Environmental Educational Material for Students in Gualaceo

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Environmental Education Materials for Students in Gualaceo

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Abstract

Despite its compact territory Ecuador is one of the most megadiverse countries in the world. However, human interactions continue to threaten this biodiversity. Acknowledging the need for more awareness, this project seeks to create adaptable, distributable, and sustainable educational materials on local biodiversity, conservation, and ecosystems. Educational and environmental experts, along with authorities, were interviewed to gain an understanding of pressing environmental issues and the most effective way to educate about them. With these insights, a deliverable proposal was created and evaluated with a pilot study. The end deliverable culminated in an immersive collaborative scavenger hunt coinciding with additional materials to facilitate the greatest educational outcome.

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Executive Summary

English Version

Introduction

The increasing prevalence of environmental issues has placed an emphasis on the importance of biodiversity conservation, a priority that is especially pertinent to Ecuador. Ecuador's unique location on the equator and ten distinct natural regions equip it to be one of the most biodiverse places in the world containing two of the 36 hot spots of the world, despite being so small. In locations where there is rich biodiversity local species co-evolve together and adapt to change (Ruano, 2016). These inter ecosystem relationships include the interactions between humans and nature. According to the World Bank (2021), Ecuador continues to decrease in forest area percentage and as of 2021 was at 50.1% which is a 2.72 percent decrease over the past five years of observation. This dimensioning percentage is of concern because “deforestation is a major cause of loss of biodiversity and habitat conservation is vital for stemming this loss.” (World Bank, 2021). In order to not overuse the resources provided to us by the environment it forces us to reexamine the complex role humans play in the environment.

The 2008 revision of the Ecuador Constitution establishes the shared responsibility of both the government and public in environmental and biodiversity protection (Constitution, 2008). The escalating need and desire for immense conservation efforts specifically in the Andean region, a critical epicenter for Ecuador's biodiversity, exacerbates the growing need for impactful biodiversity conservation education. This project’s sponsor Juan Pablo Martínez Head Conservation Advisor from Ecuagenera is committed to this effort of increasing biodiversity education across Ecuador. Over the past 30 years Ecuagenera has contributed restoration efforts, orchid production, conservation initiatives and environmental educational outreach. In line with one of the main aspects of their mission statement being to raise an awareness of protection and preservation of biodiversity and natural resources, this project goal is:

To raise an understanding of local biodiversity, conservation, and the local ecosystems through the implementation of educational materials that can be adapted to additional regions. Created based on information collected during archival research, semi-structured interviews, and ethnographies. Interviews will be conducted with the local conservationists, authorities, and education experts of Gualaceo. Through this multi method qualitative research best pedagogical practices for students in the Gualaceo region along with pressing environmental issues will be identified and implemented into the final material design.

The purpose of the Methods Section is to demonstrate the strategy and approach taken throughout the project and to provide the relevance of each to the research project. This project uses a multi-method qualitative research design to achieve depth and increase findings. Throughout the data collection process, an understanding of the community's needs was developed. This was achieved using archival research, semi-structured interviews, and ethnographies to fully understand the key environmental topics and pedagogical practices that are best received in this region. Archival research provided the necessary background and information needed to start formulating questions to further develop the project goal and curriculum. Semi-structured interviews were implemented to gain a better understanding of individuals’ knowledge to explore what deliverable approach fits the needs of the Guacaleo community best. Ethnographies were used to gain a better understanding of the Gualaceo community and

environment. A pilot study was conducted to assess how students interacted with the proposed deliverable and their attitude towards learning. After data collection, the information from interviews along with the observations and archival research were analyzed to develop the findings. Together, these insights were used to curate the deliverable to best fit the community's needs.

Pressing Environmental Issues Findings

In line with the project sponsor's motives of expanding Ecuadorian biodiversity and conservation, one of the key topics this study centered around was pressing environmental issues. To accomplish this, educational and environmental experts of the region of Guacaleo were asked questions surrounding these topics during interviews. Their answers to these questions revolved around concepts including:

- The preservation of water and the care of rivers
- Waste generation and the mismanagement of waste and garbage
- The extension of the agricultural frontier
- Forest protection

Waste mismanagement was found to be very common throughout the region of Gualaceo and warned that this is of concern because the solid waste ends up in the conservation areas, streams, and rivers. To account for this, more awareness is needed about responsible consumption and disposal. Water source protection was also found to be a pressing concern as water is our future and a valuable resource that is important to protect. It was discovered that there is an interconnected nature between forests, water, and biodiversity. When trees are removed soil quality diminishes which depletes the necessary nutrients from it preventing which decreases biodiversity. Furthermore, soil is more prone to erosion and may end up close by water sources. When materials pollute water, this in turn affects the flora and fauna relying on it to live. When one entity of an ecosystem is affected, the rest are in turn. Similarly, the continued extension of the agricultural frontier is a pressing concern, for it cuts into conservation areas and natural resources/biodiversity. To address this problem, communities need to be educated and given alternatives for economic development. They are accustomed to this tradition of agricultural development. The pressing environmental concepts revealed throughout this study were also reported to be improvable through education and awareness.

Pedagogical Approach Findings

Research was completed to understand how to create educational material that would help children understand their environment. It was revealed that they focus on not teaching students solutions to problems but instead teaching them critical thinking and problem-solving skills so that they can one day overcome the new environmental issues they will face. When students activate more of their senses, they become more engaged in the activity and as a result, learn more. It was recommended that activate the senses of touch, sight, and hearing as activities such as games, videos, or taking the students out into the field would be the most impactful.

Laws/Policies and Former Initiatives

There is a constitutional commitment and practical effort aligning with the Conservation Movement and the public role in living in harmony with nature. There are massive efforts in place to improve this relationship and push beneficial human interaction with nature alongside formal legislature. The constitution is the most important regulation in place in Ecuador and that there is a specific chapter housing information that deals with the health and rights of the environment. Additionally, in different cities there are local regulations in place that influence the community's interaction with nature. Bills can allow for the execution of environmental projects.

Local regulations generate local conservation policies which shape the execution of environmental projects and education. Bills form the local norm, vital for project makers to generate the most impactful projects through aligning them with these norms. Since the implementation of these policies, there has been a positive impact. When people are aware of the actions that they should avoid complying with regulations, there is a positive environmental impact. However, there is a need for increased environmental awareness and improved practices, which is what this project seeks to address.

Since the increased emphasis on positive human nature interaction in Ecuador various projects have been enacted with varying techniques and outcomes that were used as examples to learn from in the creation of this project's final deliverable. Allowing the students to get a nontraditional approach to environmental education has been shown to produce the most successful project outcomes. Furthermore, projects like participating in school gardens, cleaning the shores, and recycling bottles on young children argue that forming good habits when children are young will help them carry over good environmental practices to when they are older. Community engagement is also essential when creating projects. Ideally to combat this obstacle, programs can be created to teach students to do things that are done day to day to help create good habits on topics like water, reforestation, and care of all species.

Deliverable Findings

The main goal of this project was to make a successful educational material that engages and teaches young children and can also be easily distributed to the local schools of Gualaceo. It was discovered that keeping in mind the interaction of the children with each other and their interaction with the environment was the most important. The requirements given by the sponsor were to make a final product, that is a PDF so it can be easily distributed, and keep it engaging to increase student participation, collaboration, and interaction. It was found to be important to keep in mind the collaborations of students with one another and with the local ecosystem throughout the process of the game design. The final deliverable was designed as an Interactive "Eco-Aventuras" deliverable. To play the student will go on a scavenger hunt, gathering pieces from nature.

Knowledge Gap Findings

This deliverable seeks to address the identified knowledge gap found in young students of the Gualaceo region regarding the ongoing environmental issues and the lush diversity that surrounds their home. Many students lack a comprehensive understanding of key concepts such as waste management, the expanding agricultural frontier, forest preservation, water protection, and how critical biodiversity is for its ecosystem. It became clear that educating students on these environmental issues will help develop skills for the students to approach the environmental issues they will face as adults. Environmental issues will change over time, but sparking these students to have a connection to the environment will help to solve this in the future. Skills such as observation and appreciation will foster a deeper connection to what is in their surroundings. The importance of showcasing this biodiversity through experimental education was discovered. Along with the need to illustrate how every aspect of the ecosystem interacts with others and to identify important flora and fauna. Education on how external impacts can negatively affect this fragile environment is also necessary. By providing students with hands-on learning that activates all their senses, they will have the opportunity to learn these identified knowledge gaps. In essence, to bridge the knowledge gap about their surrounding ecosystems, students will be given the opportunity to work on Gualaceo topics, which will create a deeper understanding and connection to biodiversity.

Pilot Study Findings

The pilot study allowed the strengths and weaknesses of the initial deliverable proposal to come to light. The students, aged 9-10, were given the game to complete, which allowed the team to access the flow of the game, student engagement, and effectiveness. The students were effectively able to complete all game steps and activities without getting stuck on any part. The version of the activity played in the pilot study is now recommended for children, 7th grade and up. An adapted activity keeping the concepts and facts intact, but with a reduction in word level and quantity was created which is recommended for children under 7th grade. The overall pedagogical approach taken proved to be a success with the students because they like activities that allow them to go outside and participate together. The students revealed to the teacher that most of the activities worked well and could be completed. One activity question was adapted for the final deliverable to improve clarity. Using the incites gathered from this study the deliverable proposal was altered to create the final deliverable design.

Results

Each methodology's findings were pieced together to create a final deliverable that accomplished this project's main objectives. Information received about knowledge gaps within schools and the greater community was used to better understand what purpose this delivery must serve. Pressing environmental issues were considered when deciding what information was most important in the "Eco-Aventuras" game and the additional booklet. The questions connected to the game were created by identifying main categories of environmental issues that interviewees felt were important in their community. The deliverable is interactive and engaging because interviewees highlighted the importance of this when speaking about past environmental projects that were implemented in schools. Knowledge gained about what pedagogical approaches worked best in classroom inspired the hands on, collaborative nature the "Eco-Aventuras" brings to the classroom. Based off advice received in interviews, the deliverable was made so that children can approach it in their own learning styles so it can benefit most students. This educational material consists of:

- Two activity booklets "Eco - Adventuras" one aimed at students, 7th grade and up the other 6th grade and under. These books consist of the scavenger hunt game.
- An additional materials book "MATERIAL DE EDUCACIÓN AMBIENTAL." This contains additional educational material that further supports the topics in the game.
- Materials book "MATERIALES," which has the necessary game materials including the dice and the game boards.

Recommendations

The project sponsor has put great emphasis on this project having the deliverable be adaptable and distributable to various locations within Ecuador. Aligning with those sponsor goals, the deliverable has been distinctly designed to broad, allowing for implementation in many locations, while also retaining the key concepts and topics that were identified within Gualaceo and Ecuador. To expand upon this game, it is recommended that additional "MATERIAL DE EDUCACIÓN AMBIENTAL" booklets are created for regions besides Azuay. Maintaining consistency between the information deemed important to learn about Ecuador, while also having the ability for educators in different provinces to fill the knowledge gap within their specific students and create questions for the game that will aid those students. This flexibility will help educators tailor the material and the implementation to a new location to be smooth. Moreover, the project serves as a resource for future environmental initiatives. Beyond a classroom setting, there is potential for the activity to be implemented in municipal offices, parks, or forest trails.

This will enhance community engagement and promote nature-based activities in the community. This engaging game will also provide more attractiveness for young students to spend time at these locations and learn even more outside of the game. Overall, the project's scalability and adaptability not only ensure broad coverage of key environmental concepts but also open doors for Ecuagenera to organize future collaboration and community engagement initiatives.

Spanish Version

Introducción

La creciente prevalencia de los problemas ambientales ha puesto énfasis en la importancia de la conservación de la biodiversidad, una prioridad relevante para Ecuador. La ubicación única de Ecuador en el ecuador y diez regiones naturales distintas lo equipan para ser uno de los lugares con mayor biodiversidad del mundo y contiene dos de los 36 puntos calientes del mundo, a pesar de ser tan pequeño. En lugares donde existe una rica biodiversidad, las especies locales coevolucionan juntas y se adaptan al cambio (Ruano, 2016). Estas relaciones entre ecosistemas incluyen las interacciones entre los humanos y la naturaleza. Según el Banco Mundial (2021), Ecuador continúa disminuyendo en el porcentaje de área forestal y en 2021 era del 50,1%, lo que representa una disminución del 2,72 por ciento en los últimos cinco años de observación. Este porcentaje de dimensionamiento es preocupante porque "la deforestación es una de las principales causas de pérdida de biodiversidad y la conservación del hábitat es vital para frenar esta pérdida." (Banco Mundial, 2021). Para no abusar de los recursos que nos proporciona el medio ambiente, nos obliga a reexaminar el complejo papel que desempeñan los humanos en el medio ambiente

La revisión de 2008 de la Constitución de Ecuador establece la responsabilidad compartida tanto del gobierno como del público en la protección del medio ambiente y la biodiversidad (Constitución, 2008). La creciente necesidad y deseo de inmensos esfuerzos de conservación específicamente en la región andina , un epicentro crítico para la biodiversidad del Ecuador, exacerba la creciente necesidad de una educación impactante para la conservación de la biodiversidad . El patrocinador de este proyecto , Juan Pablo Martínez, asesor principal de conservación de Ecuagenera , está comprometido con este esfuerzo de aumentar la educación sobre biodiversidad en todo Ecuador. Durante los últimos 30 años Ecuagenera ha contribuido con esfuerzos de restauración , producción de orquídeas , iniciativas de conservación y divulgación educativa ambiental . En línea con uno de los principales aspectos de su misión de crear conciencia sobre la protección y preservación de la biodiversidad y los recursos naturales, el objetivo de este proyecto es:

Aumentar la comprensión de la biodiversidad local, la conservación y los ecosistemas locales a través de la implementación de materiales educativos que puedan adaptarse a regiones adicionales. Creado a partir de información recopilada durante investigaciones de archivos, entrevistas semiestructuradas y etnografías. Se realizarán entrevistas con los conservacionistas locales, autoridades y expertos en educación de Gualaceo. A través de esta investigación cualitativa de múltiples métodos, se identificarán e implementarán en el diseño final del material las mejores prácticas pedagógicas para los estudiantes de la región de Gualaceo, junto con problemas ambientales apremiantes.

El propósito de la Sección de Métodos es demostrar la estrategia y el enfoque adoptados a lo largo del proyecto y proporcionar la relevancia de cada uno para el proyecto de investigación . Este proyecto utiliza un diseño de investigación cualitativa multimétodo

para lograr profundidad y aumentar los hallazgos. A lo largo del proceso de recopilación de datos, se desarrolló una comprensión de las necesidades de la comunidad. Esto se logró mediante investigación de archivos, entrevistas semiestructuradas y etnografías para comprender completamente los temas ambientales clave y las prácticas pedagógicas mejor recibidas en esta región. La investigación de archivos proporcionó los antecedentes y la información necesarios para comenzar a formular preguntas para desarrollar aún más el objetivo y el plan de estudios del proyecto. Se implementaron entrevistas semiestructuradas para obtener una mejor comprensión del conocimiento de las personas y explorar qué enfoque entregable se adapta mejor a las necesidades de la comunidad de Guacaleo. Se utilizaron etnografías para obtener una mejor comprensión de la comunidad y el medio ambiente de Gualaceo. Se llevó a cabo un estudio piloto para evaluar cómo los estudiantes interactuaron con el entregable propuesto y su actitud hacia el aprendizaje. Después de la recopilación de datos, se analizó la información de las entrevistas junto con las observaciones y la investigación de archivos para desarrollar los hallazgos. En conjunto, estos conocimientos se utilizaron para seleccionar el producto que mejor se adapte a las necesidades de la comunidad.

Hallazgos urgentes sobre cuestiones ambientales

En línea con los motivos del patrocinador del proyecto de expandir la biodiversidad y la conservación en Ecuador, uno de los temas clave en los que se centró este estudio fueron las cuestiones ambientales urgentes. Para lograr esto, durante las entrevistas se hicieron preguntas sobre estos temas a expertos educativos y ambientales de la región de Guacaleo. Sus respuestas a estas preguntas giraron en torno a conceptos que incluyen:

- La preservación del agua y el cuidado de los ríos
- Generación de residuos y mala gestión de residuos y basuras
- La extensión de la frontera agrícola
- Protección forestal

El mal manejo de residuos constató que es muy común en toda la región de Gualaceo y advirtió que esto es preocupante porque los desechos sólidos terminan en las áreas de conservación, arroyos y ríos. Para dar cuenta de esto, se necesita más conciencia sobre el consumo y la eliminación responsables. También se descubrió que la protección de las fuentes de agua es una preocupación apremiante, ya que el agua es nuestro futuro y un recurso valioso que es importante proteger. Se descubrió que existe una naturaleza interconectada entre los bosques, el agua y la biodiversidad. Cuando se eliminan los árboles, la calidad del suelo disminuye, lo que agota los nutrientes necesarios, lo que impide que disminuya la biodiversidad. Además, el suelo es más propenso a la erosión y puede acabar en fuentes de agua cercanas. Cuando los materiales contaminan el agua, esto a su vez afecta a la flora y la fauna que dependen de ella para vivir. Cuando una entidad de un ecosistema se ve afectada, el resto a su vez lo es. De manera similar, la continua extensión de la frontera agrícola es una preocupación apremiante, ya que afecta las áreas de conservación y los recursos naturales/biodiversidad. Para abordar este problema, es necesario educar a las comunidades y brindarles alternativas de desarrollo económico. Están acostumbrados a esta tradición de desarrollo agrícola. También se informó que los conceptos ambientales apremiantes que se revelaron a lo largo de este estudio se podían mejorar a través de la educación y la concienciación.

Hallazgos del enfoque pedagógico

Se completó una investigación para comprender cómo crear material educativo que ayudara a los niños a comprender su entorno. Él Se reveló que se centran no en enseñar a los estudiantes soluciones a los problemas, sino en enseñarles pensamiento crítico y habilidades de resolución de problemas para que algún día puedan superar los nuevos problemas ambientales que enfrentarán. Cuando los estudiantes activan más sus sentidos, se involucran más en la actividad y, como resultado, aprenden

más. Se recomendó activar los sentidos del tacto, la vista y el oído ya que actividades como juegos, videos o sacar a los estudiantes al campo serían las de mayor impacto.

Leyes/Políticas e Iniciativas anteriores

Existe un compromiso constitucional y un esfuerzo práctico alineado con el Movimiento Conservacionista y el papel público de vivir en armonía con la naturaleza. Se están realizando esfuerzos masivos para mejorar esta relación e impulsar una interacción humana beneficiosa con la naturaleza junto con una legislación formal. La constitución es la norma más importante vigente en el Ecuador y existe un capítulo específico que alberga información que trata sobre la salud y los derechos del medio ambiente. Además, en diferentes ciudades existen regulaciones locales que influyen en la interacción de la comunidad con la naturaleza. Los proyectos de ley pueden permitir la ejecución de proyectos ambientales. Las regulaciones locales generan políticas locales de conservación que dan forma a la ejecución de proyectos ambientales y de educación. Los proyectos de ley forman la norma local, vital para que los responsables de proyectos generen proyectos de mayor impacto alineándolos con estas normas. Desde la implementación de estas políticas ha habido un impacto positivo general. Cuando las personas son conscientes de las acciones que deben evitar para cumplir con la normativa, hay un impacto ambiental positivo. Sin embargo, existe la necesidad de una mayor conciencia ambiental y mejores prácticas, que es lo que este proyecto buscaba abordar.

Desde el mayor énfasis en la interacción positiva entre los seres humanos y la naturaleza en Ecuador, se han implementado varios proyectos con diferentes técnicas y resultados que se utilizaron como ejemplos para aprender en la creación del producto final de este proyecto. Se ha demostrado que permitir que los estudiantes adopten un enfoque no tradicional de la educación ambiental produce los resultados más exitosos del proyecto. Además, proyectos como participar en huertos escolares, limpieza de costas y reciclaje de botellas en niños pequeños argumentan que formar buenos hábitos desde pequeños les ayudará a trasladar las buenas prácticas medioambientales cuando sean mayores. La participación de la comunidad también es esencial a la hora de crear proyectos. Idealmente para combatir este obstáculo se pueden crear programas que enseñen a los estudiantes a hacer cosas que se hacen día a día para ayudar a crear buenos hábitos en temas como el agua, la reforestación y el cuidado de todas las especies.

Hallazgos entregables

El objetivo principal de este proyecto fue crear un material educativo exitoso que atraiga y enseñe a los niños pequeños y que también pueda distribuirse fácilmente en las escuelas locales de Gualaceo. Se descubrió que lo más importante era tener en cuenta la interacción de los niños entre sí y su interacción con el entorno. Los requisitos dados por el patrocinador fueron crear un producto final en formato PDF para que pueda distribuirse fácilmente y mantenerlo atractivo para aumentar la participación, colaboración e interacción de los estudiantes. Se consideró importante tener en cuenta las colaboraciones de los estudiantes entre sí y con el ecosistema local durante todo el proceso de diseño del juego. El entregable final fue diseñado como un entregable interactivo de "Eco-Aventuras." Para jugar el alumno realizará una búsqueda del tesoro, recogiendo piezas de la naturaleza.

Hallazgos sobre la brecha de conocimiento

Este entregable busca abordar la brecha de conocimiento identificada en jóvenes estudiantes de la región de Gualaceo sobre los problemas ambientales actuales y la exuberante diversidad que rodea su hogar. Muchos estudiantes carecen de una comprensión integral de conceptos

clave como la gestión de residuos, la expansión de la frontera agrícola, la preservación de los bosques, la protección del agua y lo crítica que es la biodiversidad para su ecosistema. Quedó claro que educar a los estudiantes sobre estos temas ambientales ayudará a desarrollar habilidades para que los estudiantes aborden los problemas ambientales que enfrentarán cuando sean adultos. Los problemas ambientales cambiarán con el tiempo, pero lograr que estos estudiantes tengan una conexión con el medio ambiente ayudará a resolver esto en el futuro. Habilidades como la observación y la apreciación fomentarán una conexión más profunda con lo que hay a su alrededor. Se descubrió la importancia de mostrar esta biodiversidad a través de la educación experimental. Junto con la necesidad de ilustrar cómo cada aspecto del ecosistema interactúa con los demás e identificar flora y fauna importantes. También es necesaria la educación sobre cómo los impactos externos pueden afectar negativamente a este frágil entorno. Al brindarles a los estudiantes un aprendizaje práctico que active todos sus sentidos, tendrán la oportunidad de aprender estas brechas de conocimiento identificadas. En esencia, para cerrar la brecha de conocimiento sobre los ecosistemas circundantes, los estudiantes tendrán la oportunidad de trabajar en temas de Gualaceo, lo que creará una comprensión y una conexión más profunda con la biodiversidad.

Hallazgos del estudio piloto

El estudio piloto permitió que salieran a la luz las fortalezas y debilidades de la propuesta de entregable inicial. A los estudiantes, de entre 9 y 10 años, se les dio el juego para que lo completaran, lo que permitió al equipo acceder al flujo del juego, la participación de los estudiantes y la efectividad. Los estudiantes pudieron completar efectivamente todos los pasos y actividades del juego sin quedarse atascados en ninguna parte. Ahora se recomienda la versión de la actividad realizada en el estudio piloto para niños de séptimo grado en adelante. Se creó una actividad adaptada que mantiene intactos los conceptos y hechos, pero con una reducción en el nivel y la cantidad de palabras, recomendada para niños menores de 7º grado. El enfoque pedagógico general adoptado resultó ser un éxito para los estudiantes porque les gustan las actividades que les permiten salir y participar juntos. Los estudiantes le revelaron al maestro que la mayoría de las actividades funcionaron bien y pudieron completarse. Se adaptó una pregunta de actividad para el entregable final para mejorar la claridad. Utilizando los incentivos recopilados en este estudio, se modificó la propuesta de entregable para crear el diseño de entregable final.

Resultados

Los hallazgos de cada metodología se reunieron para crear un producto final que logró los principales objetivos de este proyecto. La información recibida sobre las brechas de conocimiento dentro de las escuelas y la comunidad en general se utilizó para comprender mejor el propósito que debe cumplir esta entrega. Se consideraron cuestiones ambientales urgentes al decidir qué información era más importante en el juego “Eco-Aventuras” y el folleto adicional. Las preguntas relacionadas con el juego se crearon identificando las principales categorías de cuestiones ambientales que los entrevistados consideraban importantes en su comunidad. El entregable es interactivo y atractivo porque los entrevistados resaltaron la importancia de esto cuando hablaron sobre proyectos ambientales anteriores que se implementaron en las escuelas. El conocimiento adquirido sobre qué enfoques pedagógicos funcionaron mejor en el aula inspiró la naturaleza práctica y colaborativa que “Eco-Adenturas” trae al aula. Basado en los consejos recibidos en las entrevistas, el producto se elaboró para que los niños puedan abordarlo en sus propios estilos de aprendizaje para que pueda beneficiar a la mayoría de los estudiantes.

Este material educativo consta de:

- Dos cuadernos de actividades “Eco - Aventuras,” uno dirigido a niños de 7º grado en adelante y el otro de 6º grado y menores. Estos libros consisten en el juego de la búsqueda del tesoro.
- Un libro de materiales adicionales “MATERIAL DE EDUCACIÓN AMBIENTAL.” Contiene material educativo adicional que respalda aún más los temas del juego.
- Libro de materiales “MATERIALES,” que contiene los materiales de juego necesarios incluyendo los dados y los tableros de juego.

Recomendaciones

El patrocinador del proyecto ha puesto gran énfasis en que este proyecto sea adaptable y distribuible a varios lugares dentro de Ecuador. En consonancia con los objetivos de los patrocinadores, el producto final se ha diseñado claramente para ser amplio, lo que permite su implementación en muchos lugares, al tiempo que conserva los conceptos y temas clave que se identificaron en Gualaceo y Ecuador. Para ampliar este juego esrecomendado ese adicional “MATERIAL DE EDUCACIÓN AMBIENTAL” Se crean folletos para regiones aledañas al Azuay.Mantener la coherencia entre la información que se considera importante para aprender sobre Ecuador, y al mismo tiempo tener la capacidad de que los educadores de diferentes provincias llenen la brecha de conocimiento entre sus estudiantes específicos y creen preguntas para el juego que ayudarán a esos estudiantes. Esta flexibilidad ayudará a los educadores a adaptar el material y la implementación a una nueva ubicación para que sea fluida.Además, el proyecto sirve como recurso para futuras iniciativas medioambientales. Más allá del aula, existe la posibilidad de que la actividad se implemente en oficinas municipales, parques o senderos forestales. Esto mejorará la participación de la comunidad y promoverá actividades basadas en la naturaleza en la comunidad. Este atractivo juego también brindará más atractivo para que los jóvenes estudiantes pasen tiempo en estos lugares y aprendan aún más fuera del juego. En general, la escalabilidad y adaptabilidad del proyecto no solo garantizan una amplia cobertura de conceptos ambientales clave, sino que también abren puertas para que Ecuagenera organice futuras iniciativas de colaboración y participación comunitaria.

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1.0 Introduction

1.1 Background

The increasing prevalence of environmental issues has placed an emphasis on the importance of biodiversity conservation, a priority that is especially pertinent to Ecuador. Ecuador's unique location on the equator and ten distinct natural regions equip it to be one of the most biodiverse places in the world containing two of the 36 hot spots of the world, despite being so small. In locations where there is rich biodiversity local species co-evolve together and adapt to change (Ruano, 2016). These inter ecosystem relationships include the interactions between humans and nature. According to the World Bank (2021), Ecuador continues to decrease in forest area percentage and as of 2021 was at 50.1% which is a 2.72 percent decrease over the past five years of observation. This dimensioning percentage is of concern because “deforestation is a major cause of loss of biodiversity and habitat conservation is vital for stemming this loss.” (World Bank, 2021). To not overuse the resources provided to us by the environment, it forces us to reexamine the complex role humans play in the environment.

The 2008 revision of the Ecuador Constitution establishes the shared responsibility of both the government and public in environmental and biodiversity protection (Ecuador Constitution, 2008). The escalating need and desire for immense conservation efforts specifically in the Andean region, a critical epicenter for Ecuador's biodiversity, exacerbates the growing need for impactful biodiversity conservation education. This project’s sponsor Juan Pablo Martínez Head Conservation Advisor from Ecuagenera is committed to this effort of increasing biodiversity education across Ecuador. Over the past 30 years Ecuagenera has contributed restoration efforts, orchid production, conservation initiatives and environmental educational outreach. In line with one of the main aspects of their mission statement being to raise an awareness of protection and preservation of biodiversity and natural resources, this project goal is:

To raise an understanding of local biodiversity, conservation, and the local ecosystems through the implementation of educational materials that can be adapted to additional regions. Created based on information collected during archival research, semi-structured interviews, and ethnographies. Interviews will be conducted with the local conservationists, authorities, and education experts of Gualaceo. Through this multi method qualitative research best pedagogical practices for students in the Gualaceo region along with pressing environmental issues will be identified and implemented into the final material design.

With this goal in mind this research question was created: What is the most impactful environmental educational material for young students that is distributable, sustainable, and expandable to best raise awareness of local biodiversity, conservation, and the ecosystems?

1.2 Objectives

- To answer this question these main objectives have been identified:
- Design and implement environmental education materials for children in Gualaceo.
- Design and produce engaging, adaptable, and sustainable educational materials addressing the educational needs of the local community on environmental issues
- Identify the educational needs of the local community on environmental issues, their relationship to the environment, and their role in protecting it.

- Identify impactful pedagogical practices for the deliverable
- Design educational materials that allow for the local schools to feel connected to the program

1.3 Sponsor Background

Ecuagenera is a family-owned foundation for research, conservation of biodiversity, and development of the tropical Andes. Their mission is to preserve native species as well as aiming to establish sustainable management of Ecuadorian natural resources thanks to the preservation and conservation of natural orchid species. This is done through research, production and commercialism, conservation, ecosystem restoration, and tourism. Ecuagenera goes about these steps in a cycle like fashion, and it has been proven to be an effective method (Figure 1). By using their brand, they can raise awareness about protection and preservation of biodiversity and natural resources; Doing this to discover some of the most beautiful natural ecosystems in the world. The company was founded in the 50's by Salesian Father Angel Andreeta, whose love of nature led him to the selection and conservation of certain orchids. Another man, Mario Portilla, joined him as an ally for conservation. In 1993, they were awarded legal permission for the export of endangered species. This project works with Ecuagenera to build understanding of biodiversity, conservation, and the local ecosystems in the southern Andean reserves of Ecuagenera through an implementation of educational materials that can be adapted to additional regions.

Figure 1: Ecuagenera Conservation Cycle Strategy

The designed deliverable is of concern to Ecuagenera due to their mission of preserving native species as well as aiming to establish sustainable management of Ecuadorian natural resources. To accomplish this goal Ecuagenera promotes a continued effort to raise awareness about preservation of biodiversity and natural resources through social and community engagement. The deliverable will fulfill sponsor goals and add educational value, this will aid Ecuagenera's efforts standing as a beacon to educate and inspire others to show interest in preserving wildlife through raising awareness.

2.0 Background

2.1 The Conservation Movement in Ecuador

Scholars Caria and Dominquez (2015), Jokisch (2005), Jokisch and Bridget (2002), Akchurin (2015) and Himley (2009) all discuss the interaction of humans and nature, as systems that rely on each other and prosper in coexistence. Their debate centers on the Buen Vivir movement in Ecuador, which is, “a new form of coexistence, in diversity and harmony with Nature and others, to achieve good living, sumak kaway” (Constitution, 2008). This movement gained momentum in Ecuador due to the historical “presence of environmentalist social movements that had done the groundwork of elevating the environmental issue to the national level” (Akchurin,2015) along with indigenous communities and their call “demanding respect for indigenous territories and ways of life…about the environment” (Akchurin, 2015). These scholars consider social dynamics including culture, history, economy, and environmental practices as the conservation movement is gaining momentum in Ecuador.

Jokisch and Bridget (2002) discuss the complexity of the montane forests across Ecuador being converted to agriculture and the tension between maintaining the constitutional commitment to nature and economic needs. Jokisch and Bridget (2002) argue that the rate of deforestation across Ecuador has greatly increased over the past 50 years due to agricultural needs. Although Ecuador has been experiencing an increased rate of deforestation, Jokisch and Bridget (2002) discuss “two areas have experienced considerable regeneration and even afforestation”: the upper Mazar and the “secondary forest” in the Bosque Merchan. In both cases intentional conservation practices lead to successful environmental regeneration. Throughout this article Jokisch and Bridget (2002) argue deforestation led by economic drivers is negatively impacting the Ecuadorian environment. They argue that for conservation efforts to be successful a holistic approach considering the environmental, social, and economic needs of the region must be considered. Similarly to Jokisch and Bridget (2002) and motivated by the conservation movement and the increasing conservation efforts over the past decade in the Sierra Region of Ecuador, Himley (2009) also explores the interplay between conservationists and the rural communities who reside in this region. Based on his 15-year examination of community interaction with nature, he concludes that acknowledging the history and current needs of the relationship between the community and ecosystem is a catalyst for developing an effective, socially responsible, and sustainable conservation strategy. These stances align with the harmonic coexistence pushed by the Buen Vivir movement.

By 2008, the Buen Vivir movement occurring in Ecuador became embedded within the new Ecuadorian Constitution. This revision prioritizes environmental conservation and sumak kaway. In the Ecuador Constitution preamble, it is stated: "Hereby decide to build A new form of public coexistence, in diversity and in harmony with nature, to achieve the good way of living, the ‘sumak kawsay’". This vision is supported throughout the constitution. The Ecuadorian Constitution Title One Chapter Two Section Two: Healthy Environment guarantees the right of the population to live in a healthy and ecologically balanced environment. To accomplish this, environmental conservation of biodiversity is declared a matter of public interest. Similarly, The Ecuadorian Constitution Title Two Chapter Two Section Two: Healthy Environment provides a legal environmental protection and biodiversity conservation framework. Throughout this section, it highlights both the importance and the responsibility surrounding conservation. It is outlined as the government’s duty to carry out protective measures. However,

Ecuadorian citizens are also expected to share in this responsibility, as the conservation of biodiversity is integral to overall welfare and sustainability of Ecuador. With the inclusion of these provisions, Ecuador "became the first country to extend legal rights to nature…. affirming nature's intrinsic right to exist, to maintain and regenerate its vital life cycles and to be restored if damaged" (Aukchrin, 2015). This radical constitutional shift exemplified Ecuador's commitment to the environment.

Caria and Domínguez (2015) comment on the conservation practices in Ecuador amidst the growing interest in the Buen Vivir movement in Ecuador. They observe that the Constitutional protection of nature in Ecuador is positive; however, they feel that the constitutional commitments are being contradicted in practice. Recent policies continue to emphasize old priorities, focusing on economic growth over environmental protection and indigenous rights. The shifting Ecuadorian government view of the Yasuní-ITT Initiative exemplifies their ultimate priority being economic growth. Aligned with the new constitutional protection of biodiversity conservation, this initiative aimed to protect Yasuní National Park, one of the most biodiverse areas in the world, by refraining from using the oil fields. At first the government supported this initiative; however, they ultimately shifted their view to support the economic needs of the country over the environmental ones. Policy reversals like this call into question how committed the government is to environmental considerations that are "protected" by the constitution.

Ruano (2016) argues that an old example of human to nature interaction is found in native and indigenous people who continue to train people in "bio-literacy look". This tactic has been taught for thousands of years, "focusing on strengthening linkages and relations between human beings and nature". This contrasts with the current standard of education which tends to place an unequivocal priority of preparing the student to be a productive economical worker. Like the other authors, Ruano discusses how an ecosystem is made up of interconnected entities that form cooperative interactions. However, Ruano also warns that ecosystems are "built in the limits of available resources and as a result" the current capitalist ecosystems extract more than the environment can keep up with (Ruano, 2016).

These sources along with the constitutional commitment to biodiversity conservation and the broader Buen Vivir movement underscore the intertwined connectivity between humans and nature. The sources provide historical information surrounding biodiversity conservation and the complexities behind balancing environmental and community needs with broader economic needs. Throughout these readings, factors affecting successful conservation in Ecuador are explored and critiqued along with the interplay among conservationists and the government. To successfully complete this study an understanding of the long-standing struggle was important to understand when conducting research on this topic and creating the end materials.

The conservation movement in Ecuador provides relevant background to answer the research question as it argues that when considering environmental issues such as conservation, it is necessary to take into consideration human environment interactions and the role citizens play in the conservation of biodiversity to effectively create harmonic coexistence, as pushed for in the Buen Vivir movement. Furthermore, the constitutional revision displays the governmental commitment to protecting biodiversity and outlines the shared responsibility of all citizens in maintaining biodiversity. Understanding this responsibility and factors that make conservation successful were pertinent to the project.

2.2 Environmental Education Pedagogy

Environmental education pedagogies surround the methods in which teaching and learning can occur for environmental topics. It is essential for the successful completion of this project, as one of the main project goals is to select a pedagogical practice that best fits the community within the Gualaceo region. Aligned with this topic, Herodotou (2019) discusses pedagogy for an interactive world with the goal to guide teaching and transform learning with the methods presented. Herodotou proposed both the teach-back method and the place-based method as pedagogies that have great effect on a student's understanding of the taught material. With the teach-back method, students are asked to demonstrate their understanding of the topic either back to their teacher, to another student, or to family and friends at home. By asking this of a student, one ensures that they comprehend the material so fully that rather than spewing memorized facts, they can articulate their own interpretation and understanding of it. This is an extremely popular method used in classrooms as it can clearly show where a student's understanding of the topic lies. With place-based learning, students would be instructed through extremely hands-on, interactive curriculums. Place-based learning leads students through an immersive experience where they can learn at their own pace. This can be anything from a community garden to taking students into the Andes to see the biodiversity for themselves. Instead of just hearing about environmental conservation, students would have the opportunity to see in person what they are supposed to understand. Both methods allow students the space to connect to the material to improve their understanding.

Following the thought of a student showing their full understanding of a given topic, in the Universal Journal of Educational Research, Abdi (2014) discusses the effects of Inquiry-Based Learning on students' academic achievement in science courses. In inquiry-based education, students can engage in the thinking processes practiced by scientists. By starting at the beginning and being the one to ask questions, students develop a better understanding of the topic. Rather than seeking answers for a grade, students are encouraged to prove their own scientific theories. While this pedagogy tactic was originally created for science labs, its effect can be translated across multiple subjects in the classroom. In a common classroom setting, students are expected to follow the information they are given by their instructor without questioning it. This creates an atmosphere of passive learning in which students are unengaged and uninterested. Inquiry-Based Learning takes on a bit of a flipped classroom approach to drag out the curiosity in children and encourage them to understand the importance behind the subject they are learning. It leaves room for independent thought, a part of learning that is crucial to ensure an individual's full understanding of a topic. This pedagogy could be extremely useful when developing a deliverable centered around environmental conservation. Students would not only learn more about it based on their curiosity levels, but it would also leave a lasting impact on them as they understand the reasoning behind the need for this education. Inquiry-Based Learning helps students understand complex topics and become more confident in the classroom with the skills they gain. These methods contributed to the final approach taken in the project deliverable through creating a base idea of what activities and interactive pieces are important to include in the curriculum.

Aligning with place-based learning and inquiry-based learning, the "common world" pedagogy combines elements of both pedagogies to teach students how connected they are with the world around them. Much like place-based learning, the "common worlds" pedagogy focuses on immersive experiences to connect students with their learning material

and much like inquiry-based learning, it encourages the free thinking of students by having them consider their own perspective and connection to environmental topics. This pedagogy's goal is to bring nature into the classroom as well as bring students out into nature to use the environment as a secondary classroom, thus ensuring the connection between students and the world around them. It weaves present issues into a curriculum that prepares students for the future. While reflecting on ways their elders dealt with past issues, students can gain critical thinking and problem-solving skills that will become imperative for future decision making. Students today will face different environmental issues in the future, so they must be prepared with the necessary skills to approach these situations and know what questions to ask to overcome them.

These sources help develop the initial understanding of pedagogical methods centering around active learning. They provide the necessary background to create a deliverable that successfully integrates learning methods that have been proven to aid children in their understanding of environmental topics.

2.3 Biodiversity and Eco-Conservation in Ecuador

Ecuador is known for the biodiversity present in each of its unique ecosystems: the Amazon Rainforest, the Pacific Coast, the Galápagos Islands, and the Andes Mountains. Biodiversity is the variety of life in an ecosystem and conservation is protecting, maintaining and restoring ecosystems. Ecuador is part of the vast Amazon Basin which is known globally as one of the most biodiverse areas on Earth. Yasuní National Park located within the Amazon, adds to the biodiversity with 99.73% of the park's biosphere reserve consisting of original natural vegetation (UNESCO,2022). In addition to the Amazon, Ecuador's Pacific Coast is known for the mangrove forests, beaches, and coastal ecosystems.

Located on the Pacific Coast, the Galápagos Islands are renowned for their endemic species. Furthermore, the Andes mountains, which not only is home to Gualaceo, the location of the project's sponsor, Ecuagenera, run through the center of Ecuador creating diverse habitats at various altitudes. The paramo ecosystems found at higher altitudes, such as Cajas national park, are unique to the Andes and have specific plant and animal life that are adapted to cold and often harsh conditions. Ecuador has immense biodiversity due to the combination of these ecosystems. The country has a high commitment to conservation for preserving this wealth of life and ensuring the continued existence of its unique species, but even with all these conservation efforts the biodiversity is still facing endangerment putting these ecosystems at risk.

Biofin (2017) emphasizes the different threats areas and species are facing. Tropical ecosystems, like the Amazon, are the most biodiverse on earth, and Ecuador exemplifies this diversity. The country has around 23 taxonomic species of animals and plants reported, which constitutes 6,1% of all species reported worldwide, (Biofin, 2017). Biodiversity Gr., (2021) discusses how roughly 8% of amphibian species, 5% of reptile species, 8% of mammal species, and 16% of bird species in the world are found in this diminutive country, which comprises only 0.2% of the world's land area. To put this into perspective, this area is about the same size as Arizona, U.S.A.

The main area of expertise of Ecuagenera is orchids, specifically their preservation in the wild and creation of new species. José Portilla Andrade (n.d.) discusses how Ecuador is a small but super diverse country with lots of different biodiversity, especially its orchid species. 15% of all the orchids in the world are found in Ecuador. Articles from NatureServe (2015), Jorge (n.d.) and Aronson et al (2010) discuss the 9,000 orchid species present in Ecuador, and how that number may drop

to 6,000, approaching extinction. This decline is concerning given that the primary cause of this extinction is the destruction of Andean forests, which are home to a lot of biodiversity (Jorge, n.d). Several types of flora and fauna of the Tropical Andean Hotspots are facing endangerment due to the threats within their ecosystem. The Andes are one of 35 global biodiversity hotspots, defined as those regions that have at least 1,500 endemic plant species. Unfortunately, they have lost more than 70 percent of their natural habitat, (NatureServe, 2015). Despite its rich biodiversity, the hotspots rank as one of the most severely threatened areas in the tropics, with a large portion of its landscape having been transformed. There is a pattern of extinction due to the mountain forests being cut down due to the expansion of cattle grazing, forest fires and unsustainable harvesting, (Aronson et al, 2010). Meisel and Woodward (2005) warn that a majority of orchid species are found in the tropics. However, due to habitat destruction in the tropics numerous species are now endangered and becoming extinct. This has placed a higher emphasis on maintaining and protecting the biodiversity present in montane forest, which is forests found at high altitudes, but not high enough for growth to be so limited that trees cannot take root there.

Iberdrola (2021), Borchsenius (1996), Wiegant et al (2020), Oldfield et al (2012) Mestanza-Ramón et al (2020) and Stephenson et al (2022) all highlight important parts of endemism, a term used in biology to talk about the distribution of a “taxon limited to a small geographic area and which can therefore be found naturally in this place", Iberdrola (2021). A significant portion of plant species in the country is restricted to small areas, emphasizing the need for targeted conservation efforts. The spatial analysis indicates distinct floristic elements and endemism regions, with variations in protection levels across the country, underscoring the importance of understanding and addressing regional differences in conservation strategies, (Borchsenius, 1996). Wiegant et al (2020) delves into the challenges faced in Ecuadorian forest and landscape restoration governance . Biodiversity conservation policies in Ecuador, emph asize both in-situ and ex-situ conservation approaches . In situ conservation protects species in their native habitat, while ex situ conservation ensures plant material is available for research, horticulture, and education activities that ultimately support reintroduction efforts, to prevent species from going extinct (Oldfield et al, 2012). Despite a sound policy framework, the article discusses the challenges in the progress of ex-situ conservation, calling for international collaborations and small-scale breeding programs to address financial, infrastructural, and knowledge-related obstacles (Mestanza-Ramón et al , 2020). Stephenson et al (2022) discusses the importance of monitoring fauna, flora, and fungi to measure the impact of conservation efforts. This emphasizes the responsibility of various stakeholders, including governments, businesses, and civil society, in collecting and sharing data to inform decisions and enhance sustainability. Aligned with Meisel and Woodward (2005), Cuesta et al. (2017) and Comer (2022) argue s that despite subnational and national conservation strategies to protect and develop biodiversity in Ecuador, more needs to be done. As habitat transformation persists at accelerating rates, it is becoming more pertinent to identify which regions would benefit the most from land management goals to promote the conservation of biodiversity.

Similarly, Noh (2020) discusses the analogous criteria for the Red List of Threatened Species developed by the International Union for Conservation of Nature. These criteria translated to the creation of the Red List of Ecosystems method, which is used to analyze the threats present in forest ecosystems throughout Ecuador. It is the researcher’s hope that this study will lead to more public awareness towards ecosystem conservation and provide reasonable strategies for future improvements.

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In Gualaceo specifically, this project’s focus, there is a discussion on the overall land cover which indicates the physical land type such as forest or open water (N.O.A.A., 2024) Vizzuality (n.d.) discussed that in 2010, Gualaceo had 15.0 kha (kilo hector acres) of natural forest, extending over 44% of its land area. In 2022, it lost < 1 ha of natural forest, equivalent to 104 t of CO_2 emissions. In 2020, Gualaceo had 24.4 kha of land above 10% tree cover, extending over 71.6% of its land area. There is much discussion on the importance of preserving the land. Furthermore, VisitaGualaceo (2018) talks about the Collay forest and the Mylas lake in Gualaceo. The Collay Forest was established with the aim of preserving the terrain, vast water resources, and rich biodiversity in the area. Situated 21 km from the heart of Gualaceo, along the route to Limón, the forest spans across the cantons of Paute, Guachapala, El Pan, and Sevilla de Oro, with a population of 15,000 inhabitants. It is within this forest that the crucial water sources, supplying the city with water, originate. Preserving land like the Collay Forest and the Mylas lake is crucial along with teaching the local community members on the importance of the conservation of these important land areas.

Overall, biodiversity and eco-conservation align with each other exposing the risk to biodiversity that different regions are experiencing. Due to the immense risk to biodiversity that several distinct regions are facing it is pertinent that conservation efforts are prioritized in regions where biodiversity remains high.

2.4 Ecotourism, Activism, and Responsible Community Engagement

Ecotourism, activism, and responsible community engagement emphasizes the responsibility of participating members to align with

project leaders. Volunteers traveling from various locations of the world contribute to conservation initiatives. Some traveling volunteers can come in and try to do quick fixes. Though it is critical to provide lasting education and aid communities, it is crucial volunteers understand political, social, cultural, and economic differences when aligning project goals with the host. As Grimm (2013) states in a case study revolving around the Western Andes region, the success or failure of a project depends on the ability for beliefs to co-exist and it is important to try and create a global definition of conservation. Recognizing diverse perspectives and approaches to conservation can help to preserve culture as well. Nazarea (2006) analyzes these topics by examining if biodiversity is a scientific trait or if it is a social construct of the region. Local knowledge is critical to make correct decisions and be aware. Nazarea (2006) suggests that local knowledge is not only essential for effective teaching but also serves as a cornerstone for sustainable and culturally sensitive conservation practices. These insights contribute to the development of a comprehensive and culturally sensitive approach to ecotourism and activism. Local school systems actively involve local communities in the co-creation of educational content, ensuring that it is relevant and respectful of local cultural contexts. Communities in Countries such as Ecuador, Vietnam, Oman, and China were found to benefit from a consistent system to track ecosystems to put current conservation efforts into action to sustain biodiversity. Severs (2023) analyzes the best ways to plan for conservation on many scales, including education. With a modern approach to collecting data and preparing deliverable strategies that can be used in the project. A case study on Mangrove forests and their importance is delved into, making sure to keep these key areas for biodiversity and carbon emissions safe through a mapping system. While Herodotou (2019) discusses the best systems for preparing an education, Severs (2023) has presented the best systems for planning and collecting data to present to communities. These two readings may be used side by side to create a full education preparation process. Projects like this foster a sense of cultural pride and ownership over educational initiatives. These same educational practices are given from locals to tourists seeking to help, through skill and knowledge building progra ms. Keeping constant connection between locals and volunteers is critical for project success.

2.5 Conclusion

Together these topics form the background necessary to create a meaningful deliverable. Each source was used either as information in the end deliverable or reasons to back up the creative liberties taken with this project. By researching the conservation movement in Ecuador, an understanding of valuable environmental topics was gained, which was necessary as it is important to educate students on topics that are currently happening in their community. Having knowledge of multiple pedagogical approaches was crucial when designing the concept of the deliverable because it needed to be something students would respond to in order to make an impact. Understanding the levels of biodiversity and eco-conservation in Ecuador helped create the content presented to the students. Researching how to responsibly engage with the Gualeceo community as foreigners allowed for an appreciation of their culture which aided in the creation of small details throughout the final product. This research served as a starting point to guide the decision making surrounding the methods used to gain more information and influenced the direction of the creation of the deliverable.

3.0 Methodological Section

3.1 Outline

3.1.1 Objective

This project aims to raise an understanding of local biodiversity, conservation, and ecosystems through an implementation of educational materials that can be adapted to additional regions. With this purpose in mind, the methodological section was approached to gain deeper insight into the best pedagogical approaches and topics to implement into the deliverable along with the current state of the research problem including relevant laws/policies and previous or ongoing initiatives.

3.1.2 Overview of Methods

The purpose of the Methods Section is to demonstrate the strategy and approach taken throughout the project and to provide the relevance of each to the research project. This project uses a multi-method qualitative research design to achieve depth and increase findings.

The methodological section will discuss:

1. Archival Research
2. Semi-structured interviews
3. Ethnographies
4. Pilot Study
5. Ethical Considerations

Throughout the data collection process, an understanding of the community's needs was developed. This was achieved using archival research, semi-structured interviews, and ethnographies to fully understand the key environmental topics and pedagogical practices that are best received in this region. Before starting the process of creating the deliverable, it was necessary to understand the information used in it. Archival research provided the necessary background and information needed to start formulating questions to further develop the project goal and curriculum. Semi-structured interviews were implemented to gain a better understanding of individuals' knowledge to explore what deliverable approach fits the needs of the Guacaleo community best. Ethnographies were used to further understand the Gualaceo community and environment. Through observation and immersion into the community, knowledge of how human nature interaction occurs and what ways the community could improve their conservation methods was gained. A pilot study was conducted to assess how students interacted with the proposed deliverable and their attitude towards learning. After data collection, the information from interviews along with the observations and archival research were analyzed to develop the findings. Together, these insights were used to curate the deliverable to best fit the community's needs.

3.1.3 Overview of Data Collection and Analysis

To collect data, audio recordings were taken during each interview in addition to written notes of key points. After the interviews, each audio recording transcript was used to analyze responses and sorted by questions and main themes. This allowed for a clear understanding of the answers received, through a comparison of the commonalities between each interviewee's perspectives. To further accomplish this, Voyant was used to create word bubbles displaying word count frequency on response

segments from aligning questions. Each key theme became an important aspect that was thoroughly considered when designing the deliverable.

Ethnographies were discovered through observed human interaction in every new environment while spending time in the field. General notes were taken describing the way individuals speak about and treat the natural world. An understanding of local culture was gained by discussing what environmental issues they felt most impacted by and how their communities came together to combat them. Photos and notes were taken during a tour of Satana Elementary School, keeping track of the activities and tools the school uses to educate their students. After organizing the key findings during interviews and the observations made while in the field, it was understood what was most important to include in the deliverable for it to be meaningful as well as successful.

3.2 Methods

3.2.1 Archival Research

The objective of this qualitative method is to build a comprehensive, credible knowledge base aiding in the understanding of the context of the problem statement relating to conservation and biodiversity education in Ecuador thus allowing for informed fieldwork and educational materials. The bulk of the archival research was done in the early stages of the project due to the accessibility and quantity of this data. Through conducting archival research these key questions have been answered:

1. What is the current state of conservation movement in Ecuador?
2. What is civic involvement in environmental conservation and biodiversity?
3. What are the legal regulations surrounding environmental conservation and biodiversity?
4. What are the best pedagogical practices for teaching young children about environmental topics?
5. What are the current conservation efforts in place?
6. What are economical, historical, and social factors that contribute to conservation and educational practices?
7. What is the biodiversity present in Ecuador and why is Eco Conservation important?
8. What are pressing environmental issues present in Ecuador? How do these contribute to biodiversity loss?
9. What aligns sponsor and volunteer goals? How can volunteers successfully conduct their experiences?

During this step, the key findings from those questions were compiled into an inclusive literature review grouped into four sections: Societies Role in Conservation, Environmental Education Pedagogy, Eco-Conservation and Ecotourism. Each section of the literature review incorporates multiple sources that outline varying points of views.

While conducting this method, extensive research across numerous sources and platforms was done. To compile this data, various online academic publication databases including the WPI (Worcester Polytechnic Institute) Gordon Library database, JSTOR, Springler and Google Scholar were utilized. Additionally, relevant articles provided by the project sponsor Juan Pablo and interviewees were researched while in Ecuador. Key articles, their references and google scholar citations, were used to find additional sources that were related to the research.

When searching for sources, selection bias, “a non-random selection of cases that is not statistically representative of the population” (Lustick,

1996), was mitigated by a prioritization of peer reviewed sources and triangulation: “in an effort to strengthen the findings and potentially enrich the eventual analysis and understanding” (Lune & Berg, 2017). This triangulation validated the stance through a review of numerous sources to arrive at one synthesis. When learning from these sources, critical lenses were applied to not be overconfident.

In addition to selection bias, one of the most prominent weaknesses to the archival research method is that only available records can be used. Since this research was conducted to address a problem that had not been previously solved, there were no resources available that solved this project’s research question. Another shortcoming of this method is that archival research may be out of date and that English sources are primarily being used. The research question centers on Ecuador, a primarily Spanish speaking country. To mitigate this weakness , the project sponsor Juan Pablo Martinez and interviewees sent additional Spanish sources.

It was integral to the project's success that archival research was completed in depth prior to conducting the other methods, such as interviews and ethnographies. Conducting this research method first provided the project with the relevant background information along with the current state of the problem context, which cultivated a clear vision of where to push progress. To further account for the weakness of archival research and best complete the project, other methods were employed to cultivate a holistic understanding of this research domain. The other methods worked together to fill the gaps that were unachievable in this step, validating information found in this initial method, and expanding upon key topics.

3.2.2 Interviews

Semi-structured interviews were conducted to collect perspectives from locals in the Gualaceo region to further the knowledge on key themes. Unlike structured interviews, these interviews were conducted in a manner to allow for decreased pressure and allow for a more relaxed discussion, leading to more honest answers, unlike structured interviews (Lune & Berg, 2017). Throughout this process every interviewee was given the space to speak about what they feel is important.

At the beginning of each interview, consent was secured through an IRB consent form (Appendix Figure 1), with copies in both English and Spanish (Appendix 2) to ensure every interviewee had a full understanding of what was being asked. To avoid ethical issues such as selection bias, individuals with multiple professions and backgrounds were interviewed.

Background research (Appendix 3) was conducted prior to each interview to establish objectives, key takeaways, and interview questions. Throughout the preparation process, conversation topics were differentiated and adapted based on who the interviewee was to ensure the information gained was most beneficial based on their expertise. Each interview was formatted around five questions which fall under different themes with the space to add upon each question (Appendix 4). The input received on the different topics added insight to the end deliverable, as they are the experts within their fields. Different conversation topics and questions were centered around the following themes:

1. Pressing Enviromental Issues Findings
2. Pedagogical Approach Findings
3. Laws and Policy Finding

4. Knowledge Gap Findings
5. Deliverable Findings
6. Human Nature Interaction Findings
7. Former Initiatives and Projects Findings

Answers from each interview were compiled into documents that broke each transcript down by question to compare answers and find similarities (Appendix 5). The information gained from this method helped to create informative education materials that engage students. An understanding of pressing environmental issues that specifically the Gualaceo region is facing along with the efforts being made surrounding them, key knowledge gaps and successful strategies to promote a greater understanding was developed. From the interviews, insight was gained on different initiatives, educational pedagogies and what has allowed them to be successful or not. There was a gain in comprehension on what policies or laws must be abided through the creation process of the deliverable. The collection of this qualitative data, qualitative research and gathered non-numerical approaches helped find a feasible environmental educational material.

Voyant tools were created after interviews to facilitate reading and interpretive practices for its users. Word clouds were generated from given documents to show word frequency and perform text mining functions with plain text (Appendix 6). It helped triangulate and extract key themes that are present across the interviews.

3.2.3 Ethnographies

In this study, ethnographic methods were used to gain a deeper understanding of local culture and social life of Ecuador, particularly the cities and communities of the Gualaceo region. Ethnographies are a qualitative research practice involving participatory fieldwork and

To keep track of this information, audio recordings, photographs, and detailed field notes were taken (Appendix 10). These notes included descriptions of surroundings paired with other tools to maintain freshness of the information.

These tools are:

- Transcribed audio recordings to add a layer of detail. Transcriptions and audio recording interviews via Otter.AI.
- The tool, Voyant, was used to capture similar themes throughout the notes, to identify specific things observed within the community, for instance games or activities popular among youth.
- Notes on overall maintenance, location appearance, and available amenities captured observations of the physical environment, interactions, and practices.

As Roitman (2009) states, to understand this culture, the team must be involved in locations of heavy social interaction and planning. Three main locations that the team has observed and participated in are community gatherings, school events, and observations at Ecuagenera. By immersing in these locations, it became easier to see what was feasible for this deliverable. The deliverable must be distributed to many locations so must fit the needs and availability of all locations.

3.2.4 Pilot Study

To further validate the findings that lead to the deliverable proposal, a pilot study was conducted to assess strengths and shortcomings of the initial design. The pilot test was run at Santana Elementary School during one class period of 40 minutes with 22 children, ages nine and ten. To ensure the game's use would be able to continue after the project's team

departure, a teacher at Santana ran the game with her students without the help of the project team. The directions were explained, and the students were split into groups of four. Students were taken outside and from there, lead themselves through the game. General notes were taken throughout the test regarding the imperfections of the proposed deliverable and the response students had to the game. After conducting the pilot test, the teacher asked students what parts of the game were too difficult to understand and what parts they liked the most. The collected data wa s used to make changes to the proposed deliverable. This pilot study allowed for a new perspective o f the game and an understanding of the feasibility and success.

3.2.5 Ethical Considerations

This project navigated many considerations in every method through informed consent, respect of privacy, properly securing data, and recognizing the potential situation of distress.

For informed consent, prior to interviews, participants were given detailed information on the project's research goals, and how the data is being used, as well as making it clear this is voluntary participation. A form of consent was given prior to the interview, whether verbal or written, making sure the consent practice was respectful to the interviewee's preference. The flexibility of the interview was made clear to participants. If they felt uncomfortable with a question or situation, they were not required to answer and could terminate the interview. Although this process was designed to be executed smoothly and respectfully for the most honest and accurate data, it is not expected any participants will be distressed. These interviews were conducted in the language of choice of the participant, English or Spanish. This allowed for the most accurate data. Confidentiality of information was paramount during a research process. Participants were assured that their identities and correlating response will be protected. Anonymity was maintained when presenting the data, unless clear permission was given through the consent form by the participant to be included in this final report. Participants could request different levels of confidentiality, and this flexibility was prepared ahead of time. Access to the data was restricted within the project's authoritative members and kept in an organized and safe OneDrive.

Anticipating potential distress to participants, measures were taken to minimize emotional stress during and after the interviews. Through the other ethnographic practices, the team held “small talk” conversations during interviews to get to know the interviewee. After the interview was conducted, follow-up conversations were held to discuss the conversation's success and any questions or concerns. Contact information was provided for follow-up outreach or information. If a participant is heavily distressed, local resources for counseling will be provided, but it was not expected that this is a concern regarding this project topic. While these processes were prepared, all interviews ran smoothly during this study and no participants were distressed. However, it is paramount to the project team to be well prepared ahead of time.

The outlined ethical considerations ensured that the research was conducted with integrity, respect, and a commitment for the safety of the participants. “Through extensive self-questioning reflection, I sought to understand my own subjectivity and to avoid imposing upon my research population pre-conceived theoretical categories” (Roitman 2009). This project was a great privilege and the team strived to be respectful and avoid observer bias.

3.3 Limitations

3.3.1 Limitations of Interviews

While much knowledge was gained through conducting interviews, many limitations were still present. Half of the interviews were done in Spanish and while two members of this group are proficient in Spanish, it is possible that some points were lost in translation during the interview. To combat this, audio recordings were taken and the google translate transcribing tool was used, however no translation tool is 100% accurate especially when listening to people speak. Interviews are also self-reported data, meaning it can be unreliable in some cases if someone does not have the best memory (Berg & Lune 2012). In addition, all data collected in interviews is opinions based and it must be recognized that these opinions may not represent those of the greater population. With this project, there was also no ability to interview children. This project followed the current practices of WPI's Institutional Review Board in which all the semi-structured interviews were conducted with adults. To understand children's perspectives as the deliverable was designed specifically for them, the interviewee pool focused on adults who work with children as they knew which pedagogical practices children respond best to.

3.3.2 Limitations of Ethnographies

Berg & Lune discuss the limitations found in ethnographic methods claiming that "we may spend time at a field site hoping to observe actions and encounters of a particular kind, and not find them" (Berg & Lune 2012). Due to the unpredictability of nature and unfamiliar communities, planning and researching can be done but interactions with individuals in the community may not go as hoped. It was possible to "simply fail to achieve a useful rapport with your subjects no matter who has endorsed you. In such cases, you will never really become an insider or gain the perspective of the other" (Berg & Lune 2012). To overcome this limitation, research was completed prior to any field work to better understand the customs and personalities of the communities that these methodical practices were conducted within. This aided in the mission to develop relationships and rapture within our conversations so that individuals felt comfortable sharing their stories.

3.3.3 Limitations of the Deliverable

When thinking about the application of this deliverable, it was recognized that every individual learns in their own way. No one educational tool would be able to accommodate for every learning style. To overcome this, the deliverable was made with the idea that if it were broad enough, each child would be able to approach it in their own way and gain the knowledge that their curiosity led them to. In addition, the project sponsor had requested that the deliverable be very easily distributed, which limited the options to something that could be accessed online. This deliverable was created specifically based upon the needs of the children in the Gualaceo community and these needs may differ from children in other parts of the world. It is tailored to the community based on the best pedagogical practice as well as the environment they live in and the ways in which they already practice environmental conservation. This deliverable will likely not apply to places with vastly different environments and containing other levels of biodiversity. In addition, the final deliverable needed to be something that could continue without the team's support and knowledge. This project was also limited to something that could have been completed in the seven weeks allotted for IQP Projects.

4.0 Findings

4.1 Findings

4.1.1 Introduction

Throughout this study, the team has identified concepts regarding pressing environmental issues, pedagogical approaches, law/policy, former initiative projects, and knowledge gaps. These were consistently supported by the multimethod qualitative study implemented throughout this project to create a meaningful deliverable proposal, which was further supported by a pilot study. This validation led to the creation of the end project deliverable.

The discussion of pressing environmental issues served to identify the problems that needed to be addressed to fill knowledge gaps, to educate within the end deliverable. The pedagogical approach findings included topics like game-based, collaboration-based, and student-led approaches, educational communities, multi-sense activation, and human-nature interaction. Law/Policy and Former Initiatives analyzed the role of the current policies and initiatives in place along with community engagement and support. The knowledge gap identifies the need for the deliverable's focus and what areas call for further investigation to gain a more in-depth understanding for everyone. The deliverable proposal looks over the requirements given, insights received and the proposed final game deliverable. A pilot study was conducted to test the feasibility and impact.

4.1.2 Pressing Environmental Issues

In line with the project sponsor's motives of expanding Ecuadorian biodiversity and conservation, one of the key topics this study centered around was pressing environmental issues. To accomplish this, educational and environmental experts of the region of Guacaleo were asked questions surrounding these topics during interviews.

Their answers to these questions revolved around concepts including:

- The preservation of water and the care of rivers
- Waste generation and the mismanagement of waste and garbage
- The extension of the agricultural frontier
- Forest protection

Through interviewing, overlapping environmental issues were discovered that were added to the project deliverable curriculum. Figure 2 demonstrates the word frequency of the responses given by the interviewees when asked what the most pressing environmental issues were to educate children on in this project deliverable design. This word bubble displays that waste and water were very frequently referenced when discussing this topic. Furthermore, in the word bubble other terms like agricultural, responsibility, conservation, awareness, ecosystem, forests and preserve also appear. These detected themes were emphasized within the project deliverable.

Figure 2: Voyant Word Buddle Analysis of Interviewee Responses to Environmental Issues

A comprehensive analysis of the interviews further solidified these issues as essential aspects of the deliverable design. Throughout the interview process these pressing environmental issues were consistently brought up. Gloria Aguilar the Municipality of Gualaceo Director of Environmental Management discussed that there are bad waste management practices throughout the region of Gualaceo and warned that this is of concern because the solid waste ends up in the conservation areas, streams, and rivers. To account for this, she feels more awareness is needed about responsible consumption and disposal. Andres Bonillo, the Education Director for the District of Gualaceo and Andrés Martínez-Moscoso Teacher Director of the Legal Research Institute also discussed that education surrounding waste and recycling is extremely important. Field observations further backed up these points when trash was seen in each ecosystem of the Gualaceo drinking supply source (Figure 3). Furthermore, Andrés Martínez-Moscoso urged that water is the future and a valuable resource that is important to protect. He also discussed the crucial role forests play in water protection. Similarly, Juan Pablo discussed the interconnected nature between forests, water, and biodiversity. Trees provide water protection from cow manure and solid waste (Figure 4.) Additionally, when trees are removed soil quality diminishes which depletes the necessary nutrients from it preventing which decreases biodiversity. Furthermore, soil is more prone to erosion and may end up close by water sources. When materials pollute water, this in turn affects the flora and fauna relying on it to live. When one entity of an ecosystem is affected, the rest are in turn.

Figure 3: Waste at San Fransisco River Reserve

Figure 4: Cow on the perimeter of a reserve

Similarly, the interview with Gloria urged that forests are a resource that needs protection because they are prone to forest fires. Another environmental issue that Gloria discussed is the continued extension of the agricultural frontier. This problem is a pressing concern, for it cuts into conservation areas and natural resources/biodiversity. To address this problem, communities need to be educated and given alternatives for economic development. They are accustomed to this tradition of agricultural development. One example of a problem that can be mitigated with education is that many farmers have more cows than economically necessary. This abundance adds to the farmland; however, education can be implemented to reduce this pattern. The pressing environmental concepts revealed throughout this study were also reported to be improvable through education and awareness, which is what this project addresses.

4.1.3 Pedagogical Approach

Aligned with previously researched pedagogies and learning strategies, interviewees discussed ways to keep students engaged in the classroom. In an interview with Pablo Crespo, the principal of Santana School, he explained the new methodologies they are exploring and the ways he has noticed improvements in the classroom because of it. Sanatana School is practicing techniques used by the Common Worlds Research Collective to teach their students about their connection to the more-than-human world. The pedagogies used at Santana School are a combination of previously researched pedagogies, inquiry-based learning, and place-based learning. He noted that today's children will deal with different environmental issues than those that exist today. For that reason, Santana focuses on not teaching students solutions to problems but instead teaching them critical thinking and problem-solving skills so that they can one day overcome the new environmental issues they will face.

Teachers use past examples of how their elders dealt with environmental issues as ways to help students understand the process of approaching and assessing real life problems. At Santana School, learning is very student-led. Teachers allow the natural curiosity and tangents of the children to guide each lesson, while using strategies to keep them engaged. One example given w as teachers rephrasing questions to ask their students to have them consider their own opinion and other potential perspectives.

In addition, Pablo Crespo spoke about strategies that he has seen engage students. First, he explained that when students activate more of their senses, they become more engaged in the activity and as a result, learn more. He recommended the deliverable incorporate the students' sense of touch, sight, and hearing to see the best results. Santana School also integrates more group-based activities to focus on the collaboration of students and try to steer students away from the competitive nature that can often stem from competing for individual grades. To place an emphasis on collaboration, Santana also promotes community-based learning. It is important that learning extends beyond the classroom, so parents and other community members take on an educational leadership role to aid students in solidifying their understanding of topics. Andres Bonilla also discussed the need for community involvement, saying that the collaboration of all parties allows for true education.

In an interview with Gloria Aguilar, she explained observations she has made in the past regarding student engagement. She has noticed that students respond better when the teaching style is not a professor lecturing at them, but rather activities such as games, videos, or taking the students out into the field. This aligns with the practice followed at Santana School of taking students into nature during class activities and bringing it into their classrooms as educational material. As observed when taking a tour of Santana Elementary School, students used leaves

and twigs to construct self-portraits of themselves. The interviewees recommended the deliverable be interactive, eye-catching, and simple enough for children to understand.

4.1.4 Law/Policy & Former Initiative Projects

Correlating with the findings in the literature section, the interviews backed up that there is a constitutional commitment and practical effort aligning with the Conservation Movement and the public role in living in harmony with nature. The interviews revealed that there are massive efforts in place to improve this relationship and push beneficial human interaction with nature alongside formal legislature.

They also confirmed that the constitution is the most important regulation in place in Ecuador and that there is a specific chapter housing information that deals with the health and rights of the environment. Additionally, in different cities there are local regulations in place that influence the community's interaction with nature. These local regulations are called municipal bills. An important bill in place is the one for the conservation of natural resources. Bills like this one allow for the execution of environmental projects. In addition, the interviews revealed that local regulations generate local conservation policies which shape the execution of environmental projects and education. Bills form the local norm, vital for project makers to generate the most impactful projects through aligning them with these norms. An important national standard is the Organic Law on Water Resources, Uses and Water Use that the local law from the Ministry of Environment is based on. This law promotes environmental education in the participating sectors. Gloria feels that since the implementation of these bills there has been an overall positive impact. She has seen that when people are aware of the actions they should avoid to comply with regulations, there is a positive environmental impact. However, she feels that there is a need for increased environmental awareness and improved practices, which is what this project sought to address.

Since the increased emphasis on positive human nature interaction in Ecuador various projects have been enacted with varying techniques and outcomes that were used as example to learn from in the creation of this project's final deliverable. Andres Bonillo discussed the project for the protection of sources. This project works with community organizations that provide drinking water services to showcase where the water the community consumes comes from. The bill in place helps with the success of this project. This project allows the children to learn that their water is not independent to them, but is from the shared resource of the Maila del Rio la Sol. An ongoing project implemented in the Guacaleo region is Gualardianes. The Municipality of Gualaceo along with the Ministry of Education implemented this project to support the preservation of species in the environment. annually reach 2,000 children. One of the ways this project tries to accomplish this is through the Project of the Bears. Through this project students participate in various activities like watching educational videos with bear characters coinciding with visits from these same characters where they learn about the community around them. This allows for the students to get a nontraditional approach to environmental education. Gloria and Andres Bonillo feel that the activities of the Gualardianes project are successful due to the innovative approach taken. Additionally, in the interview with Andres, he discussed the impacts of projects like participating in school gardens, cleaning the shores, and recycling bottles on young children arguing that forming good habits when children are young will help them carry over good environmental practices to when they are older.

The interviews also revealed that community engagement plays a

significant role in the impact that environmental initiatives can make. One of the biggest struggles in engaging the community and gaining support is that the programs do not have compensation or incentives. Despite this struggle Gloria thinks 40% of them have accepted local regulations and the rest have resisted due to the lack of budget for programs that generate incentives based on the needs of the communities. Ideally, to combat this obstacle, programs can be created to teach students to do things that are done day to day to help create good habits on topics like water, reforestation, and care of all species.

4.1.5 Knowledge Gap

A knowledge gap refers to the difference in understanding between individuals or a group. This separation may be present for various reasons, but it is crucial to identify, to help foster healthy education. While young students of Gualaceo are surrounded by lush biodiversity and scenery, there is often a gap with regards to understanding this biodiversity and pressing environmental issues. Key concepts targeted are waste, forests, water, the extending agricultural frontier, and biodiversity and its role in ecosystems (Figure 5). The project's initiative was to bridge the knowledge gap by having students actively participate in an activity that can connect them to this information surrounding them.

Figure 5: Pieces of trash tucked into riverbank

The interview with Pablo Crespo, the principal of Santana Elementary School, revealed that the kids whom this project's deliverable is educating will face different environmental problems in the future than those occurring today. Due to this, he advised aligning the deliverable to teach students pertinent skills that will aid them in solving the problems they may face in the future. For example, nature observation and appreciation are critical skills that have been implemented into the deliverable as a desired impact. Gloria Aguilar feels that p eople do not value what they do not know. She believes what will generate the most impact is showing them what is around them: plants that exist in the forests, animals that roam there, how each one functions in the ecosystem, along with how they respond to the other life and outside impacts.

4.1.6 Deliverable Proposal

As previously stated, the main goal of this project is to make successful educational materials that engage and teach young children and can also be easily distributed to the local schools of Gualaceo. Throughout the interviews conducted and the ethnographies collected, it was discovered that keeping in mind the interaction of the children with each other and their interaction with the environment would lead this project to be most successful keeping the main goals in mind.

4.1.6.1 Requirements

For the creation of the deliverable, there was much room for creative freedom, but the sponsor Juan Pablo gave requirements. Juan requested that all materials of the final product be a PDF. He wanted the material to be easily distributable, so that the educational materials could be implemented across Gualaceo and beyond as well as not limited to needing a physical material. Furthermore, it was asked that this material is engaging to increase student participation, collaboration, and interaction.

4.1.6.2 Insights

After an interview with Gloria Aguilar, she recommended that the educational material taught should not be with just a paper but with a hands-on activity. Pablo Crespo discussed that different hands-on activities and workshops in the classroom like gardening workshop, ceramic workshop and using waste to make renewable energy are great examples of interactions of student with each other and their surrounding environments. Focusing on making the children more observant is a result of being immersed in a connection with the environment Both interviews gave insight on how important the collaborations of students with one another and with the local ecosystem are throughout the process of the game design.

The ethnography collected from touring Santana Elementary School provided insight on the aesthetics of the final deliverable. When walking through the art class materials were gathered from the outside environment surrounding the school. (Figure 6) shows an art installation the children learned from which represented the ground and the roots underneath them.

Figure 6: Art Installation at Santana Elementary School

It included recycled plastics, yarn, fabric, and branches. Based off the interview with Pablo Crespo and from walking through the classrooms, it was evident that the children were surrounded by natural and neutral colors, colors that they would see in their everyday life while outside in the environment. In the creation process of the final deliverable, the team used the ethnographies collected as input for the design process. It was clear that keeping the final deliverable realistic to the local environment needed to be included (Figure 7). The final deliverable game book has the colors that children would see outside such as greens, blues, browns, etc.

Figure 7: A classroom at Santana Elementary School

It was also emphasized for the boost of overall engagement, keeping it simple and catchy is a necessity. Santana Elementary School's classrooms had very minimal decor. The rooms were white with occasional beige accents that were materials for learning. There were no unnecessary decorations. Pablo said this was because the students need a simple learning environment. The more complicated and useless elements there are, the higher the chance is for loss of engagement.

4.1.6.3 Interactive "Eco-Aventuras" Deliverable

Since interactions, disreputability and elementary school aged children are concepts that needed to be factored into the education material, the final idea for the end deliverable is an interactive educational environment scavenger hunt (see Appendix 7). To play you will go on a scavenger hunt gathering pieces from nature. This part of the game emphasizes the interaction of the player with the environment. The students will work in groups to gather all the pieces to compile and collaborate to create a collage of all the materials. This emphasizes the interaction of the students with each other.

The scavenger hunt consists of 3 booklets. Everything is in pdf format so it can be easily distributed and downloaded. The first booklet "Eco-Aventuras" is the activity booklet. It consists of different activities to explore outside in nature (Appendix 7). With each activity there is information that goes with topics like finding a rock for the mountain section. Each adventure booklet activity is centered around the environmental topics and issues discussed and collected in the interviews. Booklet 2 has additional information on topics including Ecuador's overall biodiversity, Ecuagenera, orchid information, important bodies of water, local forests, flora, fauna, solid waste management and information on cattle and agriculture (Appendix 8). The activity booklet

needed to be concise and engage the students, so the information needed to be to the point. The additional information gathered from research was compiled into the extra informational booklet for the students. This serves as a resource they could use if they wanted to learn more about a topic that excites them, or if a teacher wanted to further educate the students, it can be used as a guide. Booklet 3 includes all the game materials needed that are not included in the other booklets (Appendix 9). It has printable dice and game boards to place all the collected materials on once the scavenger hunt is progressing. The printable dice are in case the students do not have a set readily available. The material will first be implemented in Gualaceo so the main game board is a map of the Azuay Province, which Gualaceo resides within. There are boards for every province to allow it to be expanded to other provinces, along with an Ecuador board. The information is fitted to the Gualaceo environment, so it is most fitted to be played with the Azuay board.

4.1.7 Pilot Study Findings

The pilot study allowed the strengths and weaknesses of the initial deliverable proposal to come to light. The students, aged 9-10, were given the game to complete, which allowed for assessment of the flow of the game, student engagement, and effectiveness.

Students were effectively able to complete all game steps and activities without getting stuck on any part. This take away was further validated by the student's teacher who said that the students understood the game and were not confused by any aspect of the activity. However, the teacher advised that some of the verbs and information included within this version of the activity may be too complex for them to fully grasp at this age. Although, this did not take away from the game flow it may impact their learning outcome. To address this finding this version of the activity is recommended for children, 7th grade and up (Figure 8). An adapted activity keeping the concepts and facts intact, but with a reduction in word level and quantity was created which is recommended for children under 7th grade. To further improve clarity and increase the ease of the game flow the game steps and dice roll activities page were also simplified with fewer words and a more picturesque appearance. (Figure 9).

Figure 8: Activity Book for 7th Grade and Older vs. 6th Grade and Younger

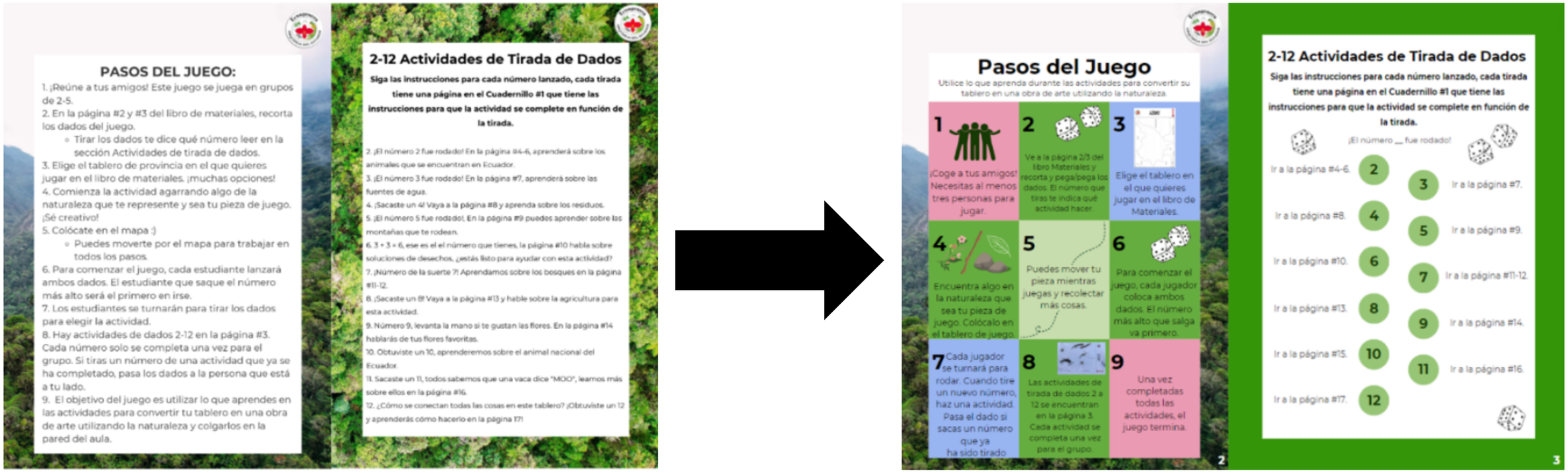

Figure 9: Updated Game Steps and Activities

When introducing the activity, the students were excited and screamed out in joy when they heard that they would be playing a game outside in groups. This excitement continued throughout the completion of the activity and was shown by their laughing, active deliberation about questions posed to them during the activities and running to gather the requested objects (Figure 10). These findings correlate with background research and interview findings which lead to the deliverable proposal design including an immersive experience in nature, collaboration, and game-based material. At the end of the study, the teacher complemented this pedagogical approach, saying that the students always like activities that allow them to go outside and participate together.

While completing the activity, the students took the time to read the activity steps and the information provided below the given activity. After the study, the students revealed to the teacher that most of the activities worked well and could be completed. There was one activity they said could be changed , an activity involving choosing an object that represents water. This activity was challenging because there were not enough examples given and led them to believe they had to find something blue, which is not common in nature (Figure 11). This question was adapted for the final deliverable to improve clarity.

Original Question: Take something that represents your local water sources (e.g., pebbles) and place it on board where there is water.

Adapted Question: Create something on your board that represents your local water source (for example, create a stream path with pebbles, mud, gravel, or draw it).

Figure 10: Students investigate activity before racing off to complete

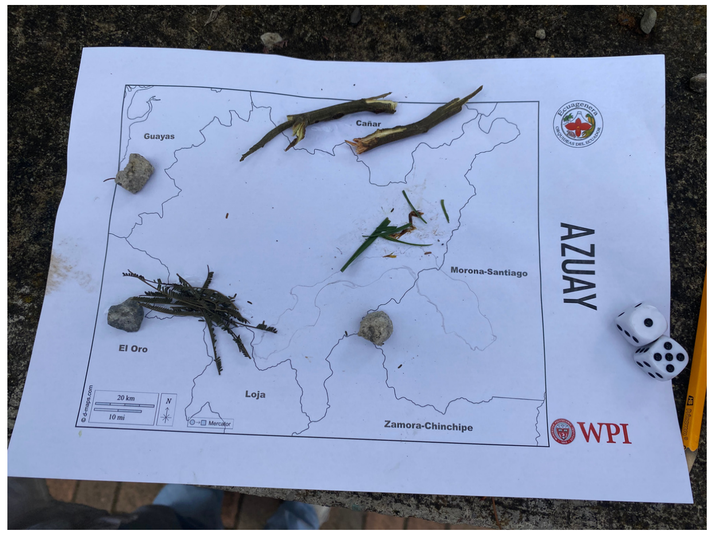

Figure 11: Completed Group Game Board

Using the insights gathered from this study the deliverable proposal was altered to create the final deliverable design.

4.2 Results

Each methodology's findings were pieced together to create a final deliverable that accomplished this project's main objectives. Information received about knowledge gaps within the community was used to better understand the purpose of the deliverable. Pressing environmental issues were considered when deciding what information was most important in the "Eco-Aventuras" game and the additional booklet. The questions connected to the game were created by identifying main categories of environmental issues based on what the interviewees felt were important in their community and previous environmental solutions that have been implemented.

Knowledge gained about what pedagogical approaches worked best in classroom inspired the hands on, collaborative nature the "Eco-Aventuras" brings to the learning space. Based on advice received, the deliverable was made so that children can approach it in their own learning styles so it can benefit most students. This game prompts students to consider their own perspectives on the environment around them, bringing in aspects of Inquiry-Based Learning. This game uses Place Based Learning by immersing the students in nature throughout the game. The Teach-Back Method can be incorporated as this game is something that students can take home and do with their families. With the information collected from interviews in mind, the deliverable was designed to have students up and moving to activate their senses by having them interact with the various parts of their surrounding environments. Students can feel nature firsthand and guide themselves through the activity, creating skills of independence and problem solving.

5.0 Conclusion and Recommendations

5.1 Conclusion

When this project was first proposed, the sponsor requested educational material for children focusing on environmental topics with a few suggestions as to how to begin creating an idea for the end deliverable The creative freedom given during the process of making the final product allowed for an opportunity to create something innovative and impactful. Every decision made surrounding the deliverable was supported by thoroughly done multi-method research. The environmental topics included were a combination of what the archival research done had uncovered to have large effects on the Gualaceo region and what issues locals felt most impacted by. The game design directly reflects the findings of which pedagogical approach would best suit the children of the Gualaceo region when focusing specifically on environmental topics. This game is adaptable, sustainable, distributable, and will truly engage the children it is presented to. The end deliverable of this project achieves every objective that it set out to complete.

It is hoped that this project will be implemented and built upon so that children can begin to understand the ways in which they impact the non-human world. While the children using this deliverable are young and may not remember doing this exact game or reading the exact facts in the provided booklet, by playing this game and similar school activities it may inspire, the students will learn to care more about their environment which is a way of life they can carry with them as they get older. This game will leave them with an understanding of the connection between themselves and the world around them, which ultimately was the most important goal of this project.

5.2 Recommendations and Future Work

One of the largest goals of this project was distribution and flexibility. Aligning with sponsor goals, this deliverable was designed to be broad so that it may be implemented anywhere in Ecuador, as well as possessing the ability for the material to be adapted to the specific province. Through the flexibility of the final deliverable, it is suggested that the main concepts, fun facts, and key knowledge of Ecuadorian biodiversity and environmental issues are kept the same, but certain sections regarding the specific regions (such as Azuay, Canar, El Oro, Loja, Napo, etc.) may be changed to improve the game for that specific province. This will also allow teachers to fill the knowledge gap they find with their own students. By having a deliverable scalable to any location, this will help cover the key points in all the findings.

While this project can stand alone as an educational tool, it can also serve as a baseline for future environmental activities or inspiration for future projects. It was presented by the sponsor that this may not only be involved in the classrooms of schools but possibly that this activity may be implemented at municipal offices at parks or forest trails. This may also increase the attraction of people to use these trails and spend time in nature that is so easily accessible to them. Also, adding an engaging aspect for young kids while they spend time at these locations, that may be less intriguing otherwise. Allowing Ecuagenera even more opportunities for community engagement and compatibility for this deliverable in several locations.

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Note: All photos without citation were taking by the team or Paúl Villa Grandes of the Ecuagenera Media Team

Appendix 1. Informed Consent Agreement for Participation in a Research Study

Informed Consent Agreement for Participation in a Research Study
Investigator(s): *Ella Moreau, Eleanor Fields, Megan Gilman, Will Crawford*
Contact Information: *Group Alias Email- gr-FloresIQP@wpi.edugr-FloresIQP@wpi.edu*
Title of Research Study: *Ecuagenera Education Implementation Group*
Sponsor: *Juan Pablo Martinez of Ecuagenera*

Introduction.
You are being asked to participate in a research study. Before you agree, however, you must be fully informed about the study's purpose, the procedures to be followed, and any benefits, risks, or discomfort that you may experience as a result of your participation. This form presents information about the study so that you may make a fully informed decision regarding your participation, and it will be read in full.

Purpose of the study.
You are being asked to take part in a research study concerning a project that aims to raise an understanding of biodiversity conservation in the southern Andean reserves of Ecuagenera through an implementation of a curriculum that we will create and design based off archival research, semi-structured interviews which we will be conducting with the local conservationist, authorities and education experts of Gualaceo, Ethnographics to learn about the best pedagogical practices for students ranging across different age groups in the Gualaceo region.

Procedures to be followed.
We are doing a multi-method research design by using multiple qualitative research methods to achieve depth and increase the strength of our findings. Within our report we will discuss data received through Semi-structured interviews and Ethnographies. The goal of this data collection is to narrow down the most affected deliverable to aid students. This will all be conducted over a two-month time span while we are located in Ecuador. While conducting this interview we will proceed with an audio recording, video recording, or written notes. The questions asked will only discuss the project topic and not be directed at personal topics. There is no requirement to answer any specific questions.

Risks/Benefits to study participants.
There are no expected risks. There will be no direct benefits to the participant.

Record keeping and confidentiality.
We plan to use record keeping procedures such as google sheets for organizational purposes. All group members, the sponsor, the advisor Guilherme Dourado and the WPI office will have access to records. We are asking for permission to share the data collected. However, the study investigators, the sponsor, or its designee and, under certain circumstances, the Worcester Polytechnic Institute Institutional Review Board (WPI IRB) will be able to inspect and have access to confidential data that identifies you by name. Any publication or presentation of the data will not identify you.

Compensation or treatment in the event of injury: *There is no expected harm so there will be no compensation. You do not give up any of your legal rights by signing this statement.*

For more information about this research or about the rights of research participants, or in case of research-related injury, contact:

Ella Moreau, Eleanor Fields, Megan Gilman, Will Crawford (Group Alias Email- gr-FloresIQP@wpi.edu))
IRB Manager (Ruth McKeogh, Tel. 508 831- 6699, Email: irb@wpi.edu))
Human Protection Administrator (Gabriel Johnson, Tel. 508-831-4989, Email: gjohnson@wpi.edu).).

Your participation in this research is voluntary. *Your refusal to participate will not result in any penalty to you or any loss of benefits to which you may otherwise be entitled. You may decide to stop participating in the research at any time without penalty or loss of other benefits. The project investigators retain the right to cancel or postpone the experimental procedures at any time they see fit.*

Interview Options.
These options are fully chosen by the participant and may be changed during the interview. Would you like to participate with the following…

- *Video Recording*
- *Audio Recording*
- *Written Records*

Final Report Options.
Inclusion in the report will be chosen by the participant. The participant may reach out to the given contact information to change their option at any time. Would you like to participate with the following…

- *Full name and information disclosure/Nombre completo y divulgación de información*
- Photos may be used involving the participant
- Confidentiality for name, full information disclosure
- Data may only be used for reflection and analysis, but will be kept out of the report

By signing below, you acknowledge that you have been informed about and consent to be a participant in the study described above. Make sure that your questions are answered to your satisfaction before signing. You are entitled to retain a copy of this consent agreement.

_____
Study Participant Name (Please print)
Date: _____

_____
Study Participant Signature
Date:_____

_____
Signature of Person who explained this study

Appendix 2. Versión en español del formulario de consentimiento.

Acuerdo de consentimiento informado para participar en un estudio de investigación
Investigadores: *Ella Moreau, Eleanor Fields, Megan Gilman, Will Crawford*
Información del contacto: *Correo electrónico grupal - gr-FloresIQP@wpi.edugr-FloresIQP@wpi.edu*
Título del Estudio de Investigación: *Grupo de Implementación Educativa Ecuagenera*
Patrocinador: *Juan Pablo Martínez de Ecuagenera*

Introducción.
Se le pide que participe en un estudio de investigación. Sin embargo antes de aceptar, debe estar completamente informado sobre el propósito del estudio, los procedimientos a seguir y cualquier beneficio, riesgo o incomodidad que pueda experimentar como resultado de su participación. Este formulario presenta información sobre el estudio para que usted pueda tomar una decisión completamente informada con respecto a su participación y será leído en su totalidad.

Propósito del estudio.
Se le solicita que participe en un estudio de investigación sobre un proyecto que tiene como objetivo aumentar la comprensión de la conservación de la biodiversidad en las reservas andinas del sur de Ecuagenera a través de la implementación de un plan de estudios que crearemos y diseñaremos con base en investigaciones de archivos, semiestructuradas. entrevistas que realizaremos con conservacionistas locales, autoridades y expertos en educación de Gualaceo, encuestas y etnografías para conocer las mejores prácticas pedagógicas para estudiantes de diferentes grupos de edad en la región de Gualaceo.

Procedimientos a seguir.
Estamos realizando un diseño de investigación de métodos múltiples mediante el uso de múltiples métodos de investigación cualitativa para lograr profundidad y aumentar la solidez de nuestros hallazgos. En nuestro informe analizaremos los datos recibidos a través de entrevistas semiestructuradas y etnografías. El objetivo de esta recopilación de datos es limitar los resultados más afectados para ayudar a los estudiantes. Todo esto se llevará a cabo durante un período de dos meses mientras estemos ubicados en Ecuador. Mientras realizamos esta entrevista, procederemos con una grabación de audio, grabación de video o notas escritas. Las preguntas formuladas solo discutirán el tema del proyecto y no estarán dirigidas a temas personales. No es necesario responder ninguna pregunta específica.

Riesgos/Beneficios para los participantes del estudio.
No hay riesgos esperados. No habrá beneficios directos para el participante.

Mantenimiento de registros y confidencialidad.
Planeamos utilizar procedimientos de mantenimiento de registros, como hojas de Google, con fines organizativos. Todos los miembros del grupo, el patrocinador, el asesor Guilherme Dourado y la oficina de WPI tendrán acceso a los registros. Solicitamos permiso para compartir los datos recopilados. Sin embargo, los investigadores del estudio, el patrocinador o su designado y, bajo ciertas circunstancias, la Junta de Revisión Institucional del Instituto Politécnico de Worcester (WPI IRB) podrán inspeccionar y tener acceso a datos confidenciales que lo identifiquen por su nombre. Cualquier publicación o presentación de los datos no le identificará.

Compensación o tratamiento en caso de lesión*: No se espera daño por lo que no habrá compensación. Usted no renuncia a ninguno de sus derechos legales al firmar esta declaración.*

Para obtener más información sobre esta investigación o sobre los derechos de los participantes de la investigación, o en caso de lesión relacionada con la investigación, comuníquese con: Ella Moreau, Eleanor Fields, Megan Gilman, Will Crawford (alias de correo electrónico del grupo: gr-FloresIQP@wpi.edu))
Gerente del IRB (Ruth McKeogh, Tel. 508 831-6699, Correo electrónico: irb@wpi.edu))
Administrador de Protección Humana (Gabriel Johnson, Tel. 508-831-4989, Correo electrónico: gjohnson@wpi.edu).).

Su participación en esta investigación es voluntaria. Su negativa a participar no resultará en ninguna penalización para usted ni en la pérdida de beneficios a los que de otro modo podría tener derecho. Puede decidir dejar de participar en la investigación en cualquier momento sin penalización ni pérdida de otros beneficios. Los investigadores del proyecto se reservan el derecho de cancelar o posponer los procedimientos experimentales cuando lo consideren oportuno.

Opciones de entrevista.
Estas opciones son elegidas íntegramente por el participante y pueden cambiarse en cualquier momento durante la entrevista. ¿Te gustaría participar con lo siguiente…?

- Grabación de vídeo
- Grabación de audio
- Registros escritos

Opciones de informe final.
La inclusión en el informe será elegida por el participante. El participante puede comunicarse con la información de contacto proporcionada para cambiar su opción en cualquier momento. ¿Te gustaría participar con lo siguiente…?

- **Nombre completo y divulgación de información.**
- **Se podrán utilizar fotografías que involucren al participante.**
- **Confidencialidad del nombre, divulgación de información completa.**
- **Los datos sólo podrán utilizarse para la reflexión y el análisis, pero se mantendrán fuera del informe.**

Al firmar a continuación, usted reconoce que ha sido informado y acepta participar en el estudio descrito anteriormente. Asegúrese de que sus preguntas sean respondidas satisfactoriamente antes de firmar. Tiene derecho a conservar una copia de este acuerdo de consentimiento.

_____
Nombre del participante del estudio (en letra de imprenta)
Fecha: _____

_____
Firma del participante del estudio (formal)

Fecha: _____

_____
Firma de la persona que explicó este estudio.

Appendix 3. Pre-interview Research and Background

Interview Subject and Role	Objective of Interview	Key Background Summary	Question Themes
Rebecca Castellanos, Universidad Nacional de Educación Rectora	• Due to her background on pedagogy and teacher training, we are hoping to gain insight on what pedagogical practices would be most successful for learning purposes and for implementation success purposes.	• She has published scientific articles in addition to contributing as a researcher, columnist, lecturer, and national and international speaker on topics related to teacher training, pedagogy, and research. • Director o Universidad Nacional de Educación UNAE	•Personal teaching style •Adjustments and collaborations
Javier Collado Ruano Universidad Nacional de Educación Coordinador de Innovación Educativa y Emprendimiento	• Due to his background in environmental education initiatives, interviewing him will give us key insight into past initiatives or educational pedagogies and what has allowed them to be successful or not.	• Educator, environmentalist, Dean of Educational Innovation • ONGD Educate to Live • President of the NGO Educate for Life • Multiple books/chapters on education and environment	◦ Pressing Environmental Issues ◦ Human Nature Interaction ◦ Pedagogical Approaches
Grace Carolina Reyes Universidad Nacional de Educación Técnico de Innovación Educativa y Emprendimiento e Influencer	• Due to her background in environmental conservation and education through both trips and content creation interviewing with her will allow us key insight into pressing environmental issues, key knowledge gaps and successful strategies to promote a greater understanding.	• Ecosystem engineer and entrepreneur in environmental education, sustainability, and scientific tourism projects ◦ Focused on the creation and organization of trips and courses that combine adventure, science, and conservations Topics include: -Environmental education scientific illustration -Herpetology -Field genetics •She works as a content creator, being a figure that influences thousands of people on social networks on issues of environmental awareness, love for nature, education, and entrepreneurship	◦ Environmental Issues ◦Knowledge Gaps ◦ Educational Techniques ◦ Deliverable information/research help

Andres Bonilla Educación Director Distrial Gualaceo	• The objective of this interview is to learn more about pedagogies on a broader scale. While Andres Bonilla doesn't specifically work in a school, through his job he works to get teachers the resources they need in the classroom he is able to observe what works and what doesn't. We will also be able to learn more specifically about the Gualaceo region as that is where he specifically works.	• Andres Bonilla is currently the District Director of the Gualaceo Basin at the Ministry of Education Ecuador. •He has a doctorate in Educational Technology and in an interview discusses how he wants to improve the quality of educational methods using twenty first century methods.	•Pedagogical Approaches •Gualaceo Region
Pablo Crespo Principal de Santana High School	•Understand how to effectively run a curriculum, as well as how to connect to students best. What would be the most feasible program and available resources	•Principal of Santana High School since 2007	•Pedagogical Approaches Deliverable Feasibility
Andres Martinez Moscoso	•Aim to gain more information about professional expertise, what legislation or documents may be important to our research, as well as comparing learning vs. research.		•Professional Experiences •Legal Advice •Publications and Education • Deliverable
Gloria Aguilar Municipio de Gualaceo Directora de Gestión Ambiental	•Due to her ample experience in Environmental Management her familiarity with the pressing environmental issues and initiatives to address will allow us to gain a greater understanding of environmental problems facing the region along with the efforts being made surrounding them. We will also hope to gather what characteristics have made programs successful or not along with policies or laws we must abide with when creating our deliverable design.	•Roles: - Coordinator of the Environment Management Unit Gualaceo (10 years) - Agricultural Science Specialist •Academics: - Agricultural Engineering - Environmental Management	•Pressing Environmental Issues •Former Initiatives (Success/Unsuccessful) •Laws / Policies

Appendix 4. List of Interview Questions

Professional Experience Questions:

- *Could you quickly tell us about some of what you do and what your career is based around?*

Pedagogical Approach Questions:

- *Do you have examples of educational programs that have been implemented to expand biodiversity and conservation education? Were they successful? Why or why not?*
- *In your opinion, what are the most successful strategies for impactful lasting education?*
- *Are there any recent changes to classroom life that you believe have improved the quality of educational methods? (Technological advancements, curriculum changes, etc.)*
- *You have discussed that an interest of yours is participative learning. How do you define this and what do you think are the key values?*
- *What do you think captures a student's attention the most every day in the classroom?*

Gualaceo Region Specific Questions:

- *What environmental issues specific to Gualaceo do you think are important for students to be educated about at a young age?*
- *What local cultural aspects can we implement into our deliverable to make it more impactful to the students in the Gualaceo region?*

Pressing Environmental Issue Questions:

- *What environmental issues/topics do you believe to be the most pressing?*
- *In the Andean region specifically?*
- *Can you explain the factors contributing to these issues and their potential consequences? Why is it important that the community understand these problems?*
- *What do you feel are the most impactful ways the public can impact biodiversity conservation?*

Former Initiatives (Success/Unsuccessful) Questions:

- *Can you share examples of successful community engagement in environmental initiatives?*
- *Are there any ongoing environmental initiatives or projects addressing these challenges?*
- *Have you been involved in conducting or reviewing environmental impact assessments for projects?*
- *Have you noticed any trends revolving around what works and what does not?*
- *How do you ensure the comprehensive evaluation of potential environmental impacts?*

Laws and Policy Questions

- *Are there any local, national, or international environmental regulations and policies that are important for us to be aware of when considering deliverable ideas?*
- *Can you provide examples of how these regulations have impacted environmental practices in the past?*
- *Are there any main rules, regulations, or laws that may be used as fun facts and help kids learn more about what is around them?*
- *Do you have any advice for us regarding how we are trying to do what is in the best interest of the project but also make sure our sponsor is happy about the outcome as well? As you have personally worked on a lot of projects connecting networks between people.*
- *How has the 2008 revision of the Ecuador Constitution influenced your role in biodiversity conservation?*
- *What have you noticed the shared responsibility of government and public to look like? How do you think the communities have responded to this?*

Deliverable Questions

- *What kind of project under our themes is feasible?*
- *Do students often go on field trips?*
- *Do your students have ready access to the internet?*
- *Do your students have availability to learn at home?*
- *What strategies do you use for managing your teachers?*
- *As someone who is a leader in student lives, what do you find connects best with students?*
- *Based on the deliverable options we have and your experience with implementing programs and connecting the public with organizations. What deliverable do you think is most feasible and will be most effective?*

Publications and Education Questions

- *If you have any specific publications or articles that would be important to us, it would be valuable for our research.*

Appendix 5. Interview Summaries

Appendix 5.1. Pablo Crespo Interview Summary

Pablo Crespo
Interview

1. Juan told us that this school is testing new methodologies involving experiential learning. What have you noticed to be the impact of this? What works and what doesn't?
    a. I wouldn't say it's an experimental project. It's more of a research collective program that we're connected with.
    b. Serving as an agent of the evolution of the planet more than ever. So, how we can relate the interactions between nature or non human right human agency with human agents.
    c. These kids will have different problems to solve in the future. Now this problem is that we have different ones. So we have you know, the intention to keep them wider and more real concepts and perceptions of reality.
    d. Bringing the outside into the classrooms, understanding that children will have different problems to face in the future and teaching them the skills the deal with those problems
    e. Not trying to tell the students solutions to problems, letting them get there on their own
2. Do you have examples of educational programs that have been implemented to expand biodiversity and conservation educations? Were they successful? Why or why not?
    a. Different hands on activities and workshops in the classroom, gardening workshop, ceramic workshop, using waste to make renewable energy
    b. Focusing on making the children more observant- a result of being immersed into a connection with the environment
3. Are there any type of materials that are kind of in line with the same ideological approaches that are more material based and less teacher based?
    a. Teachers are "co-learners"
4. What strategies have you seen in the classroom that promotes student engagement and which do you think were most successful?
    a. Most powerful tool is to provoke with real problems
    b. Robot building competition, students need to be creative to problem solve for natural disasters
    c. It's difficult to have general strategies because not all of the children will be engaged and interested in the same topics and processes
    d. One strategy is to reframe questions that students have and ask it back to them
    e. Very student led learning, their curiosity and their tangents- no textbooks just a general curriculum to follow
5. Do you have any suggestions of what is feasible or what can be distributed?
    a. The children should ask "what did the elder generation do with that?"- let the students think of other approaches
    b. Create a gadget that allows students to use all of their senses (touch, sight, smell…) - videos of nature
    c. Don't just give scientific facts about nature, children won't respond to that
6. Do you think it's important that the kids have somebody that can keep themselves or like just memory retention is okay?
    a. Hands on is better, doesn't particularly need to be take home
7. How do you suggest we navigate that where we're going to be giving them this information, but it might not always outcome the right way, but they get the information of like successful learning and like I went through this process even though it might be done differently from kid to kid?
    a. Shouldn't be individual success and competitive, students can learn from each other through their discussions and group activities
8. Is there anything that you feel like in your classrooms that is missing, maybe because our project is supposed to be an aid for the classroom so is there any gap that you think we could fill with this project? Are there any activities that you've noticed that students really get engaged in?
    a. Students will each be excited about different things
9. I think something we're struggling with is just the learning process for every child is such an like, student by student basis. So our project has to cover something for so many students. I think we're struggling to see how we'll pick something that the majority of students will engage in, like even between the four of us, our learning processes are different and we're interested in different things.
    a. I will guess that if you find something to relate with physics, so we can we can play with it and not exactly explain the physics principles but to to be absorbed and silly and about how this little thing moves so fast. Because it is this move or whatever, they'll be fantastic time to to torture and like so thanks for that kind of like, triggered there own curiosity.
10. I think that's kind of where I'm running into the biggest roadblock is that the distributed ability of that and like it needs to be easy to be sent everywhere. Conflicts with the, I guess, curiosity sparking students, because we can make a kit and implement it in schools here but that's hard to implement in other places. Unless it's on paper.
    a. I'm thinking in probably a table game with how do you know how to say it but a dice with different characters where you can throw it away and see the relationship with the with the patterns you have shown in the table and you can kind of follow that in the middle thing. So the kids can kind of go around making points whatever.
    b. My recommendation will be recommendation goes as simple as it gets.
11. The more simple is, the more likely each student will be able to take their own approach. Is that what you're saying?
    a. Each of the students will adapt and approach it in their own way
12. Do you have suggestions on how we can create something that can be used even after we go home? More deliverable suggestions
    a. Make it simple and catchy
    b. Use natural colors, use things found in ecuador, (etc. not giraffes, not colors that are man made)

Appendix 5.2 Gloria Aguilar Interview Summary

Gloria Aguilar
Interview

1. What environmental issues/topics do you believe to be the most pressing?
    a. **Most urgent issues:**
        i. Waste generation and the mismanagement of waste and garbage
            1. Bad management practices
            2. Solid waste is garbage it goes into the conservation areas and ends up in streams and rivers
        ii. Extending the agricultural frontier
            1. The border area between farm land and conservation land is diminishing
        iii. Forest fires in the summer
            1. Paramo regions aren't directly experiencing them, however the bordering regions are

2. Can you explain the factors contributing to these issues and their potential consequences? Why is it important that the community has an understanding of these problems?
    a. Waste generation
        i. Need awareness and the issue of responsible consumption
        ii. A large amount of waste is generated due to the levels of consumption
            1. Lack of responsible management of the disposal of this
        iii. Overall lack of awareness and knowledge of the impacts the generare
    b. Extending the agricultural frontier
        i. Issues: training the farmers and giving them alternative for economic development because they are accustomed to the tradition of agriculture
            1. Example: many farmer have more cows than are economically necessary that just add to the farm land space
    c. Main issue is to look for alternative economic development opportunities, and to produce sustainability

3. What do you feel are the most impactful ways the public can impact biodiversity conservation?
    a. Showing them through media like videos or books
        i. People don't value what they do not know → to generate the most impact is showing them what we have: plants that exist in the forests, animals that exit and which ones along with their function in the ecosystem

4. Can you share examples of successful community engagement in environmental initiatives?
    a. Project for the protection of sources
        i. **What it does:** works with the community organizations that provide the drinking water services and showcases where the water they consume initiates
            1. Already protected reactivities with a law or ordinance that helps with the support of this activity
        ii. **Results:** there were a lot of children who thought that when they were at home their water was independent to them, but now they know it comes from the Malia del Rio la Sol

    b. Issues with environmental education
        i. Working with 7 and 8 year olds (3rd year they've worked with them)
            1. Asking "big kid" simple questions sometimes they are offended by the question

5. Are there any local, national, or international environmental regulations and policies that are important for us to be aware of when considering deliverable ideas?
    a. Local regulations that are an ordinance
        i. The ordinance for the conservation of natural resources.
            1. Allows for the execution of several projects
        ii. Local regulation generates local conservation policies which allows for the execution of environmental protection projects, environmental education
    b. The national standard is related to the Organic Law on Water Resources a law from the Ministry of the Environment Education

6. Can you provide examples of how these regulations have impacted environmental practices in the past?
    a. The regulation has been in place since 2015
    b. Overall there has been a positive impact since the ordinate
    c. People are aware of actions that they should avoid to comply with the regulations
        i. Some areas may need more environmental awareness and practices

7. What are your goals for the future?
    a. Environmental Education
        i. Bolardianes
            1. Annual goal of more than 2000 children benefitting
    b. Conservation Area called the Municipal Conservation and Sustainable use Areas
        i. Goal: raise this area within the National System of Protected Areas this is at the national level an area that is part of the states Natural Heritage as a Municipal Conservation Area

ii. Project of the Bears takes place here
    1. Monitoring of the sandino
    2. Hope is that this project will continue and will have indicators what show conservation value

8. From Cobinero and the public. How do we believe that the communities have responded to this?
    a. It depends on the area many communities are resisting because there is not a program the generated compensation or incentives
    b. Gloria thinks 40% of them have accepted local regulation and the rest have resisted due to the lack of budget for programs that generate incentives based on the needs of the communities

9. What environmental issues are important to educate students on from an early age?
    a. Knowledge of resources and showing them what they have around them and where is comes from
        i. In rural areas many children, for example, know what the bear lives, but they don't understand what the value of this bear is in the ecosystem. It is important to indicate the natural resources, but at the same time their role within the ecosystem so that once they know, they value that of why to take care of them.

10. Advice for the project
    a. A recommendation: not taught with paper but a game, video, or recreational activity
        i. Gloria has seen the best results when educational isn't done traditionally with the teacher lecturing instead using videos, games, or taking them into the field
    b. Example: Environmental Education Program going on now
        i. In April they take the students to the countryside they see the water, experimentation works well to teach them because they are able to feel and not only read and then the are able to learn while being in direct contact with nature
            1. Works well when paired with something in the classroom to reaffirm
        ii. Bear project
            1. Students watch fun educational video with bear character that educate them on the environment around them then the bear characters come into the classroom and play with the children and then they go out
            2. Financed by state-owned enterprises such as the gaucho
        iii. Interactive activities work well with children
            1. They like to play and can learn by playing
        iv. Students have also visited where their water is treated at the water plant and how it comes to the toilet
        v. World Environment Day - June 5th
            1. An event is usually held where schools can be awarded for the completion of environmental education projects
            2. Green Initiatives Competitions
                a. Children come up with alternatives to reduce wastewater or recycling initiatives - best is rewarded
        vi. Amaru Zoo project
            1. researching the bear and we are following up on the Andean bear and we have several videos from cameras in the forest of how the bears are doing. What species are there then?
                a. Amaru is 1 of the donors of the project,
            2. On World Environment Day they will also come with animals that have been reduced and will teach the children about conservation

Appendix 5.3 Andres Bonilla Interview Summary

Andres Bonilla
Interview

1. Do you have examples of educational programs that have been implemented to expand biodiversity and conservation educations? Were they successful? Why or why not?
    a. In the digital direction there are projects maintained jointed with the Municipality of Canton
        i. What are these called? Guardians ?
        ii. **Purpose:** the preservation of biodiversity and fauna that is there
        iii. **What they do:** carry out processes of reforestation, care of the environment, and recycling
        iv. **Motivation:** the municipality of Guacelo along with the Ministry of Education to support the preservation of species in the environment
    b. Student Engagement Projects
        i. Student led initiatives where they make their own schedule and activities they are going to do
            1. Example:
                a. Student Garden Project
                    i. Kids tried to encourage their classmates to help with the cultivation of crops, preservation of agriculture and so on.
2. What makes a project successful to you?
    a. Andres feels that all the projects have been successful
        i. Mainly the ones with Guardian?
            1. The are coordinated on the side with the municipality and on the side of the ministry
            2. Within the activities of the students they go week by week telling them what to do
                a. Example:
                    i. This February they are going to carry out reforestation where the kids are going to plant trees.
                        1. This is commonly taught and should be made known
4. Successful strategies for lasting educational impact?
    a. The things that are done day to day to help create good habits in topics like water, reforestation, care of all species
        i. Ideally the students learn this early
        ii. **Projects:** school gardens, clean the shores, recycling bottles
            1. **Outcomes:** doing this from when they are young to when they are older creates good habits that they can continue doing in high school or college, since they have the awareness of preservation and care for the environment
5. ¿Hay algún cambio reciente en la vida en el aula que cree que ha mejorado la calidad de los métodos educativos? (Avances tecnológicos, cambios curriculares, etc…)
    a. One change that has been made into the classroom happened during the pandemic
        i. Most students did not benefit from virtual schooling
            1. The schools were not prepared and did not have the resources to tackle virtual or distance education
6. ¿Durante la pandemia, lo que funcionó bien para los estudiantes?
    a. One of the things that worked well was the teachers ability to self - study or train and adapt to the situation
        i. Prior there were no virtual classes and the pandemic forced the teacher to learn technology and be able to teach with it
    b. Another was the importance of utilizing the whole community in education
        i. The educational system involves several actors: the teachers, the students, the part, the community
            1. The collaboration of these parties allows for a true education
7. ¿En el aula vuelve a ser como antes del proceso?
    a. No now the entire educational community is aware of the importance of technological tools in the educational process
        i. Now the Ministry of Education is able to use technology and is prepared to → continuing educational programs that give teachers the appropriate knowledge to be able to give virtual classes

Academically they see how to take plant the tree, take care of the tree and how to protect the environment. After that, they take photos and make videos and share the information. (successful program)

ii. There are also similar citizen participation activities where they do something similar but in a short amount of time.

iii. **Results:** Have been good, these activities can help students understand topics and be more engaged allowing them to leave more about the environment and feel connected to it

1. In each their is a local and cultural aspect

b. The canton is located in the Guacacelo region

i. These communities are producers and generate their main source of income plating vegetables and various products. This is done alongside on of the schools of the colleges of the educational institution that focuses on preservation

ii. There is an initiative that is not with an educational institution that focuses on the preservation of the production of vegetables or the planting of products to be sold.

iii. **Motives:** the people taking part are able to reflect on various environmental topics such as the importance, water or what global warming is, the use of insecticides

3. ¿Qué temas ambientales específicos de Gualaceo cree usted que son importantes para educar a los estudiantes desde una edad temprana?

a. It is very important to educate student from a young age

i. Because of the location of the canton it is important for everyone to understand

b. **Key topic:** The preservation of water and the care of rivers

i. If you don't understand where it comes from it is harder to appreciate it

8. ¿Hubo materiales adicionales para niños pequeños además de en línea durante la pandemia?

a. It was a joint effort with the parents

b. With young children tasks with motor skills are usually used

i. Everything is soft skills, forgiveness skills, motor skills

9. Consejos para nuestro proyecto

a. Important information for us to get: statistics from the district management on the number of projects that have been developed

i. Specifically the number of projects that have been developed and the number of beneficiaries also photos

b. Past projects

i. Mingas: groups of people who go to clean the rivers

ii. Photo Ideas:

1. Bottle Recycling Projects

a. Take pictures of bottles that are recycled

2. Stories of school children where they plant flowers at school

iii. Activities students like to participate in that got them excited about learning

1. They like activities that require collaboration

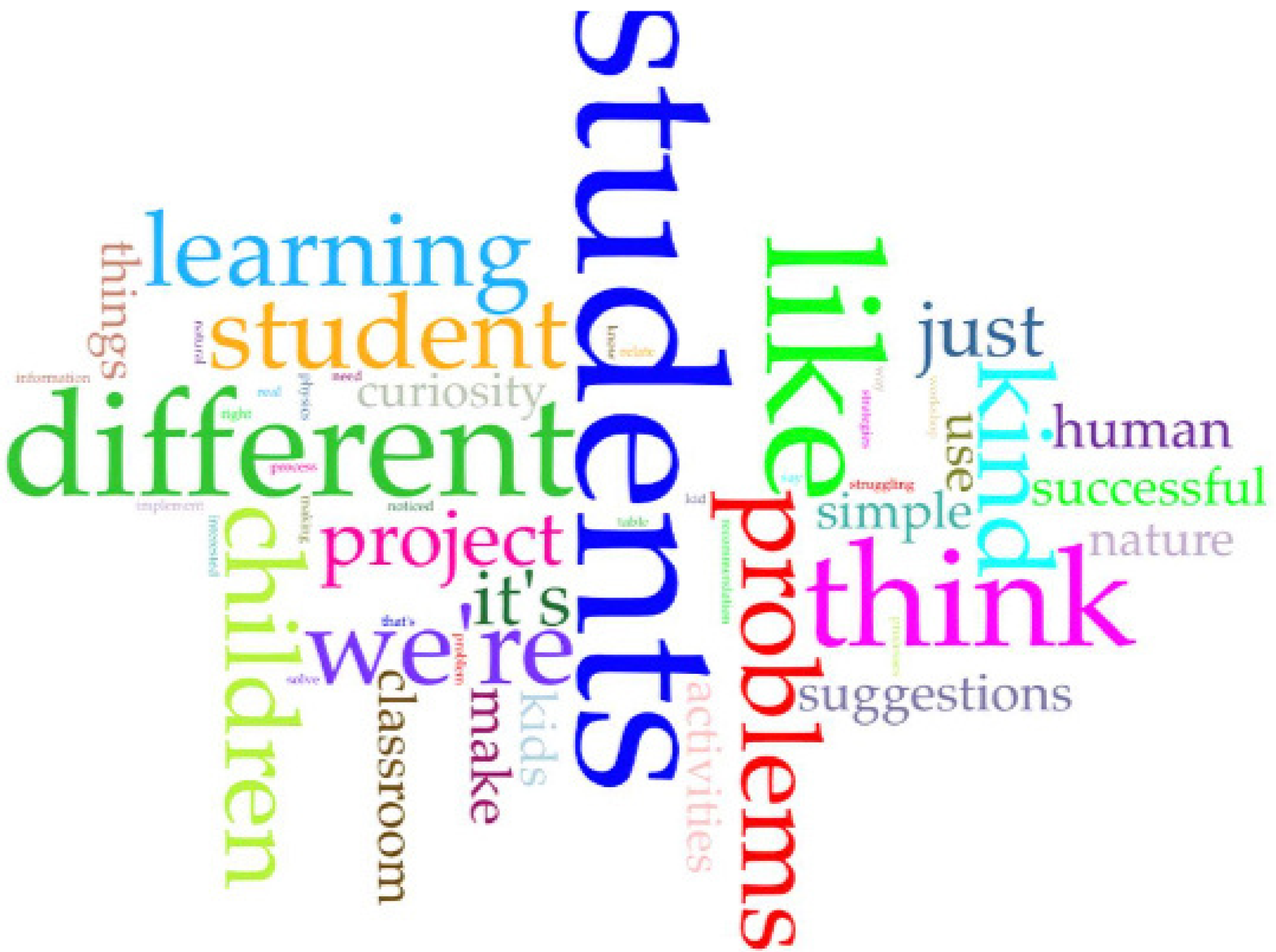
a. Example: Planting a tree where everyone does a different job

Appendix 5.4. Andres Martinez-Moscoso Interview Summary

Andres Martinez Moscoso

1. Could you quickly tell us about some of what you do and what your career is based around?
    - Management is through the community. So management of water is decided by this organization.
2. Are there any local, national or international environmental regulations and policies that are important for us to be aware of when designing our deliverable?
    - Ecuador is always right there during international discussions of environmental laws and rights.
    - Environmental national code. There are 7 chapters regarding regulations.
    - He notes the two papers he has written before that are about the constitution changes as well as regulations.
    - All local governments, provinces, and municipalities now have coordination with the national government regarding environmental issues unlike the past.
3. Besides that, do you have any environmental issues or topics that you believe to be the most pressing? That'd be important and trust to educate within our deliverable?
    - Forests and water: It is important to protect water because this is our future and an extremely valuable resource.
    - Without forests we don't have good water production
    - Waste: Educate on recycling and waste. There is a specific normative circular economy which can be interesting to research.
    - Illegal mining
    - Small municipalities are tackling these issues alone. So it is important to highlight this to the public so that they are involved and informed as well.
    - Public is often not informed on circular economy as well.
4. Can you share any examples of successful community engagement and environmental initiatives?
    - Repurposing of Machanga river: The entrance is near to the industries, so 40% of the water comes from this vicinity. Water flows industries, agriculture, drinking water. There are educational industries close to the entrance of the river.
    - A person implemented an education program and a governing process about natural resources. On top you have energy resources then the river flows down to agriculture, then drinking water, and then it goes into the industries. At the very top mouth of the flow was the education programs.
    - "Catavias"
    - Programs where songs were created to help women learn how to cook with certain ingredients
    -
5. what do you feel are the most impactful ways that the public can make an impact on biodiversity in conservation?
    - Relate their own life to the environment. This will get people's interest the most.
    - For children it is important to be theatrical. Use their emotions to get them passionate about their learning.
    - For adults it is almost like working out a muscle. You have to remind them many times and make it so the topic is brought up in their head often and thought about.
6. Advice on deliverable
    - Most schools have internet connections that could be used very easily.
    - Working with their own people. Relate to what is around them.
    - It is important for students to see their own faces in the work or something that they can relate to.
    - If we use any vocabulary make sure it is ecuadorian
7. Young age, what is important to learn growing up?
    - Water. Learn where the water comes from.
    - Waste. Impact that each person makes.
    - Concept of climate change in their own lives. Point out changes.
    - Weather
    - Things that make people feel responsibility of what is going on around them

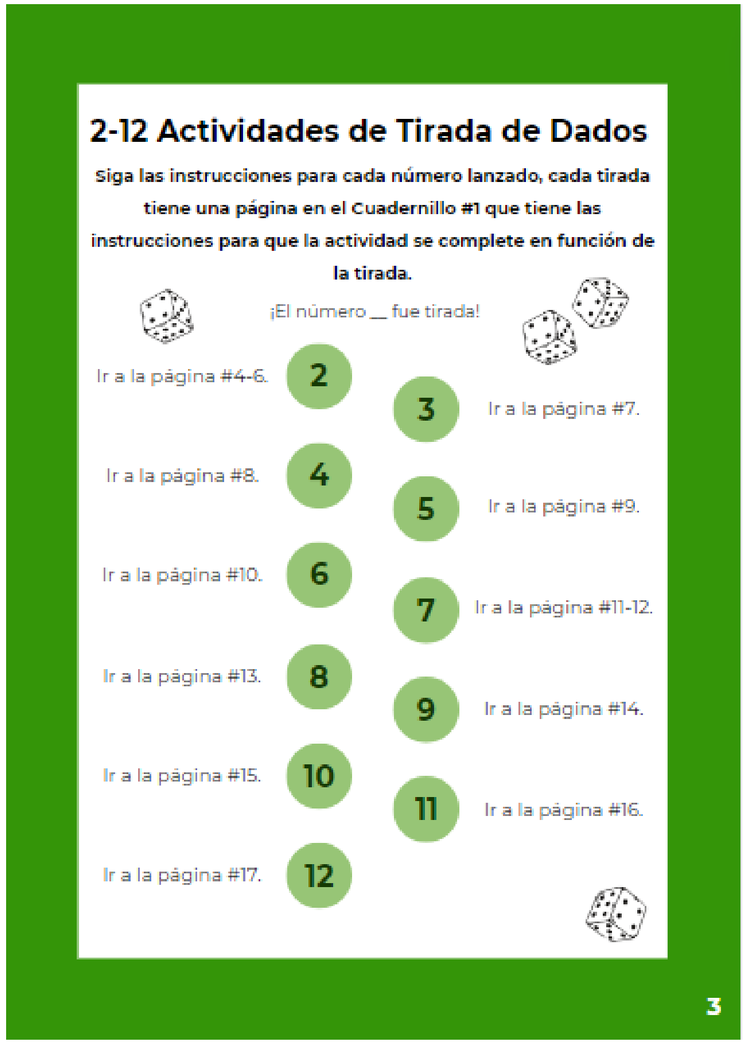
Appendix 6. Voyant Tool from Pablo Crespo Interview



Appendix 7. Eco-Aventuras Booklet Excerpt Grade 6 and Under

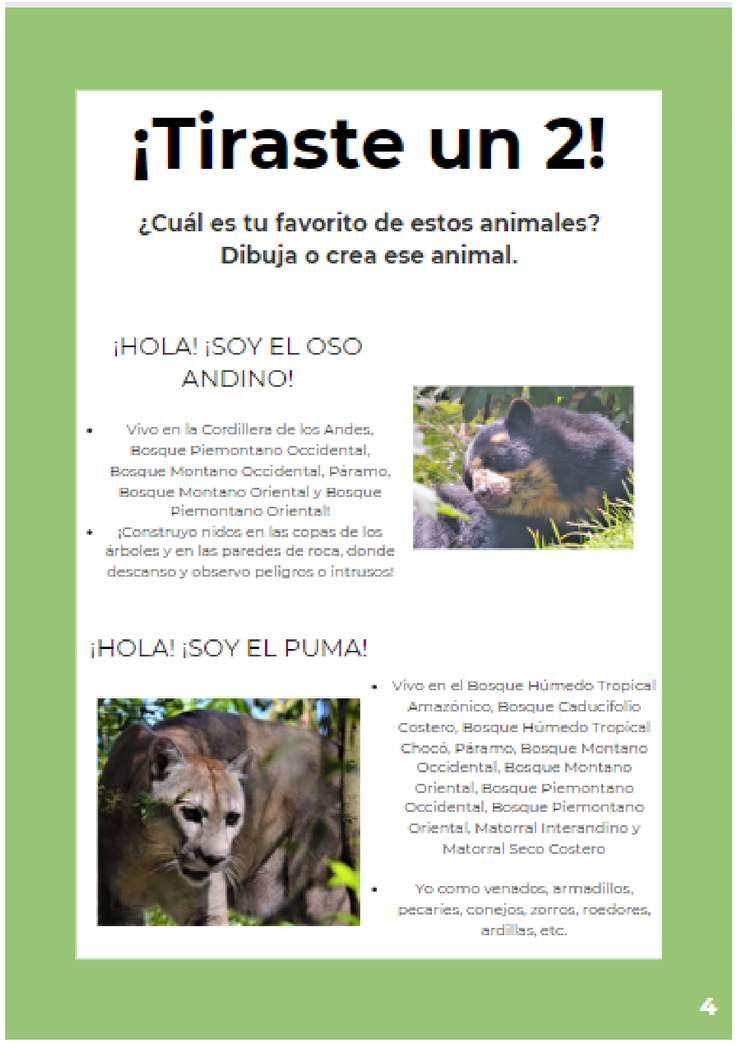
Cover Page

Game Rules



Dice Roll Steps

Appendix 7 cont. Eco-Aventuras Booklet Excerpt Grade 6 and Under

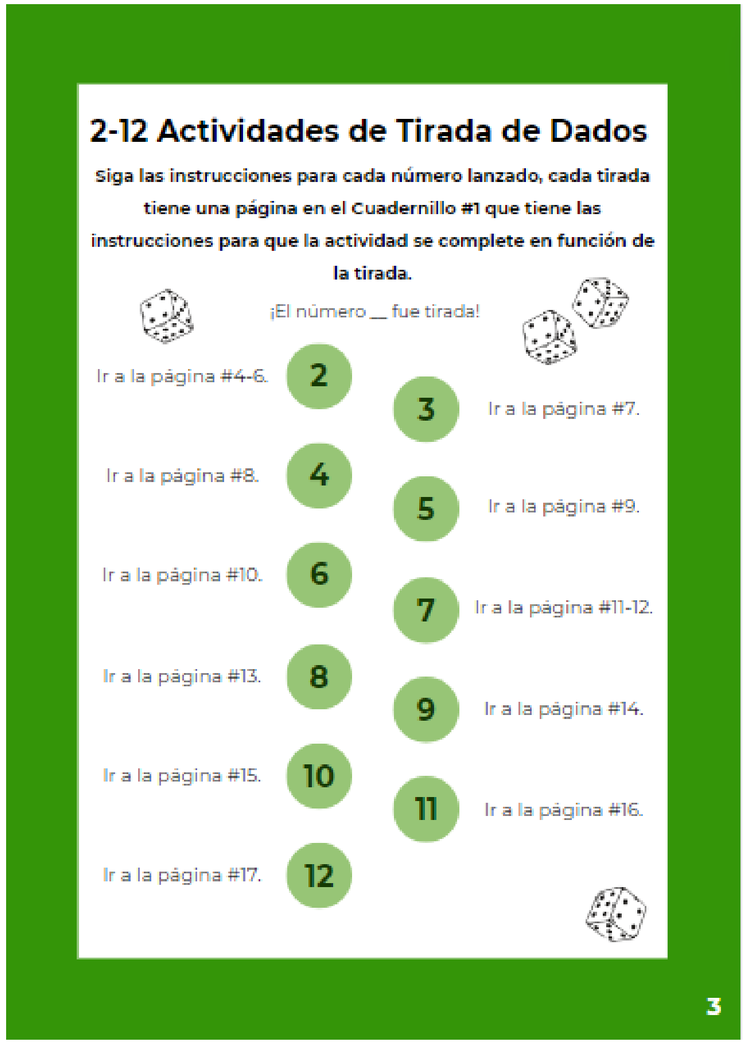


Activities 2, 4, and 7 from Booklet Grad 6 and Under

Appendix 8. Eco-Aventuras Booklet Excerpt Grade 7 and Up

Cover Page

Game Rules



Dice Roll Steps

Appendix 8 cont. Eco-Aventuras Booklet Excerpt Grade 7 and Up

¡Tiraste un 2!

Después de leer esta información, ¿cuál es tu favorito que vive en la región en la que te encuentras?
Dibuja o crea el animal que sea tu favorito de estas opciones en el tablero.

¡HOLA! ¡SOY EL OSO ANDINO!

- Vivo en la Cordillera de los Andes, Bosque Piemontano Occidental, Bosque Montano Occidental, Páramo, Bosque Montano Oriental y Bosque Piemontano Oriental!
- ¡Construyo nidos en las copas de los árboles y en las paredes de roca, donde descanso y observo peligros o intrusos!

¡HOLA! ¡SOY EL PUMA!

- Vivo en el Bosque Húmedo Tropical Amazónico, Bosque Caducifolio Costero, Bosque Húmedo Tropical Chocó, Páramo, Bosque Montano Occidental, Bosque Montano Oriental, Bosque Piemontano Occidental, Bosque Piemontano Oriental, Matorral Interandino y Matorral Seco Costero
- Como mamíferos de tamaño mediano (venados, armadillos, pecaríes) y pequeños (conejos, zorros, roedores, ardillas, etc.).

4

¡Tiraste un 4!

Encuentra algo de basura y colócala en tu tablero. ¡Empieza respondiendo esta pregunta y luego lee los datos curiosos!

La basura puede tener muchos efectos negativos en el medio ambiente. (*Pista sobre dónde colocar su artículo*)

- Los animales pueden confundirlo con algo que comen normalmente.
- puede contaminar el agua
- permanece durante años sin degradarse

¿Has notado basura en tu comunidad? ¿Donde lo ves?

Dato curioso: cualquier alimento sobrante se puede convertir en abono y utilizar en los jardines.

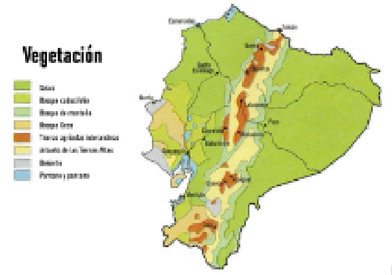
¿Cómo sabes qué puedes reciclar? ¡Sigue la foto de abajo!

8

¡Tiraste un 7!

Toma una hoja pequeña o un trozo de hoja y colócala en algún lugar donde hayas visto un bosque cerca de ti.

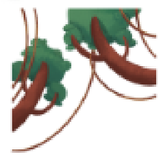
Leamos sobre los diferentes tipos de bosques en Ecuador:



Vamos

Selva

La mayoría de los bosques tropicales están construidos en 4 capas: emergente, dosel, sotobosque y suelo del bosque. Cada capa es diferente por los niveles de exposición a la luz, agua y circulación de aire.



Bosque Caducifolio

A menudo se le llama bosque tropical o bosque monzónico. Las estaciones de sequía y lluvias rotan de manera constante. La biodiversidad aquí es una de las más altas de cualquier bioma.

Bosque montañoso

Son más susceptibles a incendios forestales, tormentas de viento, sequías, destrucción de insectos y brotes de patógenos. Estos bosques son duros.

11

Activities 2, 4, and 7 from Booklet Grade 7 and Up

Appendix 9. Informational Booklet Excerpt

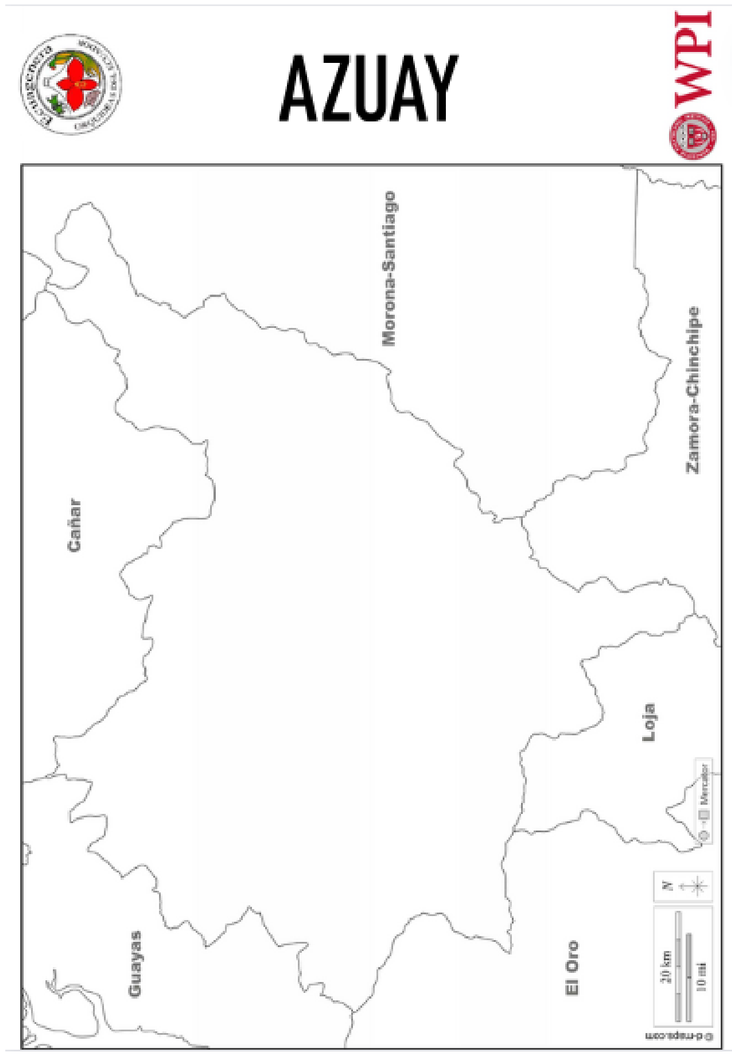
Cover Page

Chapter Divider Graphic

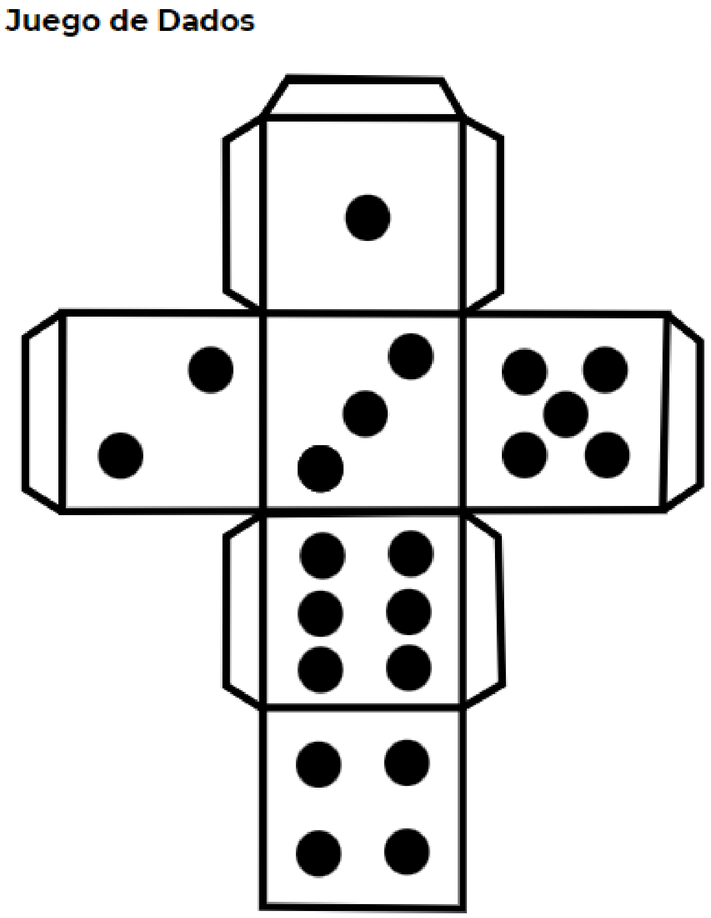
Additional Information Page

Appendix 10. Materials Booklet Excerpt

Cover Page



Game Board



Printable Game Dice

Appendix 11. Ethnographic Photos

11.1 Pilot Study

Students reading activities and completing

Complete Game Boards

11.1 Pilot Study cont.

Santana Elementary School

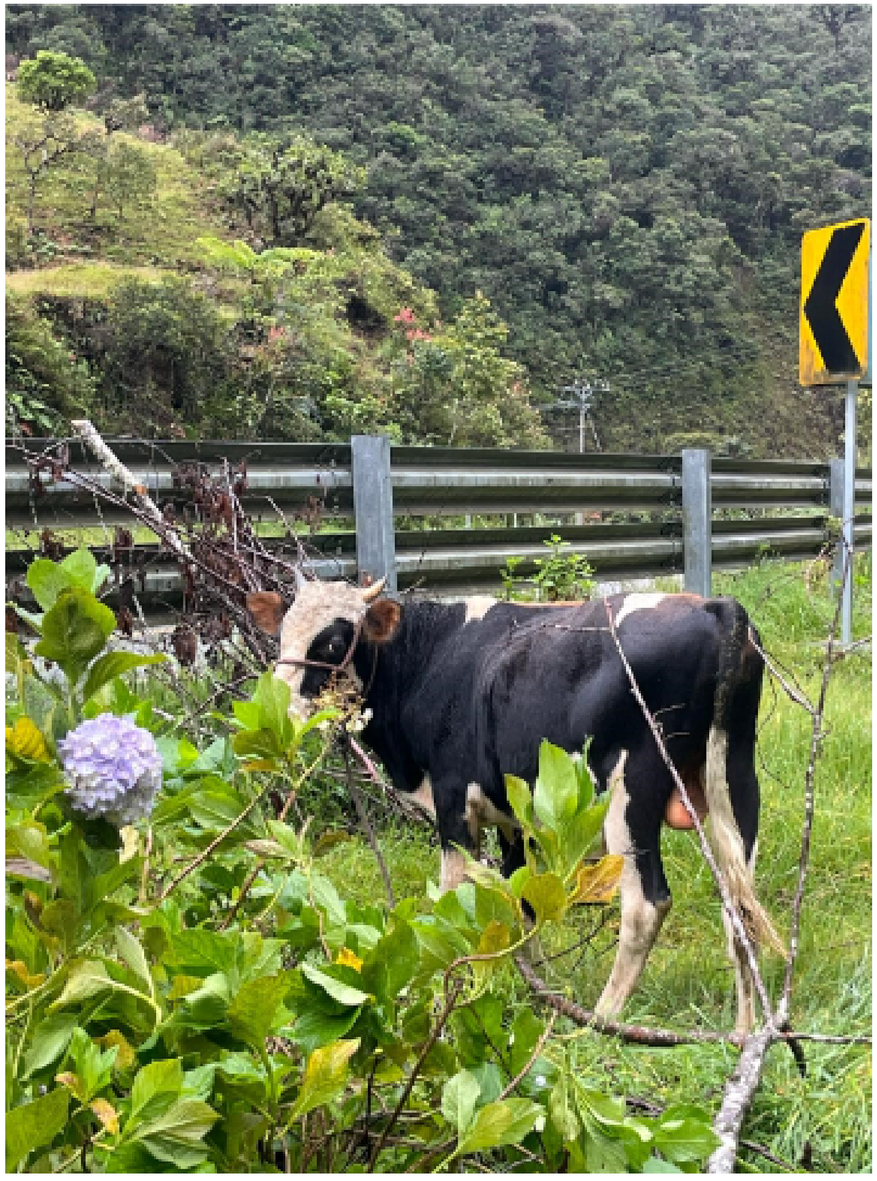
School Grounds

Outdoor Play Space

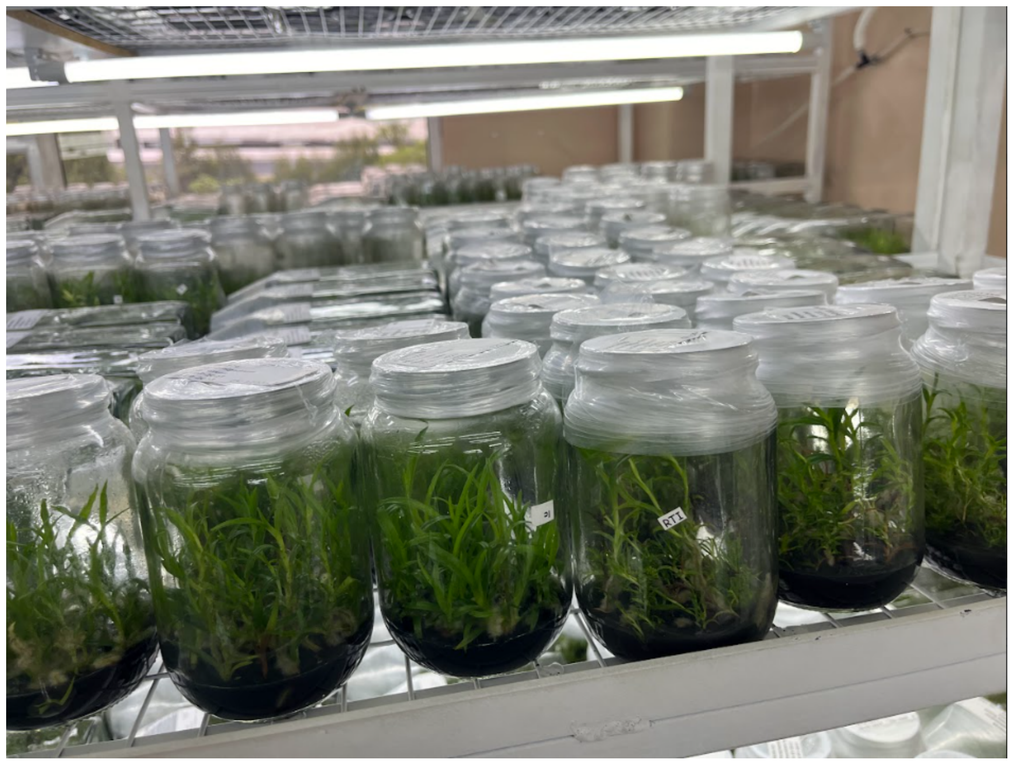
11.2 Cajas National Park

11.3 Southern Andean Reserves of Ecuagenera

11.4 Agricultural Frontier



11.5 Ecuagenera Lab



11.6 Ecuagenera Shop