the ELWP mission and goals. These interviews were conducted on Google Meet, and both audio recordings and written transcripts were collected. We made use of conditional questions, where we followed alternative lines of questioning depending on previous answers. Our interview questions can be found in Appendix B. During these interviews, it was stressed to us the importance of educational materials that directly connect to the National Curriculum.

We participated in two sitewalks with a map of the current site of the ELWP and a graphical design envisionment of what the park could look like. These sitewalks allowed us to take pictures of the existing flora and fauna that exist around the site. The National Curriculum emphasises the importance of learning from your local environment, so a familiarity with the types of plants and animals in the park was key. The second sitewalk that we participated in was with a group of local Year 7 and 8 students. Following the sitewalk, we observed their participation in a workshop with ecoACTIVE, an environmental education charity located a 15-minute walk from the ELWP site. The workshop was focused on conservation principles and the '6 Rs': Reduce, Reuse, Recycle, Refuse, Rethink, and Repair. This observation helped us see a clear example of bringing together National Curriculum requirements with hands-on activities that focus on the environment.

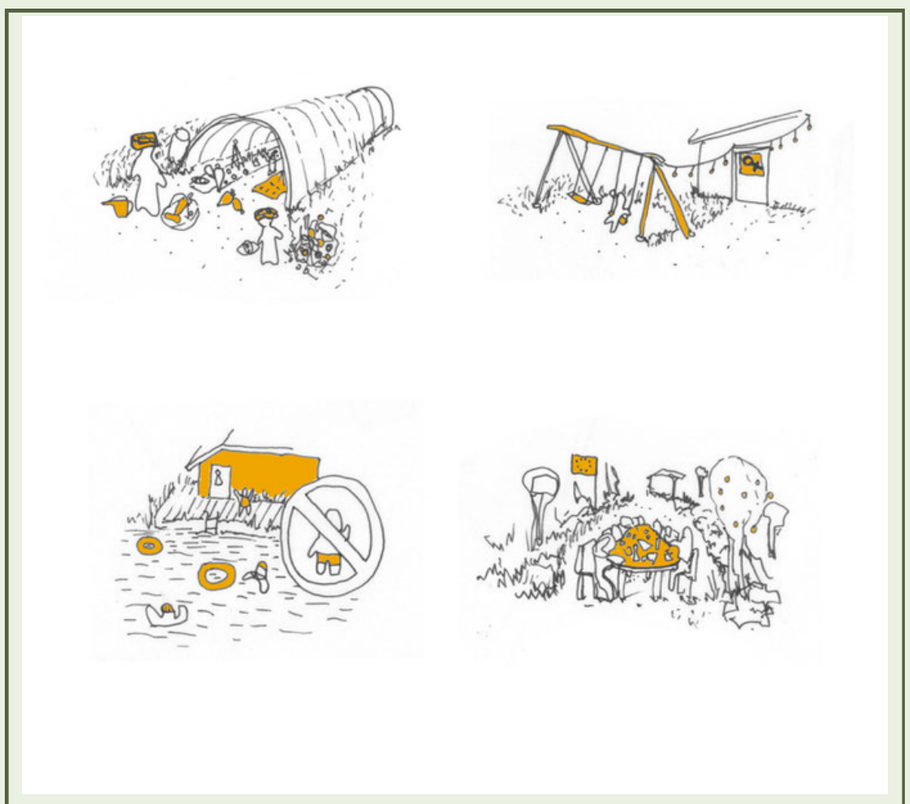

Fig 12. Community focused landscape areas

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The combination of these methods deepened our understanding of the UK national Curriculum and allowed us to effectively align our nature-based educational material with the National Curriculum's requirements and objectives for Key Stage 1 students.

OBJECTIVE 2

Develop nature-based educational materials for experiential outdoor engagement for Key Stage 1 pupils

To meet our second objective, we interviewed three Learning Circle members. In these interviews, we learned about the elements that made an engaging set of materials, as well as the format into which these materials were typically organised. We also added guidelines from the National Curriculum to ensure our materials were in alignment and pulled additional valuable insights from our Learning Circle interviews and from existing forest school activities. This served as the foundation for our structure.

By combining these inputs, we developed a framework for each set of materials. This framework is shown in the figure below:

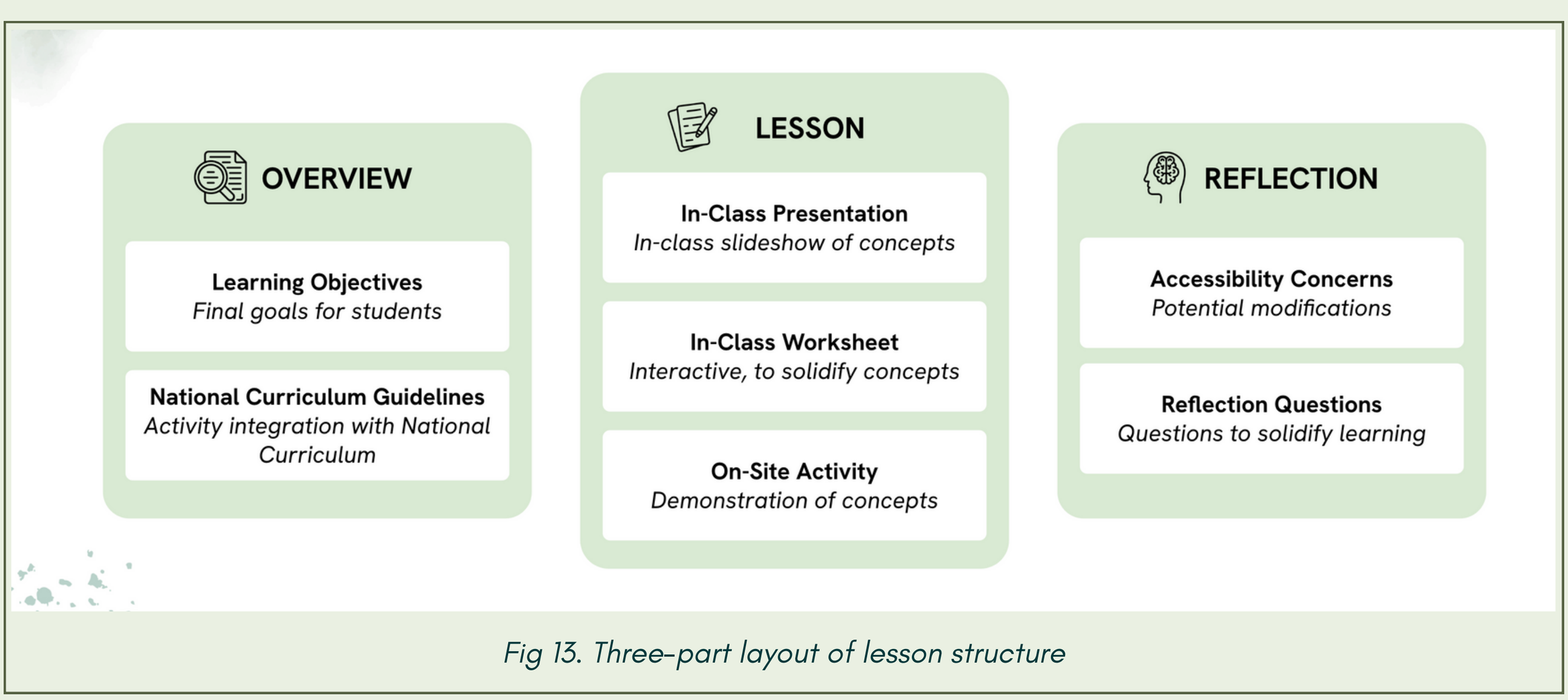

Fig 13. Three-part layout of lesson structure

This became a valuable tool as we built and iterated on our materials. They ensured consistency between activities, so that each could be easily picked up by an educator and integrated into the curriculum. Its modularity also allowed it to be adapted as necessary, updated for accessibility concerns, and expanded for use in other forest schools or outdoor learning programs.

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OBJECTIVE 3

Collect feedback from educational professionals to improve our materials

Fig 14. Sitewalk with Year 7-8 students

Our third objective was to collect feedback from educational professionals to improve our materials. To achieve this, we conducted three in-depth interviews with former and current teachers. These were conducted through Google Meet, and audio and written transcripts were recorded. We began each interview with questions about career path and teaching background. This stage allowed us to introduce ourselves with some preliminary conversation, and established a point of reference from which they would be speaking. With this background, we were able to shift questions slightly, keeping in mind that a program coordinator would offer different feedback from a traditional classroom teacher.

After this, we showed the interviewee one of our draft educational materials, and explained that all the plans followed the same structure. We found that we would gain the most productive feedback from an in-depth review of one plan, and a verbal summary of the others. During the walkthrough of this plan, we asked targeted questions in three parts: lesson content (which subjects were being taught and how), materials (age-appropriateness of worksheets and slideshows), and reflection (accessibility measures and reflection questions). We also asked about feasibility, ease of implementation, and for general feedback. The full list of questions can be found in Appendix C.

The team found common themes among the interviews by undertaking a coding process, marking quotes from the interview in line with our coding legend. The legend included categories for feedback on each element of the materials set — the overview document, the hands-on activity, the associated worksheet, and the presentation — as well as comments on feasibility and implementation.

Throughout both rounds of interviews, we pulled insights which allowed us to develop a list of specific

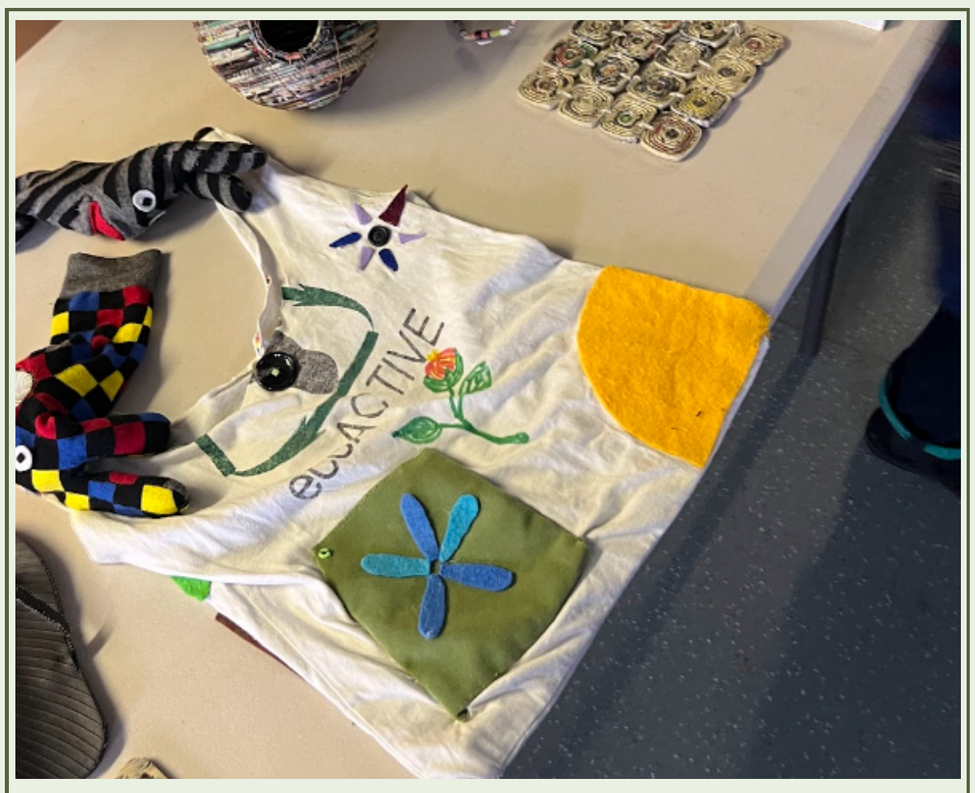

Fig 15. Sustainable materials at a sitewalk with a primary school

Methodology

changes we would make to our educational materials. These were all targeted and clear, and included items such as removing text from slides or increasing the focus on environmental appreciation. Each set of materials was reviewed in depth and necessary edits were made, refining down to the final versions.

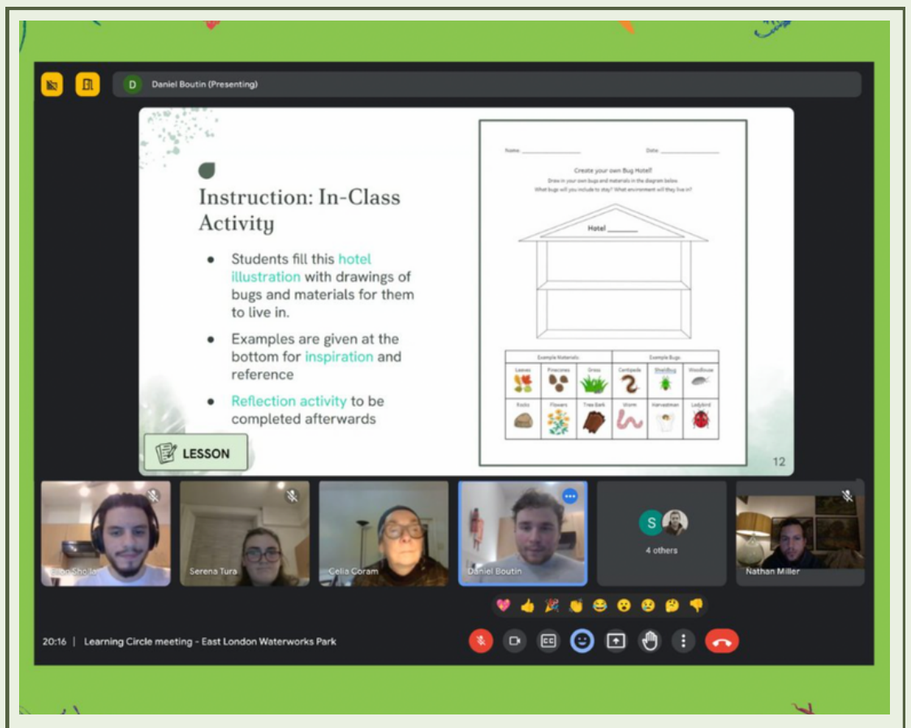

Fig 16. ELWP team presenting deliverables to the ELWP Learning Circle

We were also asked to discuss our findings in the monthly Learning Circle meeting, where we were able to complete a final round of outreach before finalising our materials. We developed a presentation that was structured similarly to the interviews, discussing our framework, deep-diving into one activity, and then briefly describing the other three. We also incorporated checkpoints throughout the presentation, where we asked for feedback about feasibility, structure, and age-appropriateness. We were met with overwhelmingly positive feedback from the group, and found that no major changes were necessary. This solidified the integrity of our ideas, and ensured that our educational materials would readily be put to use in the classroom.

Ethical Considerations

Fig 17. Illustration of open water spaces

Our project underwent the WPI IRB process, with a commitment to safeguarding the data provided and the individuals' privacy. The data collected from human subjects was from interviews and stored in Google Drive folders, where only the four team members, advisors, and sponsor contact had access, and will be deleted after the completion of the project in line with the UK General Data Protection Regulation 2018. We will not be publishing data in a way that individuals' responses could be traced back to them. In the case of interviews, direct quotes were used in the published report, but no direct attribution was used so as to protect their identity. Individual data will be deleted after the publishing of the project.

Results

The team achieved our objectives by conducting a review of the National Curriculum, two site walks through the ELWP, observation of an environmental workshop, and six interviews. Our findings from these data collection methods were analysed and presented below:

Appreciation of the Environment

We found that many students had limited experiences in the environment, and there is a vital need for forest schools and outdoor education programs. This gap was emphasised in an interview with a retired primary school teacher, with the quote on the right. Our goal is to cultivate a feeling of belonging in the environment, and to make sure students have a basic knowledge of the types of creatures they share the world with, especially in their local area.

> *"It is absolutely crucial for them to make those links to the natural world that is close to them, not something that they just see on television or on a screen."*
>
> *- Learning Circle Member*

We also found that the East London Waterworks Park has a role to play in the local community as a space that is local to students in the Hackney and Waltham Forest area. It allows them to acquaint themselves with the nature that is essentially in their own backyard. The group's Learning Circle pushes this for students, in line with the ELWP mission to enable the community to live in harmony with nature. The sitewalks and workshops they conduct are essential to this mission, and to familiarising young students with the natural resources in their area.

This appreciation for the ELWP site is built up by its volunteers, who understand and believe deeply in the potential of the site. Each of the Learning Circle members we interviewed had a background in education, and each emphasised the distance between the National Curriculum guidelines and the lack of opportunities that students had to explore the natural world.

The National Curriculum itself has a range of guidelines that relate to the natural world, and it advises to complete as many of these activities as possible on-site in the outdoors. However, our literature review, combined with our interviews, shed light on the concerns this raises for teachers. First and foremost, they may be missing a physical space in which to carry out outdoor activities. They would have to coordinate with an existing program, like ecoACTIVE, which could pose logistical challenges. Also, they would be required to come up with the structure and details of the experience, which would take a strain on their already limited time and resources. The ELWP aims to provide a free, open,

Fig 18. Proposal for the ELWP forest school

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accessible space for these teachers to use; our project goal was to develop robust materials for learning experiences to do in the park. These are two major obstacles to getting students outdoors, and removing them would make it easier for teachers to integrate the natural world into their curricula.

The need to build an appreciation for the environment was again highlighted in the second round of interviews, with emphasis on allowing students freedom to explore the site as much as possible, within necessary safety constraints, so that they could indulge in their own curiosities about nature.

Hands-On Learning Experiences

We found that hands-on learning is important to keep students engaged and enhance information retention. Students, especially younger ones, need to be active participants in lessons rather than just passive listeners. Making sure that the majority of the learning in a lesson is done during an interactive activity, rather than during a lecture portion, was a key piece of advice we received during our second round of interviews with educators.

Outdoor learning experiences with hands-on activities are an extremely effective way to teach students about the environment and are heavily encouraged by the Department for Education. The National Curriculum emphasises using the local environment as much as possible in Science education. It suggests that students should learn about plants and their needs by observing the growth of flowers and vegetables that they have planted, and using observations to answer questions about animals and their habitats.

"...the joy to be around young children when they've discovered it, that's the thing... You see a young child, and the wonder, the amazement, that stays with them for life. Because the maths lessons don't. These are the experiences that stay with them for life."

- Learning Circle Member

Direct sensory experiences are essential in nature-based education as they help to establish a bond with nature and make students curious about the world around them. One Learning Circle member is quoted about this to the left. The fact that these experiences stay with students for a long time is further supported by an interview we conducted with a different Learning Circle member. They said, "I don't have a great memory, especially my childhood. But I remember going pond dipping, and looking at all the different creatures that were in the water, I found that fascinating." Making sure activities are as hands-on as possible is key to ensuring students are retaining information.

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Hands-on learning helps to empower students and build confidence, by allowing students to be as creative as possible. During an interview with a Learning Circle member, they said, “When I was teaching lesson plans, I always found that just giving as much as you could for the students to work out, solve or contribute to, was the key.” Students are more invested in an activity if they feel they have full creative freedom over the end product.

Dialogic Learning Style

Incorporating a dialogic learning style is essential when designing educational experiences for outdoor learning centres such as the ELWP. Dialogic learning refers to an educational style where educators focus on building dialogue with students, rather than teaching in the traditional lecture style. This approach allows educators to connect with their students at a deeper level, and clearly assess their understanding. Teachers have the flexibility to customise their teaching approach for the unique needs of their student group, making adjustments to lesson plans to enhance overall efficiency and clarity in learning.

> *“The whole point is setting up a dialogue. So you explore your views and your reason for your views. Rather than them being vessels of your communication, try and get a dialogue with them.”*
>
> *- Learning Circle Member*

One of our interviewees suggested this learning style to us as a suggestion for how to design a successful learning experience for the ELWP. They described one of their past educational programs, known as Philosophy for Children, where they claimed that “the whole point” of the activity was to set up a dialogue between student and teacher. They explained that this style challenged the traditional idea of educators as “vessels of communication,” and believed that this style gives teachers an opportunity to learn from their students, allowing for a two-way street of understanding.

Fig 19. Bee sand planter at the current ELWP park

We also saw first-hand the effectiveness of a dialogic learning style with the ecoACTIVE workshop we observed, which was focused on the idea of trash repurposing. The educator had a slideshow in which they asked questions to students throughout. Students maintained focused through the whole slideshow and were eager to answer the questions. The educator posed each question in a dialogic manner, where they asked follow up questions to students’ responses to prolong discussion. This connected the students to their

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educator and revitalised their enthusiasm and curiosity.

We found that one way to implement dialogic learning is by having reflection questions for teachers to ask their students throughout the lesson. This has the benefit of keeping students engaged and on track throughout the lesson, limiting downtime between question breaks, and allowing students to express their personality and creativity in their responses, building confidence in their ideas. Optional followup questions for teachers to ask in response to student answers is another way to promote dialogic learning, allowing for a back-and-forth between student and teacher.

Fig 20. Forest school space illustration at the ELWP

The Importance of Group Learning

Group learning was a common theme that we analysed throughout our literature review and interviews. It allows students to learn from one another, directly and indirectly, in the process of learning from the teacher [15]. It has been shown to have a positive effect on many aspects of learning, such as student achievement and academic persistence. Two main aspects of group learning we identified are peer assessment and mixed ability learning.

> *"...collaborative learning where students are in kind of mixed ability. So this way, I do like mixed ability groups... you're getting them to learn from each other, in a way."*
>
> *- Learning Circle Member*

Mixed-ability learning refers to combining students with differing strengths into groups during group projects. This relies on an educator's understanding of students and their abilities. If an educator knows that certain students have a high interest in science, and others in writing, putting them in a group together would give those students the opportunity to build their own abilities, while picking up skills from the other students. These differences can also come in the form of learning styles; some students naturally adopt a leadership role, delegating tasks to other students, while others are more efficient completing the delegated work. It is up to the teacher to analyse individual students' styles and strengths, and put them in groups which maximise their efficiency and learning ability.

This approach becomes more flexible in the forest school space, since groups are not always restricted to one age, academic level, or interest. There, mixed ability grouping can take on more dimension, since there is a wider variety of skills to pull from. In project groups, older students are

Results

able to solidify skills by explaining them to younger students, and in turn, the younger students understand better through their peers. Mixed-ability grouping allows for greater diversity of ideas and perspectives within each combination of students, enhancing the group learning experience.

Accessibility Considerations in Nature Education

Ensuring accessibility for all students was a significant theme of the second set of interviews we conducted with educators. We wanted as many students as possible to be able to benefit from nature-based experiential learning, so it was vital that we identify any possible considerations to ensure accessibility for all. Utilising large, high-contrast text is one way to make sure that in-class portions of education materials are accessible. Especially for Key Stage 1 students, it is important that minimal text is used and instead visual aids are utilised to express the same meaning for students who are just beginning to learn and write. Keeping presentations short and asking engaging questions throughout a presentation is an effective way to make sure all students are able to focus and stay engaged throughout the lesson.

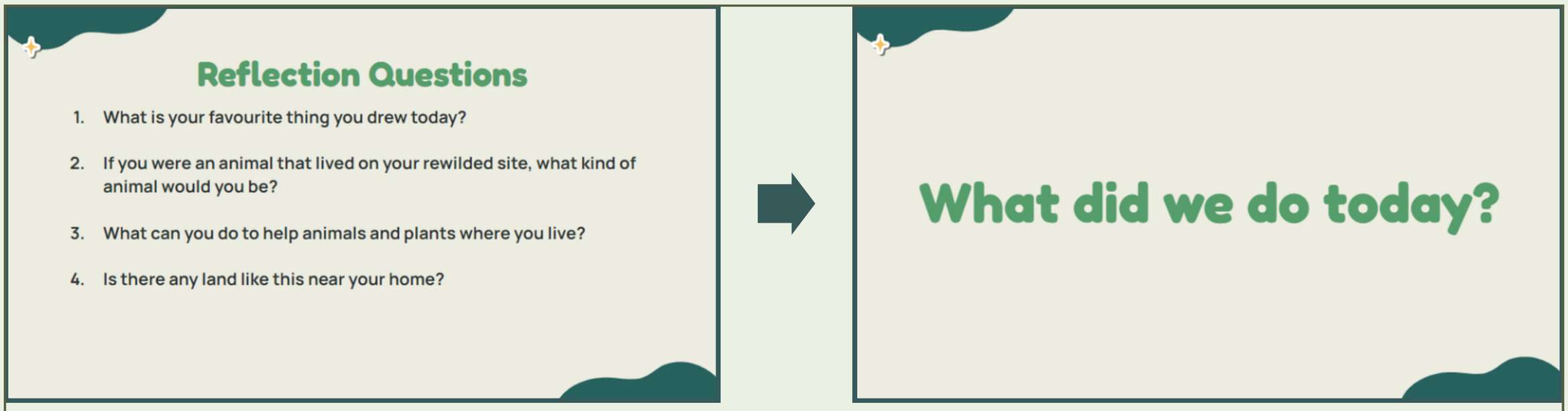

Fig 21. Changes made to a slideshow based on educator feedback

It is also important to make sure that the hands-on portion of a lesson is accessible, because this is the part of the lesson that students are more likely to remember. One way to increase accessibility is to include potential modifications to activities for students with disabilities. These modifications can take many different forms depending on the abilities of students. For students who are

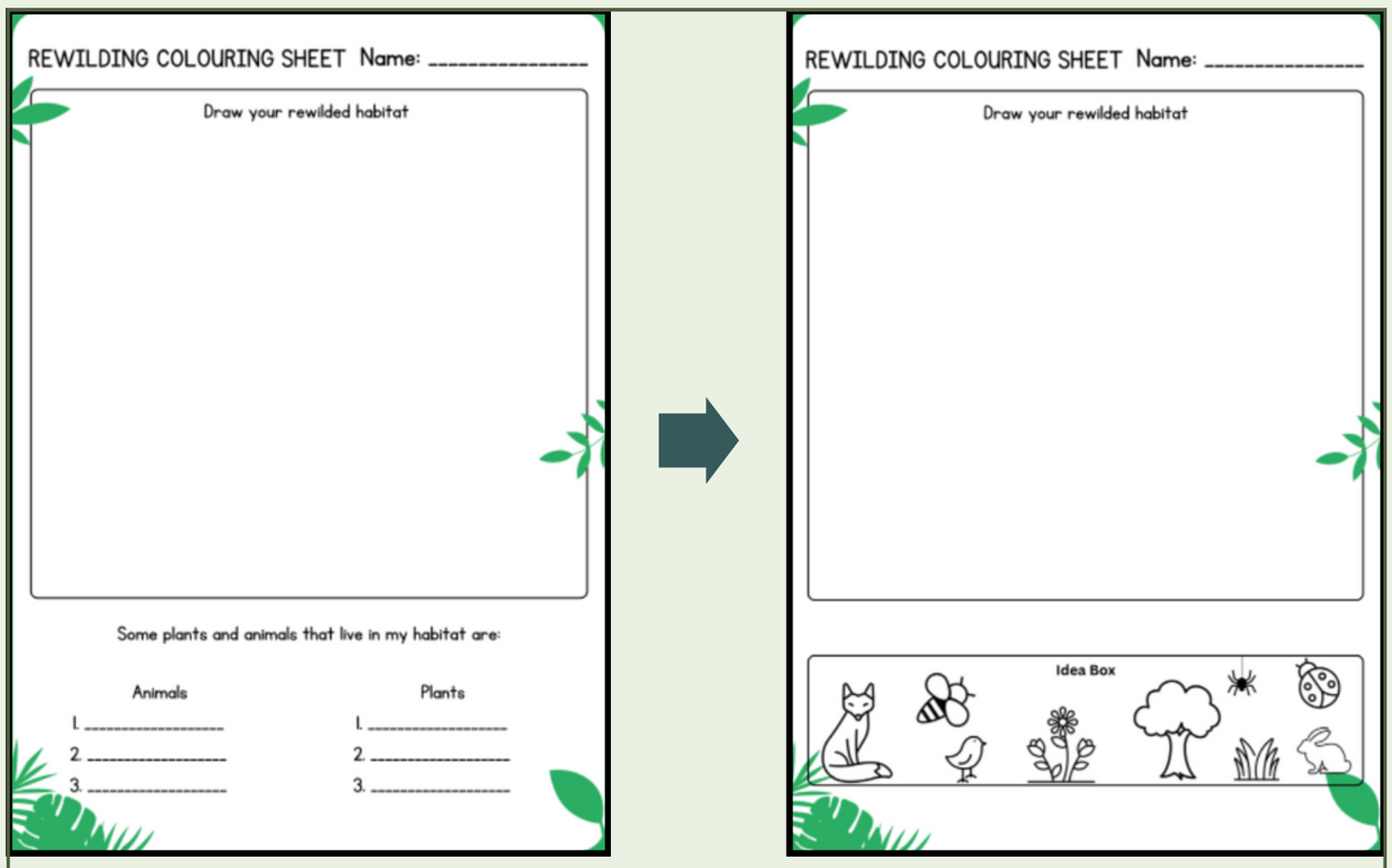

Fig 22. Two versions of the Rewilding Colouring worksheet

Results

not able to read and write, alternative worksheets that focus on drawing instead of writing can be used. For these students, reflection questions can be asked aloud to create a discussion rather than a written reflection. Additionally, students with sensory issues can be paired up with a peer or an adult to assist them in completing the activity. Finally, alternative activities with similar learning objectives can be used to accommodate students with different abilities or preferences.

Risk assessments are a crucial part of nature-based educational materials as they enable a greater number of students to be able to participate in an outdoor activity. By recognizing the potential dangers of outdoor activities such as exposure to pollen or other environmental allergens, teachers can take necessary precautions, including informing parents to make sure that the children who need to take antihistamines have taken them. Bee stings are another consideration, especially for students with severe allergies. Teachers are aware of those who are affected and can take necessary precautions to prevent any adverse reactions.

A sample risk assessment with provided modifications is below:

Risk	At Risk	Likelihood/Severity	Preventative Controls	Other Measures
Tripping	Children & Supervisors	Low risk Minor injury	- Staying in pairs - Comfortable walking shoes	First aid kits for injuries
Disturbance to the environment	Animals and plants	Moderate risk	- Adult supervision - Staying on approved paths - Correct handling of animals	Returning affected areas to their original state
Allergies	Children & Supervisors	Moderate risk Moderate injury	- Taking antihistamines as needed - Supervisor awareness of allergy - Modifications for severe allergies	Have EpiPen if needed

Creating Lesson Plans for Outdoor Experiential Learning

Throughout our research, we gathered a significant amount of data about the qualities that define a successful nature-based learning experience. We created a set of nature-based educational materials for the ELWP to expand their outreach to Key Stage 1 students. There are four lesson plans with each plan having an overview document, a slideshow presentation, and a worksheet activity. The four activities are: Bug Hotel, Special Tree, Biodiversity Bingo, and Rewilding Colouring.

We incorporated the idea of fostering an appreciation of nature into our educational

Results

materials in the form of guidelines for the activities. These guidelines emphasise to students the importance of taking care of the environment, particularly for the activities that involve touching rocks, leaves, and bugs.

All of the lesson plans have hands-on learning activities associated with them. For the Bug Hotel activity, students collect leaves, sticks, and bugs to create a bug hotel. On the Special Tree worksheet, students observe a tree, make drawings of the tree, and take bark rubbings. For Biodiversity Bingo, students observe the natural environment and cross off animals and plants that they see. In Rewilding Colouring, students observe how the ELWP site currently looks and draw how they imagine it could look, taking inspiration from the greenspace around the site.

Dialogic learning is integrated into all of the lesson plans through the use of verbal reflection activities. In our set of materials, we have provided questions for the teachers to ask their students both while presenting the slideshow and at the conclusion of the hands-on activity.

Figure 23. Bug Hotel activity at another forest school

Students are encouraged to work with partners or in groups for all of the activities which is how we incorporated group learning into our lesson plans. Teachers are encouraged to group students in a way that creates mixed ability groups, however it is ultimately up to the teacher to decide what will work best for their students.

We ensured our whole set of educational materials was as accessible as possible through a variety of methods. We included modifications to activities for students with disabilities and created the worksheets and slideshows with high-contrast text. To make our materials easier for teachers to implement into their classrooms we included time estimates for both the presentation and the activities. We also included risk assessments in the overview document for each activity.

All of these insights were incorporated into our project with the intention of making our educational materials as easy as possible to be used with students.

Results

Project Deliverables

Our group developed four complete, comprehensive lesson plans that teachers could easily implement into their day-to-day curriculums. Each activity was structured according to the accepted layout of a lesson plan, and was optimised to be as easy to implement as possible. We included all supplemental materials, presentations, and speaker notes, as well as the specific associated National Curriculum guidelines, to make it simple to integrate the curriculum into the class schedule. The plans combine everything we have learned through the data collection process in both Objectives 1 and 3, and were changed as we collected feedback from educators. With a clear understanding of existing teaching practices in the environmental and sustainability space, we were able to work with educators, as well as members of the Learning Circle, to build an addition to existing curricula, bridging the ELWP and students in the surrounding areas. The structure of each lesson plan includes learning objectives, associated National Curriculum guidelines, content, activities, accessibility concerns, and reflection questions.

All the lesson plans also include a formatted worksheet, optimised for young learners and structured to the way they would learn the best. They are simple, visually appealing, and simplify the learning process. The plans also each include a slideshow. These slideshows are intended for educators to show their students and introduce the topics to be discussed, and they contain clear topics that align with the National Curriculum objectives. These topics are broken down in simple, digestible ways to transmit the information as simply as possible, and are paired with participation activities to maximise retention.

Figure 24. Proposed zones for the ELWP

Results

Bug Hotel is a concept for an educational activity for Key Stage 1 students, with the goal of connecting students with their environment and educating students about various biological principles, including habitats and species diversity.

Learning Objectives

1. Teach children that creatures can live in a variety of different locations and habitats.
2. Build identification skills by giving students items to search for in the park.

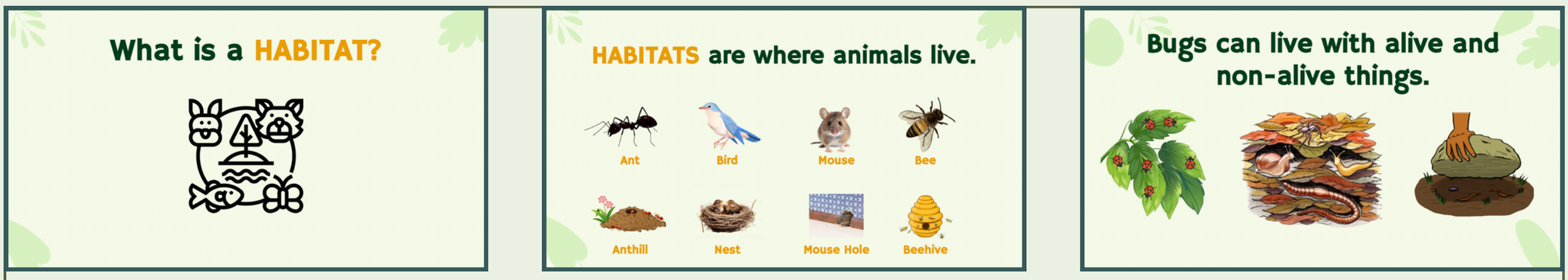

Fig 25. Slides from the Bug Hotel presentation

National Curriculum Guidelines

1. Identify and name a variety of common wild and garden plants, including deciduous and evergreen trees.
2. Identify and name a variety of common animals including fish, amphibians, reptiles, birds, and mammals.
3. Observe changes across the four seasons.
4. Identify and describe the functions of different parts of flowering plants: roots, stem/trunk, leaves and flowers.

Bug Hotel Instructions

1. Split up into groups of 3-5, each with a shoebox.
2. Help students to explore and search for various materials that bugs enjoy (ie. rocks, twigs, leaves, grass, pinecones)
3. If a student finds a bug, aid the student in picking up the bug using a twig or leaf.
4. Transfer any bugs or materials into the shoebox, attempting organization based on what bug would like to live where.
5. After ten minutes of exploration, regroup and present your group's "bug hotel" to the rest of the class. Allow students to highlight their achievements.
6. Allow students to help return the materials and bugs to the places they came.

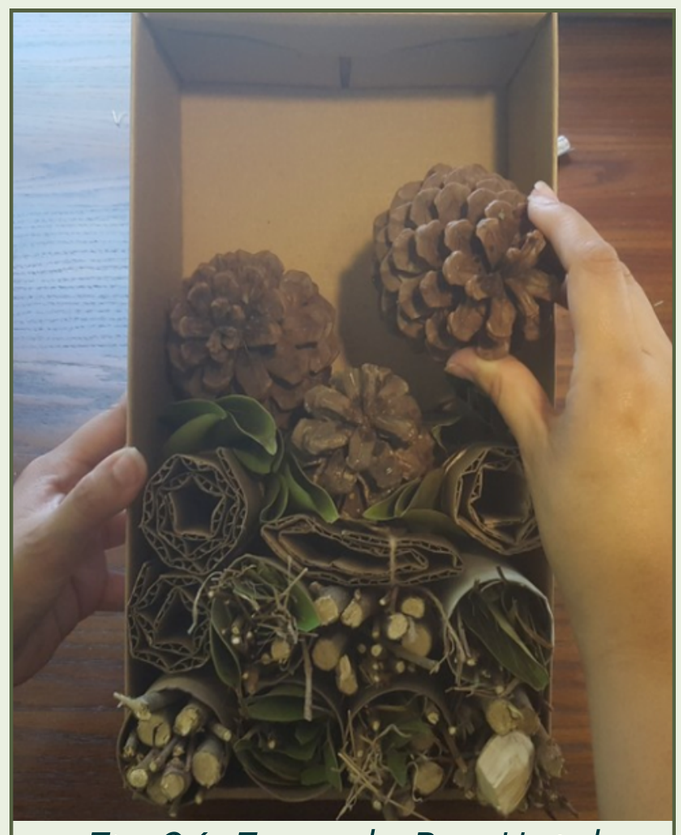

Fig 26. Example Bug Hotel

Results

Rewilding Colouring Activity is a concept for an educational activity for Key Stage 1 students, with the goal of educating students on the concept of rewilding and connecting students to nature.

Learning Objectives

1. Teach children about the concept of rewilding.
2. Understand how new habitats are provided for animals through rewilding.
3. Enhance identification skills by identifying drawings of plants and animals.
4. Build teamwork skills through working collaboratively on a shared worksheet.

Fig 27. Slides from the Rewilding Colouring presentation

National Curriculum Guidelines

1. Identify that most living things live in habitats to which they are suited and describe how different habitats provide for the basic needs of different kinds of animals and plants, and how they depend on each other.
2. Identify and name a variety of plants and animals in their habitats, including micro-habitats.
3. Find out about and describe the basic needs of animals, including humans, for survival (water, food and air).

Rewilding Activity Instructions

1. Make sure each student has a worksheet, colouring utensil, clipboard to draw on and a partner.
2. Have students observe the ELWP site and draw the buildings, fences, bricks, and other man-made structures they see on their worksheet in a black marker.
3. Have students swap worksheets with their partners and explain they are going to rewild their partners' drawing.
4. Have students draw plants and animals that they think could live on their partners land drawing.
5. Have the students swap back their drawings with their partner, and tell the students to identify 3 kinds of plants and 3 kinds of animals that their partner has drawn.

Fig 28. Rewilding Colouring worksheet

Results

Biodiversity Bingo is an engaging and educational game designed specifically for Key Stage 1 students. The game takes a twist on the classic bingo format with a major focus on biodiversity and a minor focus on literacy.

Learning Objectives

1. Students will be able to recognize and name various ecosystems, animals, plants or habitats depicted on the bingo card (e.g., forest, ponds, meadows, swans, squirrels, ducks).
2. Develop and enhance students' observational skills as they actively seek and identify elements of biodiversity during the game.
3. Students will connect biodiversity concepts to their local environment, recognizing the species and ecosystems present in their community.

Fig 29. Slides from the Biodiversity Bingo presentation

National Curriculum Guidelines

1. Identify and name a variety of common animals including fish, amphibians, reptiles, birds and mammals
2. Identify and name a variety of common animals that are carnivores, herbivores and omnivores
3. Identify and name a variety of plants and animals in their habitats, including micro-habitats

Biodiversity Bingo Instructions

1. Make sure each student has a worksheet, colouring utensil, clipboard to draw on and a partner.
2. Remind students to stay close to their group members, be safe and respectful of nature during the game, avoiding disturbance to plants and animals.
3. Teachers may consider organising the game in small teams or groups to encourage collaboration and peer interaction.
4. Keep each game round relatively short (no more than 20 minutes) to accommodate the attention span of Key Stage 1 students.
5. Maximum of two rounds, after each round, encourage students to share their findings and observations, encouraging discussion about the different elements of biodiversity.
6. Offer positive reinforcement and praise for students' efforts and discoveries during the game.

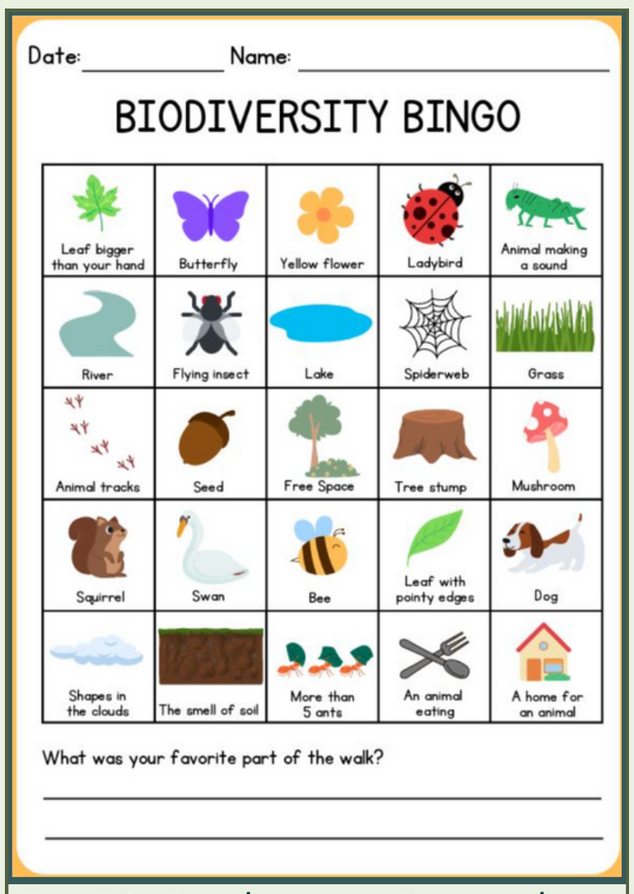

Fig 30. Biodiversity Bingo sheet

Results

Students will break into groups and choose a special tree that they will document thoroughly. They will fill out a worksheet where they will take bark rubbings, observe the surrounding animals, and draw the tree in different seasons.

Learning Objectives

1. Explain the difference between the different types of trees, and identify them when they are seen, based on bark texture and color, as well as leaf types.
2. Observe and document changes in a tree and its surroundings over time, including seasonal changes, growth patterns, and other environmental changes.
3. Work collaboratively, in pairs or small groups, building teamwork skills.

Fig 31. Slides from the Special Tree presentation

National Curriculum Guidelines

1. Identify and name a variety of common wild and garden plants, including deciduous and evergreen trees.
2. Identify and name a variety of common animals including fish, amphibians, reptiles, birds, and mammals.
3. Observe changes across the four seasons.
4. Identify and describe the functions of different parts of flowering plants: roots, stem/trunk, leaves and flowers.

Special Tree Instructions

1. Break up the group into groups of 2 - 4, depending on the class size and the teacher's discretion
2. Go through and explain the various parts of the worksheet.
3. Each group chooses a different tree, and each student receives a worksheet. The students get 25 minutes to complete the activity.

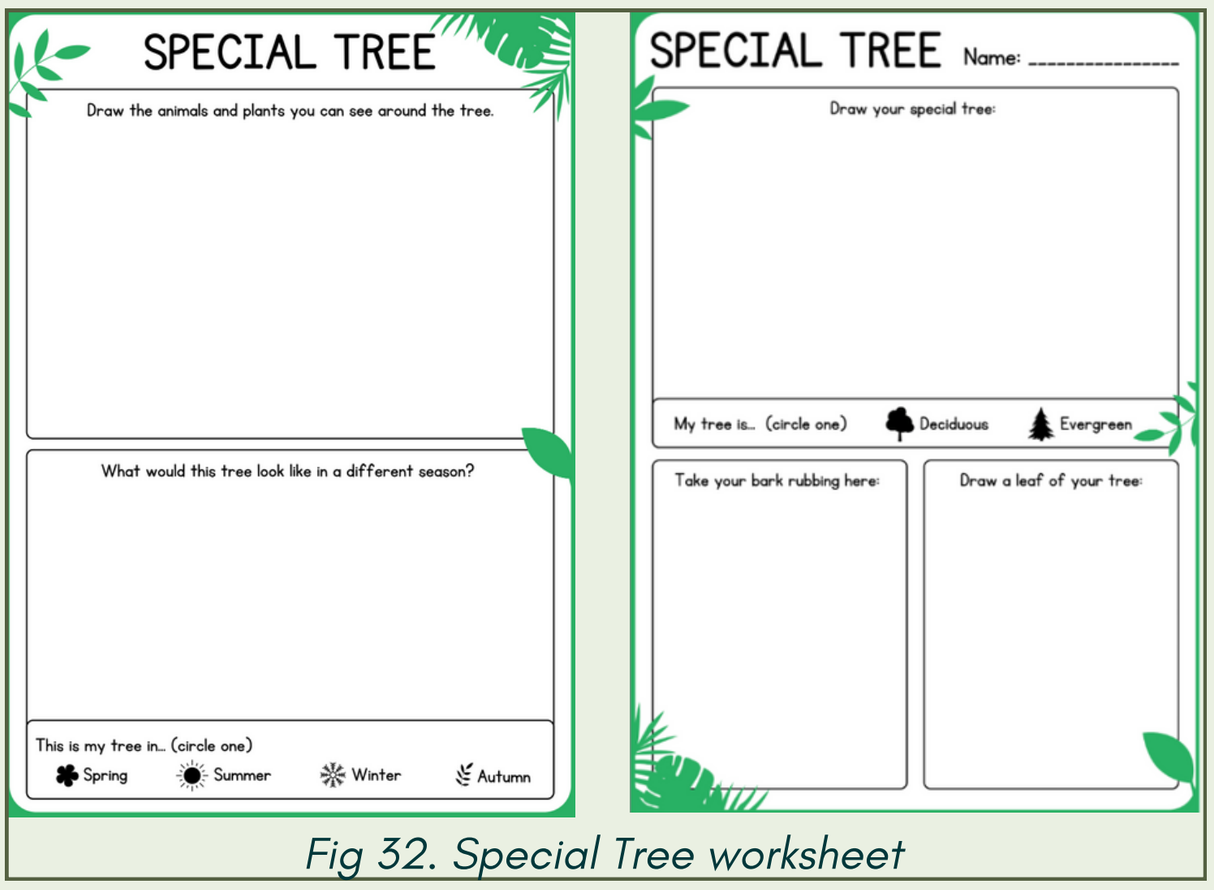

Fig 32. Special Tree worksheet

Recommendations

Throughout our collaboration with the ELWP Learning Circle, we have gained an understanding of the organisation's structure, governance, and day-to-day operations. Below, we make recommendations that the Learning Circle could use to take the deliverables forward after the completion of our project:

RECOMMENDATION 1

Collaborate with local primary schools to raise interest in incorporating the developed lesson plans into their curricula through a sitewalk with the ELWP.

A key way that the ELWP could increase the impact of the educational materials is to continue to collaborate with local schools. The Learning Circle has a set of thirteen contacts at primary schools in the Hackney and Waltham Forest area that agreed to participate in our research process, and we recommend that they connect with those contacts and look for ways those schools could incorporate ELWP activities into their curricula. In the Hackney and Waltham Forest area, there are 141 primary schools, giving the ELWP substantial opportunities for outreach. While the ELWP waits for the site to be purchased and built, teachers could run the activities with their classes around the site. This will also grow awareness of the park within the local community, and establish it as the source of these educational experiences.

Fig 33. Students canoeing as part of an EcoACTIVE workshop

- **Reach out to local primary school contacts to coordinate opportunities for their classes to carry out sitewalks and activities on the ELWP site.** Include examples of the activities they would carry out, and consider giving the educators the ability to decide which fit best into their current curriculum. If possible, give options for transportation, so there is as little extra coordination work for the educator as possible.

- **Print and prepare all project materials for the sitewalks**. To reduce cognitive load for teachers, the ELWP could provide all necessary materials, and include all safety information, as well as the measures they take to assess and minimise risk.

- **Collaborate with existing school events**. The ELWP could coordinate these events to coincide with environmental awareness holidays, such as the Big Schools Birdwatch event in January, Global Recycling Day in March, and Earth Day in April. They could coordinate activities themed around these days, providing higher motivations for schools to get their students outside.

Recommendations

- **Seek community feedback**. As the ELWP carries out these activities, they can collect feedback from students and teachers, and gather data from observations, to understand exactly how to continue to improve.

RECOMMENDATION 2

Advertise ELWP educational experiences on social media to raise awareness among local primary schools about the opportunities the park can offer.

Promoting our educational materials on the ELWP's existing social media platforms, including Facebook, Twitter, Instagram, and their blog, can generate awareness among the local community. Marketing captivating imagery from ELWP sitewalks and showcasing students actively participating in activities can appeal to parents of children in primary schools, attracting a wider audience to support the ELWP.

In addition to gathering community support, advertising to a wider demographic could expand the reach of the ELWP. Currently, the social media output from the park is targeted toward friends and family of those who are already participating, as well as to those who have time they can dedicate to the park. This is a sensible demographic because it helps the park pull in supporters and volunteers. However, a relatively untapped group in their social media marketing is younger people, including university students. These students can drive some traffic to the site and allow them to grow through social media.

Some detailed recommendations for the social media marketing of the ELWP are below:

- **Facebook marketing**: The ELWP already has a robust Facebook page, and has amassed over 1300 followers on the platform. Using Facebook Events to advertise gatherings or events within the park, collaborating with forest school-related Facebook groups, and continuing to post park visualisations and updates to their content are great ways to keep their momentum on the platform.

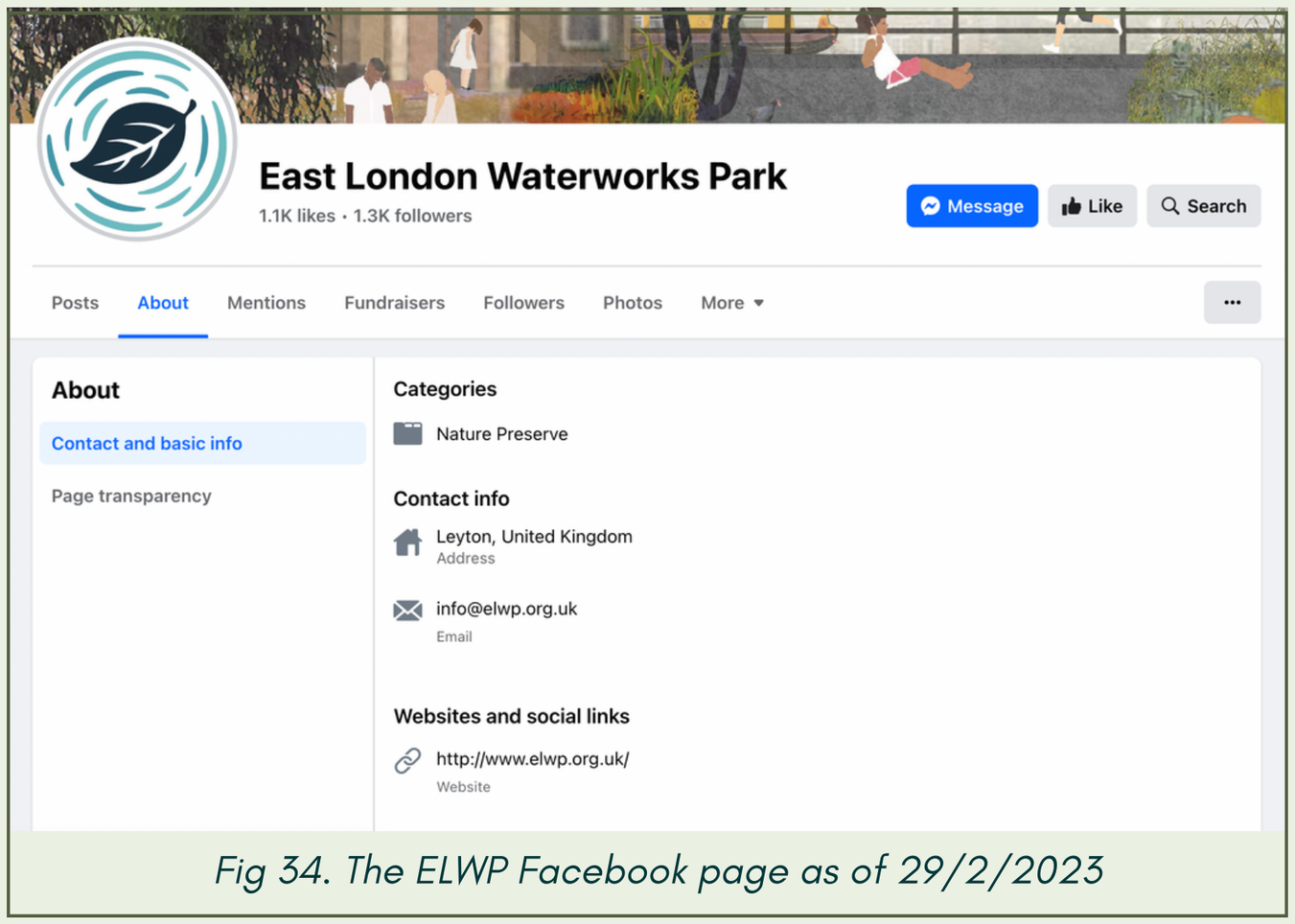

Fig 34. The ELWP Facebook page as of 29/2/2023

Recommendations

- **Instagram outreach:** The park has a growing audience of over 9000 followers on Instagram, where they primarily post about community gatherings, updates to the process of acquiring the land, and information from the university student groups that have been doing projects within the park. An option for this platform is to post short-form, digestible content, which can be determined by looking at current popular posts. They could continue to use Reels (Instagram videos) and Stories (24-hour disappearing posts), and gauge engagement with interactive polls and questions. Another option is to work with local environmental groups to host takeovers while activities are going on in the park.

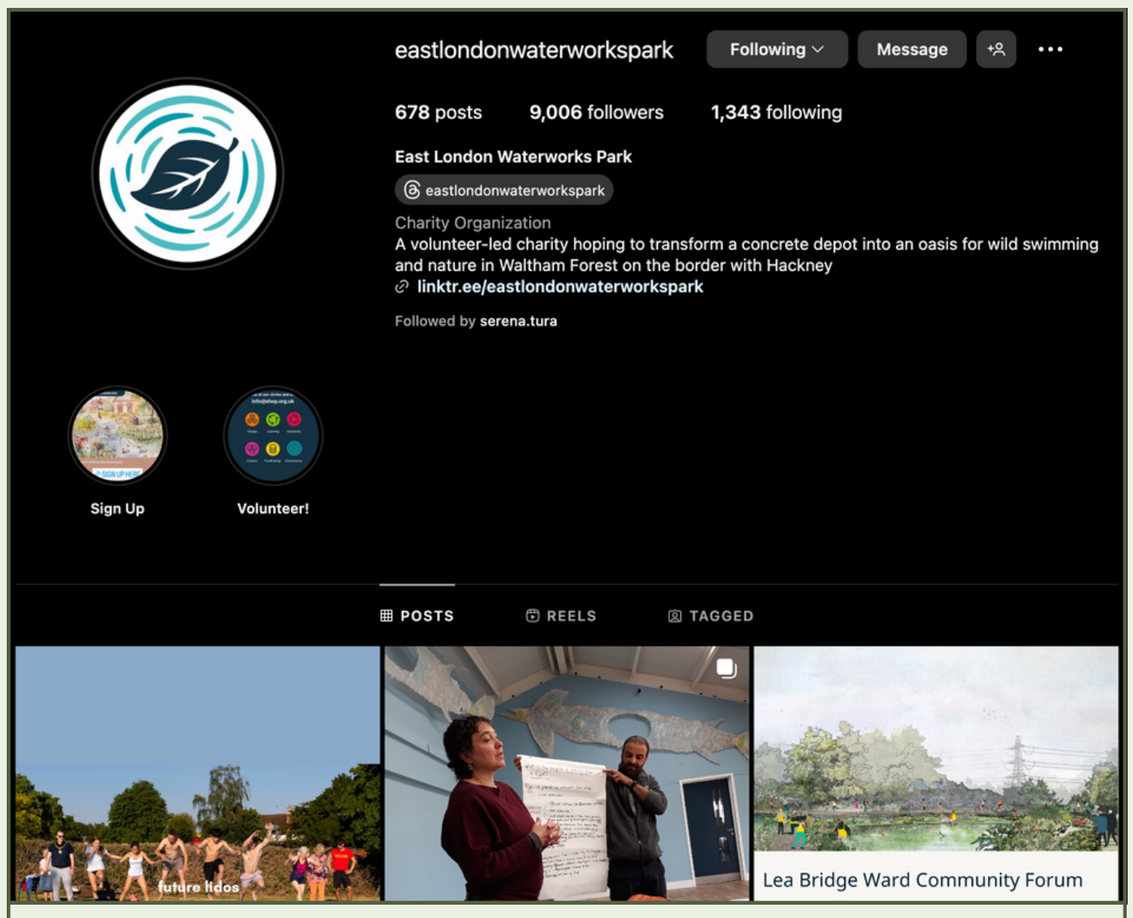

Fig 35. The ELWP Instagram page as of 29/2/2023

RECOMMENDATION 3

Create more educational experiences that are structured and complement the National Curriculum, which can be completed on sitewalks of the ELWP site.

In creating our educational materials for the ELWP, we were keen to keep all of our materials to a similar structure, which is explained in-depth in Objective 2 and is highlighted in our activity deliverables. We kept this consistent structure because we believed it would be simpler for teachers to understand each activity, and for them to implement subsequent activities with ease. This decision also had the added effect of creating a structure that can be used to produce even more educational materials. Structured materials are essential in education as they ensure that all learning objectives are met and students stay on task. We recommend that ELWP Learning Circle members produce new activities that reach a wider audience rather than only Key Stage 1, using our materials as models for hands-on learning experiences. Future work could consist of iterating on the structure we created to implement new activities. It is imperative that these outdoor learning experiences directly connect to National Curriculum requirements.

A detailed recommendation for further expansion of ELWP educational materials is below:

- **Develop additional materials based on the existing framework**: The ELWP could undertake additional research about content and National Curriculum requirements for a

Recommendations

wider variety of educational experiences, and implement those using the framework we developed. These experiences could be designed to fill additional gaps in the curriculums, or be themed to specific sustainability events.

Opportunities for Further Research

We were unable to workshop the activities with Key Stage 1 students. Analysing student engagement and information retention from our set of materials could be an insightful addition for further research. We were primarily focusing specifically on Key Stage 1 students and did not have the opportunity to create materials for other age groups. Further research could be conducted to investigate effective methods to relay environmental education material to older students. A stronger personal connection with primary school teachers could have improved our research. We imagine that it would have allowed us to distribute our survey more effectively and receive more insightful feedback from teachers who would actually use our set of materials. Feedback from teachers who use our materials could be used to improve the activities as well as inspire the construction of new ones.

We hope the outcome of our project creates a positive impact on the East London area, and encourages a new generation of students to learn about sustainability and the environment. We hope that our collaboration with the ELWP will give students hands-on opportunities to explore and appreciate the natural world around them, and that they will go on to implement positive change in their own lives and communities.

Acknowledgements

We would like to extend our gratitude to our sponsor, Nathan Miller, and the rest of the ELWP team for their support, feedback, and perspectives, which have been invaluable throughout the course of our project. We would also like to express our appreciation to our advisors, Dr Boucher-Yip and Dr. Stanlick, for their valuable counsel and continuous support during the course of our research.

Fig 36. The WPI team with advisors Dr. Boucher-Yip and Dr. Stanlick on the ELWP site

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Appendices

APPENDIX A

List of Survey Questions for Primary School Teachers

DEMOGRAPHICS

1. Which school are you employed by?
2. What year(s) do you teach?
    a. Select all that apply (Year 1 - Year 6)
3. What subject(s) do you teach? (Select all that apply)
    a. English
    b. Mathematics
    c. Science
    d. Art and Design
    e. Computing
    f. Design and technology
    g. Geography
    h. History
    i. Music
    j. Other _____
4. How many years have you been working in the education field?

ATTITUDES TOWARDS ENVIRONMENTAL EDUCATION

1. Please mark the scale 1-5 based on the frequency you teach about environmental topics. (Never, Occasionally, Sometimes, Often, Frequently)
    1. Using the scale below, how much do you agree with the following statements, where 1 is the least and 5 is the most? (Disagree, Somewhat Disagree, Neutral, Somewhat Agree, Agree)
    1. Individuals can have an impact on their local environment.
    2. Integrating environmental education into the classroom is essential to a well-rounded curriculum.
    3. Hands-on experiences are effective ways to enhance environmental learning.
    4. My students would benefit from more opportunities to explore environmental and sustainability education.
    5. I am confident in my understanding and ability to teach environmental topics.
    6. Environmental education has positive outcomes for student learning and wellbeing.

Appendices

7. Please mark the scale 1-5 based on the frequency the following topics come up in your classroom. (Never, Occasionally, Sometimes, Often, Frequently)
    a. Climate change
    b. Air pollution
    c. Litter and Recycling
    d. Soil contamination
    e. Ocean sustainability
    f. Animals and plants
    g. Renewable energy
    h. Ecosystems
    i. Rewilding
8. Which environmental education topics do you believe are the most important to discuss in the classroom?
    a. Climate change
    b. Air pollution
    c. Litter and Recycling
    d. Soil contamination
    e. Ocean sustainability
    f. Animals and plants
    g. Renewable energy
    h. Ecosystems
    i. Rewilding

TEACHING METHOD STYLES

1. In my class, I use the following strategies...(select all that apply)
    a. Active learning
    b. Team-based learning
    c. Project-based learning
    d. Service learning/community-based learning
    e. Lecture
    f. Guided discussion
    g. Flipped Classroom
    h. Other _____
2. The most effective strategies I have used are... (select a maximum of 3)
    a. Active learning
    b. Team-based learning
    c. Project-based learning
    d. Service/community-based learning
    e. Lecture
    f. Guided discussion
    g. Flipped Classroom
    h. Other _____

Appendices

3. How do you assess the effectiveness of your teaching methods in helping students achieve learning objectives?
    a. Examinations
    b. Team Projects
    c. Individual projects
    d. Class Discussions
    e. Other (please specify)

OTHER

1. Please provide your email in the box below if you would consent to a further interview from the research team.

Appendices

APPENDIX B

Interview Questions for Educators

1. How did you get involved with the ELWP and specifically the Learning Circle?
2. What motivates you to volunteer your dedication and time to the ELWP organisation?
3. What does your career path look like?

IF APPLICABLE - EDUCATOR:

a. What are some effective lesson plans that you've used throughout your career?

b. Have you ever done hands-on outdoor learning exercises with your class?

c. What are the most effective teaching method(s) that you use in the classroom?

i. Can you give us an example of these methods?

d. In your experience, what has made a lesson plan effective?

NOT EDUCATOR:

a. How has your career experience helped you with the work you do as part of the Learning Circle?

4. What is your experience creating or working on projects with the Learning Circle?

IF APPLICABLE - HAS PARTICIPATED IN LEARNING CIRCLE PROJECTS:

a. Can you tell us about a learning project that you were involved in?

b. What do you think made that project so successful?

c. What aspects would you improve if you were to repeat it?

d. What advice would you give to us in our development of a learning project?

5. What are some interactive activities you envision for Year 1-2 students that could be implemented into the park?

6. To you, what are the most important things to keep in mind when engaging young students with the environment?

7. If you could name some of the benefits that an educational program at the East London Waterworks Park could offer over a traditional classroom experience, what would they be?

8. Do you have any questions for us? Is there anything we haven't touched on that you'd like to discuss?

Appendices

APPENDIX C

Interview Questions for Learning Circle Members

1. What does your career path look like?

IF APPLICABLE - EDUCATOR:

   a. What are some effective lesson plans that you've used throughout your career?
   b. Have you ever done hands-on outdoor learning exercises with your class?
   c. What are the most effective teaching method(s) that you use in the classroom?
      i. Can you give us an example of these methods?
   d. In your experience, what has made a lesson plan effective?

2. To you, what are the most important things to keep in mind when engaging young students with the environment?

Present one activity in depth and explain that the three others have the same structure

3. How can the worksheet and presentation be updated so they are more adequate for facilitating learning?

4. Are the learning objectives clear and achievable for the students?

5. How would you assess the appropriateness of this activity for year 1 and 2 students?

6. Are there any parts of the lesson that seem confusing or unclear?

7. Do you foresee any logistical or practical challenges in implementing our activities?

8. Do you have any additional suggestions or ideas for enhancing the effectiveness of our lesson plans?