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# CIFP MENDIZABALA LHII

## STUDY REPORT ON NATURAL PIGMENTS & FABRICS

*A practical exploration of local plant-based dyes in creative education*

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## Introduction

### About the Study

In CIFP Mendizabala LHII we are exploring the use of plant based paints in different handcraft and industrial applications. Our approach is to understand the complete process starting from the garden, the extraction of the natural pigments and the creation of the final product. The application fields we are exploring are linked with our school program activities such as graphic design, esthetics, cosmetics and car body painting.

The aim of the project is to evaluate the performance of plant based paints in real applications and obtain an alternative to reduce the use of non-environmentally friendly products.

This study explores the potential of plant-based paints as sustainable alternatives to conventional synthetic products. It focuses on understanding the complete process—from cultivating pigment-rich plants in the garden, to extracting natural colorants, to formulating and applying these paints in real-world contexts. The project is rooted in practical application, evaluating how well these natural paints perform in fields such as graphic design, esthetics, cosmetics, and car body painting, all of which are part of the educational programs at CIFP Mendizabala LHII.

What makes this work important is its direct contribution to environmental sustainability and health. Conventional paints often contain toxic chemicals and petroleum-based components that can harm both ecosystems and human health. Plant-based paints, by contrast, offer a cleaner, safer alternative. This initiative also enhances the educational experience by promoting interdisciplinary, hands-on learning that connects science, craftsmanship, and design. Furthermore, it supports innovation by providing insights into how natural materials can meet professional standards in demanding industries. By using local plant resources, the project aligns with principles of the circular economy, showing how education can drive change toward more responsible production and consumption models.

## Project & Work Package Overview

CIFP Mendizabala LHII plays a vital role in Work Package 2 by acting as a practical, multidisciplinary testing ground where plant-based pigments are not only studied but applied in real-world contexts. While the broader work package focuses on regional biodiversity, traditional knowledge, and low-tech methods for natural pigment extraction, Mendizabala enhances these objectives by embedding them directly into vocational education programs. The activities carried out at the school link plant pigment research to hands-on learning experiences in fields such as graphic design, esthetics, cosmetics, and car body painting.

By involving students and teachers in every step of the process—from plant cultivation and pigment extraction to formulation and application—Mendizabala contributes meaningful case studies that demonstrate the technical and aesthetic potential of natural pigments in professional settings. This practical dimension supports the development of green skills and connects environmental awareness with the students' future career paths. The school also contributes to the broader aims of WP2 through international collaboration and exchange, offering a space for experimentation, documentation, and peer learning.

Mendizabala's work produces results that can be shared across the partner network, including sample applications, educational videos, and design artifacts. These outputs feed into the collective knowledge base of the project and are featured in international training sessions, where students and educators present their findings and techniques to peers from other institutions. Through this contribution, Mendizabala helps to strengthen the intercultural, interdisciplinary, and intersectoral goals of the project while demonstrating how sustainable practices can be realistically implemented within vocational education and training.

## Participants

Irene Perez, Head of Internationalization and Responsible Person of the project

Javier Larroda, Internationalization coordinator and Responsible person of the project

Raul Martinez de Lahidalga, Administrator of the school and the project

Maria Eugenia Ortiz de Urbina, Hair, Beauty and Personal Image department Teacher

Daniel Beitia, Transport and Maintenance of Vehicles Department Teacher

Iñigo Oregui, Transport and Maintenance of Vehicles Department Teacher

Andrea Zarate, Audiovisual Department Teacher

Nayara Fernandez, Student of Higher Degree Personal Image and hairdressing

Iván Rosinos, Student of Higher Degree Printing and Media

Maialen Sanz, Student of Higher Degree Beauty and Hairdressing

Ainhize Grandival, Student of VET Beauty and Cosmetics

Ekain Achaerandio, Student of Higher Degree Automotive

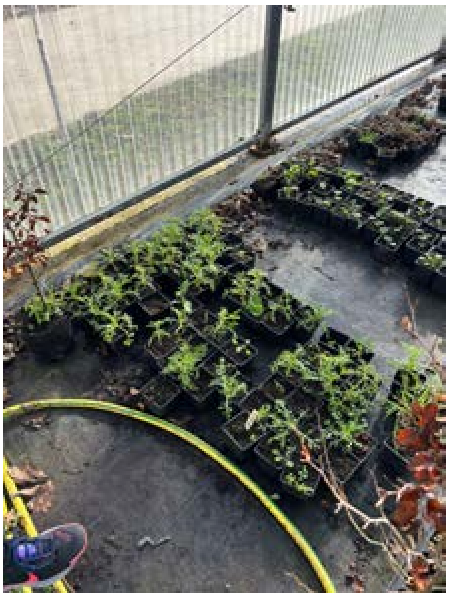
Iker Lozano, Student do VET Car Body Reparation

# 1. Discovering Local Plant-Based Colors

## 1.2. Exploring Regional Plants

### A Look into Traditional and Emerging Sources of Natural Dyes in the Basque Country

This part of the project focuses on identifying, studying, and testing local plant species that have historically been used—or have potential to be used—as sources of natural dyes. Rooted in the rich cultural and botanical heritage of the Basque Country, this research reconnects with traditional knowledge while also seeking new opportunities for sustainable pigment production. Through field observations, hands-on pigment extraction, and documentation, students and educators contribute to a growing understanding of how regional biodiversity can support eco-friendly practices in art, design, cosmetics, and beyond.



In the Basque Country, traditional dyeing practices have utilized a variety of regional plants to produce natural pigments. These plants, often found in the local flora, have been integral to the cultural heritage of the region, providing vibrant colors for textiles and other materials.

One such plant is *Alkanna tinctoria*, commonly known as dyer's alkanet. Its roots yield a red dye that has been used since antiquity in the Mediterranean region, including the Basque Country. The dye is soluble in alcohol and oils but not in water, making it suitable for various applications, including wood staining and cosmetic products.

Another notable plant is *Isatis tinctoria*, or woad, which produces a blue dye. Historically, woad was a staple in the European dyeing industry, particularly in regions like the Basque Country. Its use dates back to medieval times and was prevalent until synthetic dyes replaced it in the early 20th century.

*Reseda luteola*, known as weld, is a plant that yields a bright yellow dye. It was widely used in Europe, including the Basque Country, for dyeing wool and other fibers. The dye is derived from luteolin, a flavonoid present in the plant, and was historically mixed with blue dyes to produce green hues.

Additionally, *Xanthoria parietina*, a lichen commonly found on tree trunks and walls, has been used as a natural dye source. It produces yellow to orange hues when processed with mordants like alum. This lichen's accessibility and dyeing properties made it a valuable resource in traditional dyeing practices.

These plants not only highlight the rich biodiversity of the Basque Country but also underscore the region's historical connection to sustainable and natural dyeing practices. Reviving the use of these traditional plant-based dyes can contribute to a more sustainable and culturally rich approach to modern dyeing techniques.

### 1.3. Historical & Cultural Insights

The plants traditionally found and used in the Basque Country—such as *Alkanna tinctoria* (alkanet), *Isatis tinctoria* (woad), *Reseda luteola* (weld), and *Xanthoria parietina* (lichen)—were historically used in **textile dyeing** and in **artistic applications**, particularly in folk art and traditional crafts. These plants were integral to **rural economies, cultural expression, and sustainable local craftsmanship**. Reviving their use today ties into both **sustainability and heritage preservation**.

Textile Applications: These plants were primarily used to dye natural fibers like wool, linen, and sometimes hemp, which were commonly produced and used in the region for clothing, household textiles, and artisan goods.

- **Woad** (*Isatis tinctoria*) was especially valued for producing a strong, lasting **blue dye**. It was a major crop in parts of Europe before the introduction of indigo, and the

Basque Country, with its textile traditions, would have used woad in traditional garments and decorative fabrics.

- **Weld** (*Reseda luteola*) was known for its **vibrant yellow** pigment and was often used in combination with woad to create **green**.

- **Alkanet** (*Alkanna tinctoria*) provided a **red to purple hue**, used more selectively, often in smaller textiles or for decorative detailing due to the pigment's solubility in fats and alcohols rather than water.

- **Xanthoria parietina**, the yellow-orange lichen, was used more locally and informally for **natural wool dyeing** in mountain or rural communities, often with traditional mordants like alum or stale urine.

Artistic Applications: While these dyes were less commonly used in high-art painting (which often relied on mineral or imported pigments), they did appear in:

- **Folk art** (e.g., wood carving or painted wooden objects) where oil-soluble dyes like alkanet were used for staining.

- **Manuscript decoration**, especially in monastic or early educational centers in northern Spain, where natural pigments may have been applied alongside inks.

- **Decorative weaving and embroidery**, where dyed threads made from local plants were used to create motifs representing regional identity.

### 1.4. Sustainable Aspects

Natural pigments are considered an eco-friendly alternative to synthetic dyes and paints because they come from renewable sources such as plants. Unlike synthetic pigments, which are typically derived from petrochemicals, natural pigments can often be cultivated and harvested locally. This supports more sustainable production models and reduces reliance on fossil fuels. Local cultivation also decreases the need for long-distance transportation and industrial processing, both of which contribute to greenhouse gas emissions.

The methods used to extract and prepare natural pigments are generally low-impact and do not rely on harsh chemicals. These processes often use simple tools and natural solvents like water, vinegar, or plant-based oils, resulting in far less pollution compared to the manufacturing of synthetic pigments. Synthetic dye production frequently involves toxic substances and heavy metals, which can lead to significant contamination of waterways and ecosystems when released as industrial waste.

Natural pigments are also much safer for human health. They do not contain many of the hazardous substances found in synthetic alternatives, such as carcinogens or allergens. This makes them particularly suitable for products that come into contact with skin, such as cosmetics and body paints, as well as for use in educational environments where exposure to harmful substances must be minimized.

Using natural pigments also encourages biodiversity and helps to preserve traditional agricultural and artisanal practices. Many dye-producing plants are part of local cultural heritage, and cultivating them supports both environmental stewardship and the continuity of historical knowledge. In this way, natural pigments contribute not only to ecological sustainability but also to the resilience of local communities and traditions.

# 2. Experimenting with Natural Pigments

## 2.2. Methods of Extraction

Traditional plant-based dyeing in the Basque Country has inspired some traditional recipes and preparation methods for extracting and applying natural pigments from key plants:

**Woad (Isatis tinctoria)**
Harvest leaves before flowering. Leaves are crushed and fermented in water to release indican, which converts to indigotin—the blue dye. After fermentation, the liquid is aerated and the dye precipitates as a blue powder that can be dried and ground. The powder is then mixed with a reducing agent like a natural fermentation vat or additives (historically urine) to fix the dye onto fibers. Textiles are dipped repeatedly to build up color intensity. The resulting powder can also be applied to various surfaces and in cosmetics, using different binders. However, in cosmetics, we only use the powder.

**Weld (Reseda luteola)**
Harvest the entire plant during flowering, as this is when luteolin concentration is highest. The plant is chopped and simmered in water for several hours to extract the yellow pigment.

The dye bath is strained, and fabrics are soaked directly in the solution. Alum is commonly used as a mordant to improve color fastness. The fabric may be treated with tannin or iron mordants to alter the shade. We used the coloured water for our cosmetics.

**Alkanet (Alkanna tinctoria)**

The roots are collected, dried, and ground into a powder. Because the pigment is oil-soluble, it is traditionally extracted by soaking the powder in oils, alcohol, or fats rather than water. The resulting tincture can be applied to wood stains, cosmetics, or textiles using oil-based binders. It produces red to purple hues and requires different handling than water-soluble dyes.

**Lichen (Xanthoria parietina)**

Lichens are harvested from tree bark or stones, dried, and crushed. The powder is boiled in water with alum mordants to produce yellow to orange dyes. The process requires careful control to avoid over-extraction, which can produce brownish colors. Lichens were often combined with other plants to create a range of tones. In our experiments we used the powder to create colourful cosmetics.

## 2.3. Testing on Different Materials

### Testing Plant-Based Pigments in Cosmetic Applications: From the Garden to the Product

The journey begins with the **careful selection and harvesting of pigment-producing plants**, chosen for their color potential, safety on skin, and historical use in natural remedies or dyes. Plants such as alkanet, turmeric, calendula, beetroot, and hibiscus are common candidates due to their vibrant tones and skin-friendly properties. Harvesting is often done by hand to preserve the integrity of the raw material, and parts such as roots, petals, or leaves are collected depending on the pigment source.

The next key moment is **pigment extraction**, where the goal is to isolate the color in a form usable for cosmetic formulations. Depending on the plant, extraction can be done using oil infusions, alcohol-based tinctures, or aqueous methods. For example, alkanet root is soaked in oil to produce a deep red hue, while hibiscus petals may be boiled in water to yield a purple tone. The method used is chosen based on the solubility and stability of the pigment in different cosmetic bases.

Once the pigment is extracted, **filtration and stabilization** follow. Solid plant matter is filtered out, and the pigment solution is sometimes blended with natural preservatives like vitamin E or rosemary extract to increase shelf life. At this stage, it is also important to test for stability under light, pH, and temperature changes—especially for cosmetics like lip balm or cream, where color retention is essential.

The purified pigment is then **tested in various cosmetic formulations** such as lip balms, creams, lotions, scrubs, or eyeshadows. Small batches are created to evaluate how well the pigment blends with different bases—beeswax, shea butter, aloe vera gel, or clay—and how it behaves on the skin. Texture, color payoff, scent, and shelf stability are all assessed.

**Safety testing and patch testing** are essential next steps. The pigment-infused product is applied to a small area of skin to monitor for irritation, discoloration, or allergic reaction. Only pigments that pass these tests move forward.

Finally, the most successful formulations are **packaged, labeled, and documented**, both for presentation and for sharing with partners or in workshops. Students and researchers evaluate not only the aesthetics of the final product, but also its performance in real use, such as how long the color lasts on the skin or whether it fades under sunlight.

Each step, from pigment extraction to final application, offers a learning opportunity in chemistry, botany, formulation science, and sustainability. The process connects natural resources to hands-on creativity, resulting in cosmetic products that are safe, eco-conscious, and rich in cultural and scientific value.

## 2.4. Challenges Faced & Solutions Found

**Insights from Testing Plant-Based Pigments in Cosmetics**

Throughout the process of experimenting with natural pigments for cosmetic use, several technical and creative challenges emerged—many of which led to useful discoveries and unexpected innovations.

One of the first major challenges was **color instability**. Many plant pigments, especially those derived from flowers or fruits like hibiscus or beetroot, tended to fade when exposed to light or change color when mixed with oils, waxes, or alkaline ingredients. For example, beetroot's deep red turned brownish in lip balm formulations. The solution was to adjust pH levels and test various natural antioxidants, such as vitamin E and rosemary extract, to help preserve color. In some cases, switching from oil-based to water-based or glycerin-based extraction helped maintain a more vibrant tone.

Another challenge was **limited adhesion and pigment strength**, especially when trying to develop lip tints or eyeshadows. Some plant pigments produced beautiful colors in liquid form but did not bind well to the skin. To overcome this, natural binders like shea butter, beeswax, and arrowroot powder were introduced to stabilize the formulas. Layering techniques and micro-batch testing helped identify the best carrier bases for specific pigments.

Surprisingly, some of the **most vivid and stable results came from less-expected plants**. Alkanet root, already known for its use in herbal remedies, provided a rich, long-lasting reddish-purple when infused in oil. Turmeric, while tricky to handle due to staining, offered a bold yellow that held up well in creams and facial masks. Calendula petals, often used for skin healing, created soft orange and golden tones and blended smoothly into oils without overpowering scent or texture.

During the experimentation, students and teachers also discovered **new color variations** by layering pigments or blending different plant extracts. Mixing turmeric with indigo powder or green tea produced earthy greens and ochres. Hibiscus combined with baking soda shifted from red to violet, demonstrating how pH affects pigment chemistry—a powerful learning moment that bridged natural science and cosmetic formulation.

Unexpected effects included **natural scents influencing the final product**, especially with floral and herb-based pigments. In some cases, the plant's natural aroma enhanced the appeal of the product. In others, neutral-smelling carriers like cocoa butter were used to balance or mask overpowering scents.

In the end, the most successful outcomes came from combining **trial-and-error experimentation with an understanding of plant chemistry**, allowing students to learn not only how to make natural cosmetics but also how to troubleshoot, innovate, and adapt. What started as color tests became a broader exploration of texture, sensory experience, and sustainable design.

### 2.5. Reflections from Participants

What students and teachers found most interesting in this project was the way it brought together nature, creativity, and science in a hands-on and meaningful way. The process of transforming plants grown or gathered locally into usable pigments—and then turning those pigments into real products—was both surprising and rewarding. Many participants were fascinated by how simple ingredients like petals, roots, or leaves could be used to produce vibrant colors, and how those colors reacted differently depending on the medium, the pH, or the way they were extracted.

For students, one of the most exciting aspects was the experimental freedom. They weren't just following a recipe—they were testing, observing, failing, and trying again. Watching a red dye turn purple because of a pH shift, or discovering that one plant worked beautifully in a cosmetic balm while another faded quickly, made the science feel alive and directly connected to their work. It was a break from abstract concepts, offering immediate, visible results. The fact that their work led to a real product—something they could touch, smell, and share—made it feel purposeful and personal.

Teachers were especially interested in how the project encouraged interdisciplinary learning. It combined chemistry, botany, art, sustainability, and even history, allowing students to approach a single topic from multiple angles. The project also sparked conversations about environmental responsibility, circular economy, and traditional knowledge. Seeing students become curious not just about the “how” but also the “why” behind materials and methods gave educators a sense of deeper engagement.

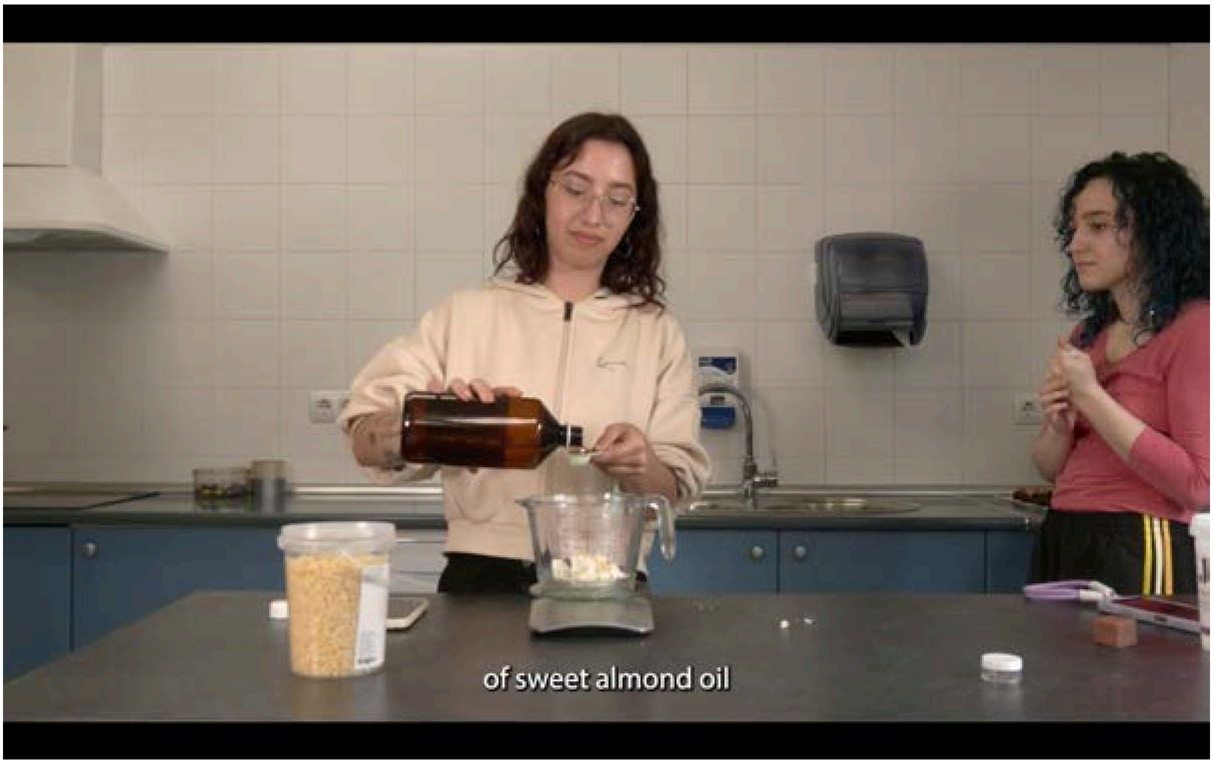
Another highlight for both groups was the collaborative and international dimension of the project. Sharing findings with other schools, comparing regional plants, and contributing to a collective effort gave participants a sense of being part of something bigger than their classroom. The chance to present their results, join workshops, and see how others approached similar challenges was both motivating and enriching.

Overall, what stood out most was the feeling that this wasn’t just a school assignment—it was real-world experimentation with a tangible environmental and creative impact.

## 3. Practical Applications & Creative Outcomes

### 3.2. Student&TeacherCreations

## 3.3. Masterclass Takeaways

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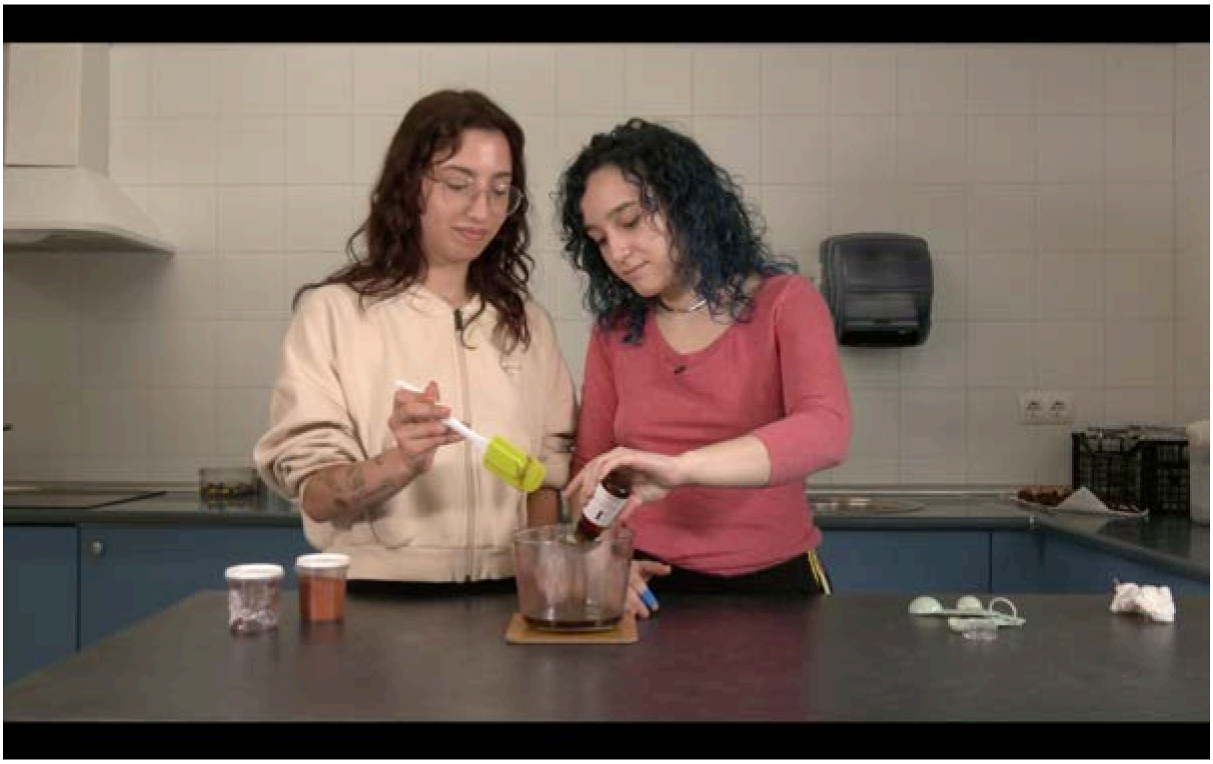

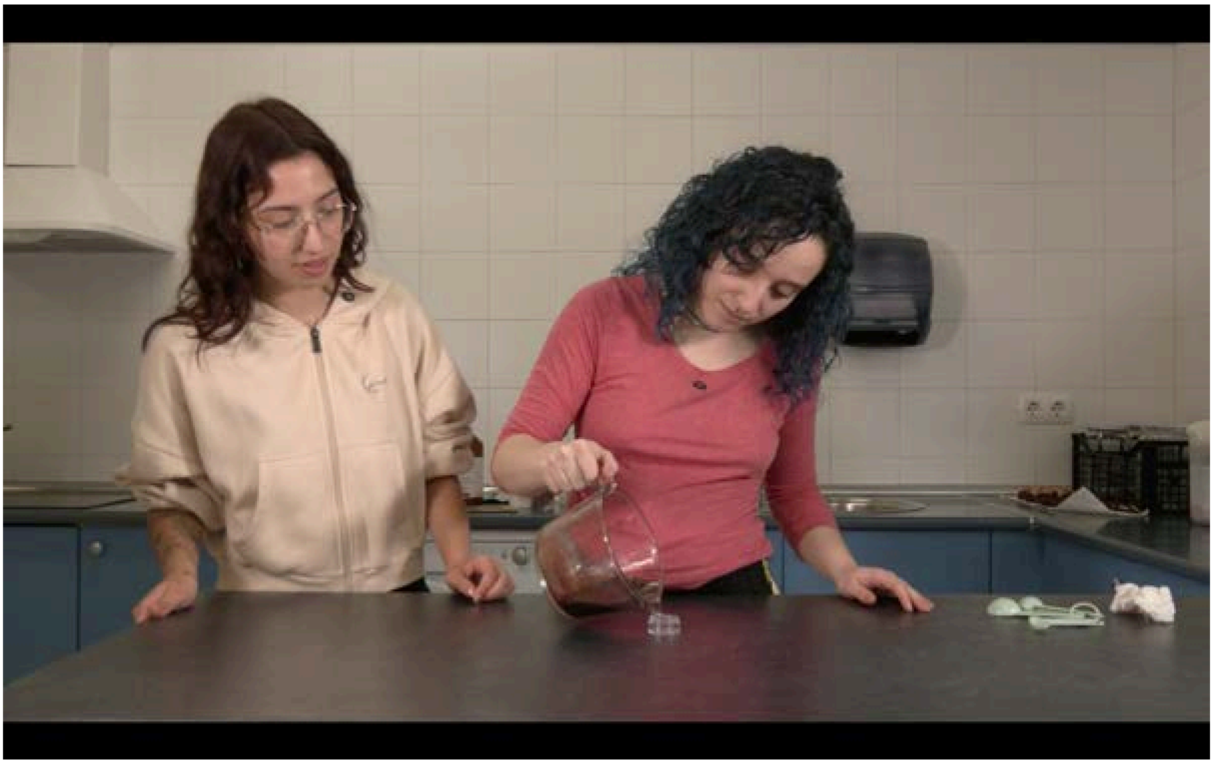

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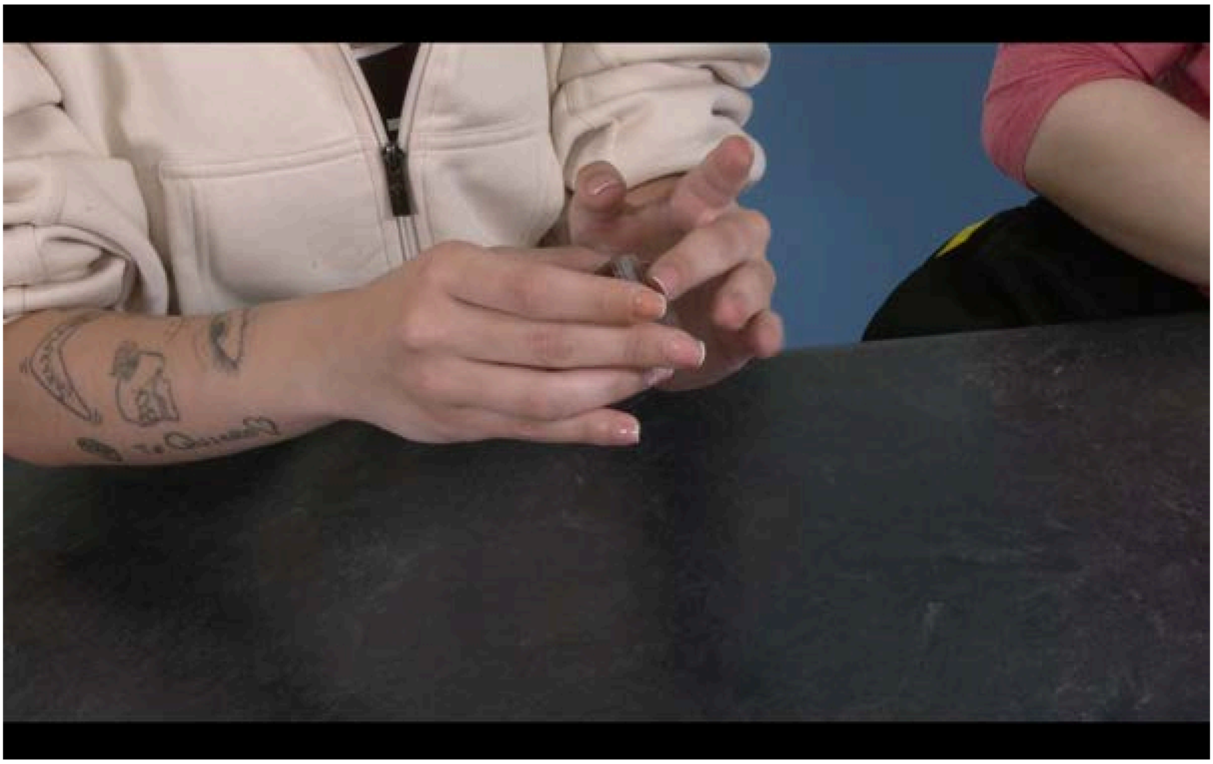

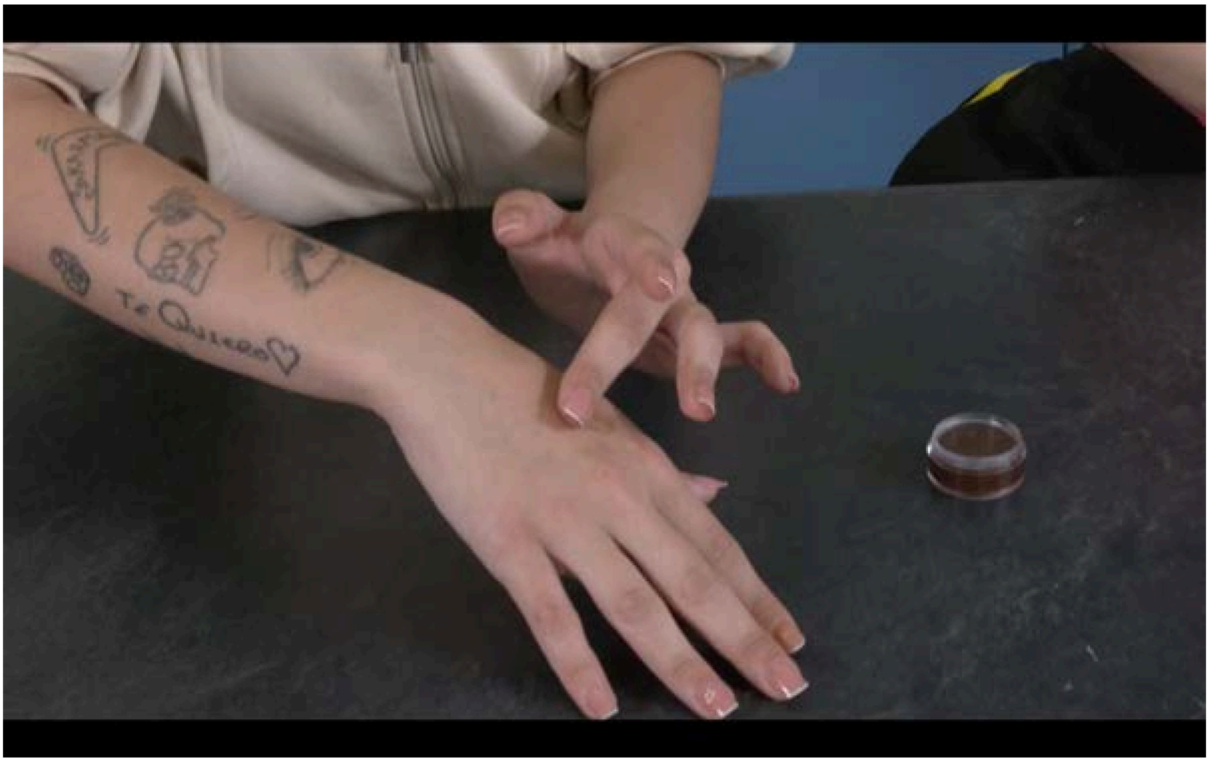

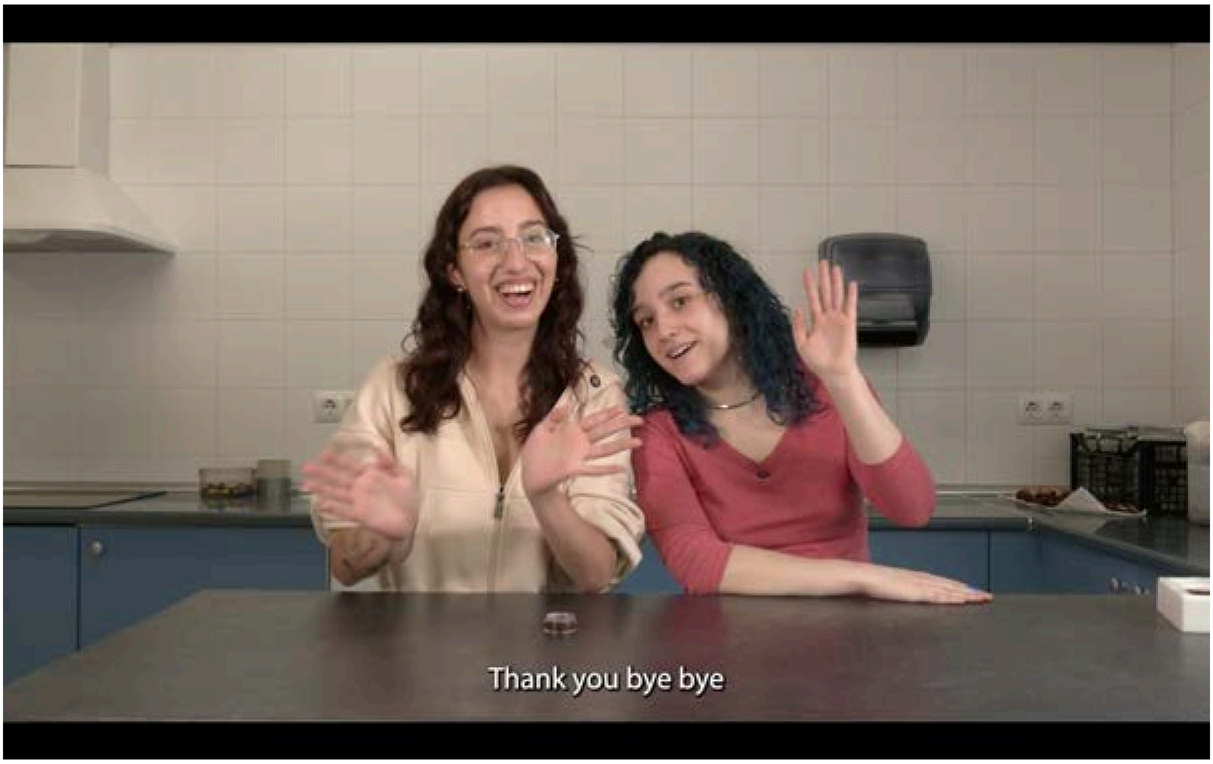
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# 4. Conclusion & Next Steps

## 4.2. Key Insights & Lessons Learned

The project offered a rich variety of insights and lessons that went beyond expectations, both technically and personally for students and teachers. One of the most valuable lessons was that natural processes are unpredictable but full of potential. Participants quickly realized that working with plant-based pigments requires flexibility, patience, and close observation. Slight changes in temperature, pH, or even drying time could completely alter the final color or texture of a product. This unpredictability became a key part of the learning process, teaching students to approach problems with curiosity and resilience rather than frustration.

Another important insight was that local biodiversity holds untapped creative and functional value. By exploring plants from their own region, students developed a new appreciation for familiar landscapes. What once seemed like common weeds or garden plants turned out to be powerful sources of color, and in some cases, healing properties. This connection to place helped frame sustainability not as an abstract concept, but as something rooted in daily choices and cultural heritage.

A recurring lesson across all activities was the importance of testing, documenting, and comparing. Through methodical experimentation—keeping notes, photos, and samples—students began to understand the value of process over instant results. They also gained confidence in presenting their findings, learning to communicate challenges, improvements, and outcomes in a structured way. Teachers observed a noticeable improvement in students' ability to collaborate, troubleshoot, and articulate their work.

On a broader level, the project showed that interdisciplinary learning can be both effective and engaging. Combining science with creativity and environmental awareness helped students see how different subjects connect in real-world applications. It also reinforced the idea that sustainable alternatives, like plant-based pigments, can be both functional and beautiful when developed thoughtfully.

Perhaps most importantly, the project inspired a shift in mindset. Students and educators began to see that eco-friendly solutions are not just idealistic—they are achievable, relevant, and worth pursuing. The experience encouraged a deeper respect for nature, a greater sense of agency, and the belief that innovation doesn't always require high-tech tools—just careful observation, creativity, and collaboration.

## 4.3. Potential for Future Work:

This experience has opened up strong potential for future development, both within CIFP Mendizabala LHII and across the broader project network. One of the clearest opportunities is to deepen the technical and creative work started in this phase by expanding into **more advanced formulations and professional applications**. Now that a foundation has been built—understanding which plants perform well, which extraction methods are most stable, and how pigments behave in real products—the next project phases can focus on refining, standardizing, and scaling up the most promising results.

There is also strong potential to introduce **more diverse product lines**, moving beyond cosmetics into areas such as natural inks for graphic design, sustainable surface finishes for car bodywork, or plant-based pigments for textile printing. These possibilities align perfectly with the multidisciplinary strengths of the school and offer practical ways to integrate natural dyes into real vocational training paths.

The international collaboration dimension will remain central. The experiences, results, and techniques developed at Mendizabala can be shared and compared with other schools through joint exhibitions, workshops, and training mobilities. Likewise, new inspiration and techniques from partner schools can be brought in, enriching local work and offering new challenges to explore.

Finally, this experience has planted the seeds for **long-term cultural and environmental impact**. Future students can build on this work through yearly cycles of research, planting, formulation, and product development—turning what began as a temporary project into an evolving, living part of the school's identity. The project can grow into a sustainable innovation hub where tradition meets modern practice, and where young people actively shape the future of eco-friendly materials and vocational creativity.

## 4.4. Expanding the Knowledge:

The results of the study on natural pigments and fabrics will be shared through a variety of channels to ensure wide dissemination and engagement:

- Digital Platform: All partner schools will contribute to a shared digital platform where the study report, 360 photos, videos, and other educational materials will be published and made accessible to the public.

- Exhibitions: Each partner school will organize exhibitions involving students, teachers, and students to present the findings and practical applications of natural pigments and fabrics. For example, one of these exhibitions will take place during the training session in Vitoria-Gasteiz on May 2026.
- Social Media and school website: Key results and highlights from the project will be regularly shared on the Instagram account of Mendizabala (@Mendizabalafp) and on the official websites (www.mendizabala.eus) of the participating institutions, ensuring broader visibility.
- Multiplier Events: At the end of the project, all the partner schools will host multiplier events to showcase the outcomes and share best practices with other educational institutions, local stakeholders, and professionals in relevant fields.
- Educational Integration: The study findings will be integrated into classroom activities and shared with other educators within each school through internal teacher training sessions or staff meetings.

This multi-channel dissemination approach ensures that the project results reach both local and international audiences, encouraging replication and inspiring sustainable practices in education and beyond.

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## 5. Appendix – Additional Visuals & Resources

- Detailed List of Plants & Color Results/ **Example Table of Plant-Based Colors**

| Plant Name | Part Used | Color Outcome | Notes |
|---|---|---|---|
| Isatis tinctoria | Flowers | Blue | We used it in powder |
| Reseda luteola | Flowers | Yellow | We used it in powder |
| Alkanna tinctoria | Roots | Red-Purple | We used it in powder |
| Xanthoria parietina | Lichen | Yellow-orange | We used it in powder |
| Onion | Skin | Brown | We used it in powder |
| Avocado | Seed | Red | We used it in powder |
| Rose | Petals | Pink | We used it in powder |
| Calendula | Flowers | Yellow | We used it in powder |
| Hibiscus | Flowers | Purple | We used it in powder |
| Turmeric | Root | Orange | We used it in powder |

- Additional Testimonials from Participants

**"I had never worked with natural pigments before, and it was surprising to see how much color you can get from plants you see every day. It changed how I think about the materials we use in design."**
*— Ivan, Graphic Design Student*

**"Going to the workshop in another country was a highlight. We got to see how other students worked with completely different plants, and we shared ideas about extraction methods. It felt like being part of something bigger."**
*— Raul and Maru, Car Bodywork Program and Cosmetic teachers*

**"What I enjoyed most was testing the pigments in real cosmetic formulas. Some worked beautifully, others didn't at all, but learning by doing—and failing—taught me more than a textbook ever could."**
*— Maialen, Esthetics and Cosmetics Student*

**"This project gave us the freedom to experiment. We weren't just following steps—we were discovering. And when something worked, it felt like a real achievement."**
*— Nayara, Hairdressing and Personal Image Student*

**"Before this project, I had no idea how much there is behind color. Now I look at plants differently—I see potential in them."**
*— Ainhize, Esthetics and Cosmetics Student*

**"Learning dying and printing techniques together with expert teachers was a completely new experience for me. This project gave me the chance to feel like an artist."**
*— Ekain, Car Bodywork Program*