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Universitat Autònoma de Barcelona

Final Degree Project

LEARNING THROUGH NATURE: A DYE PLANT GARDEN FOR CATALAN PUBLIC PRIMARY SCHOOLS

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“There were trees before there were books, and perhaps when books come to an end, trees will still remain. And perhaps humanity will reach such a degree of culture that it no longer needs books, but it will always need trees, and then it will nourish the trees with books.”

— Miguel de Unamuno

RESUM

Aquest Treball de Fi de Grau explora el potencial educatiu dels jardins de plantes tintòries com a espais d'aprenentatge interdisciplinari a les escoles públiques de primària de Catalunya. El projecte respon a la desconnexió entre els infants i la natura proposant activitats d'aprenentatge a l'aire lliure i vivencials vinculades al currículum d'educació primària. L'objectiu principal és dissenyar una guia pedagògica en línia per a la creació i l'ús d'un jardí de plantes tintòries a les escoles. La proposta combina educació ambiental, expressió artística i aprenentatge pràctic mitjançant activitats relacionades amb la plantació, l'observació dels processos naturals i la creació de tints naturals. El projecte combina una metodologia d'estudi de cas i de recerca experimental basada en una revisió bibliogràfica amb el disseny d'una proposta educativa pràctica. El marc teòric incorpora conceptes com la biofília, l'aprenentatge vivencial i l'educació a l'aire lliure, recolzats per autors com Freire (2011), Kolb (1984) i Kellert (2005). La guia també s'inspira en experiències educatives reals i en col·laboracions amb projectes com *HortAula* i el *Jardí de les TINTAcions* de la *Universitat Autònoma de Barcelona*. Com a resultat, s'ha desenvolupat una guia educativa en línia que inclou informació pràctica sobre plantes tintòries adaptades al clima mediterrani i activitats interdisciplinàries vinculades a les ciències, l'art, la llengua i la sostenibilitat. El projecte conclou que els jardins de plantes tintòries poden promoure la creativitat, la consciència ambiental i l'aprenentatge significatiu amb el contacte directe amb la natura.

Paraules clau: plantes tintòries; aprenentatge a l'aire lliure; aprenentatge vivencial; horts escolars; interdisciplinarietat; educació primària

RESUMEN

Este Trabajo de Fin de Grado explora el potencial educativo de los jardines de plantas tintóreas como espacios de aprendizaje interdisciplinario en las escuelas públicas de educación primaria de Cataluña. El proyecto responde a la desconexión entre la infancia y la naturaleza proponiendo actividades de aprendizaje al aire libre y experiencial vinculadas al currículo de educación primaria. El objetivo principal es diseñar una guía pedagógica en línea para la creación y el uso de un jardín de plantas tintóreas en las escuelas. La propuesta combina educación ambiental, expresión artística y aprendizaje práctico mediante actividades relacionadas con la plantación, la observación de los procesos naturales y la creación de tintes naturales. El proyecto combina una metodología de estudio de caso e investigación experimental basada en una revisión bibliográfica junto con el diseño de una propuesta educativa práctica. El marco teórico incorpora conceptos como la biofilia, el aprendizaje experiencial y la educación al aire libre, respaldados por autores como Freire (2011), Kolb (1984) y Kellert (2005). La guía también se inspira en experiencias educativas

reales y colaboraciones con proyectos como *HortAula* y el *Jardí de les TINTAcions* de la *Universitat Autònoma de Barcelona.* Como resultado, se ha desarrollado una guía educativa en línea que incluye información práctica sobre plantas tintóreas adaptadas al clima mediterráneo y actividades interdisciplinarias relacionadas con las ciencias, el arte, la lengua y la sostenibilidad. El proyecto concluye que los jardines de plantas tintóreas pueden promover la creatividad, la conciencia ambiental y el aprendizaje significativo mediante el contacto directo con la naturaleza.

Palabras clave: plantas tintóreas; aprendizaje al aire libre; aprendizaje experiencial; huertos escolares; interdisciplinariedad; educación primaria

ABSTRACT

This Final Degree Project explores the educational potential of dye plant gardens as interdisciplinary learning spaces in Catalan public primary schools. The project responds to the disconnection between children and nature by proposing outdoor and experiential learning activities connected to the primary education curriculum. The main objective is to design an online pedagogical guide for creating and using a dye plant garden in schools. The proposal combines environmental education, artistic expression and hands-on learning through activities related to planting, observing natural processes and creating natural dyes. The project combines case study and experimental research methodology that is based on a literature review with the design of a practical educational proposal. The theoretical framework incorporates concepts such as biophilia, experiential learning and outdoor education, supported by authors such as Freire (2011), Kolb (1984) and Kellert (2005). The guide is also inspired by real educational experiences and collaborations with projects such as *HortAula* and the *Jardí de les TINTAcions* at the *Universitat Autònoma de Barcelona*. As a result, an online educational guide has been developed including practical information about dye plants adapted to the Mediterranean climate and interdisciplinary activities connected to science, art, language and sustainability. The project concludes that dye plant gardens can promote creativity, environmental awareness and meaningful learning through direct contact with nature.

Keywords: dye plants; outdoor learning; experiential learning; school gardens; interdisciplinarity; primary education

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1. INTRODUCTION

Nowadays, based on my experience in different jobs and teaching internships in public primary schools in Catalonia, I have observed that many children have limited contact with nature in their daily lives. Although schools often talk about environmental education, learning activities are usually carried out inside the classroom and are not always connected to real, hands-on experiences in natural environments.

In several schools, I have also noticed that it can be difficult to create interdisciplinary projects that connect different subjects in a meaningful way. Some schools have a school garden, but it is often used only occasionally and in science lessons, instead of being used in other subjects like art or language.

This Final Degree Project focuses on the need I have personally experienced to offer practical educational resources that help reconnect children with nature through experiential learning. For this reason, the project proposes the creation of a guide to design and use a dye plant garden (*hort de plantes tintòries*) in public primary schools in Catalonia. Working with dye plants gives students the chance to explore nature, practice creativity and learn about sustainability through practical activities.

The idea for this project also comes from my experience as a fourth-year student collaborating with professors from the *Departament de Didàctica de l'Expressió Musical, Plàstica i Corporal*, and taking part in the *Hortaula project*, an educational initiative developed at the Universitat Autònoma de Barcelona (UAB). This experience has helped me to better understand the process and the importance of providing practical and easy-to-use guidance for teachers.

Finally, this project is inspired by educational approaches such as Waldorf pedagogy, which focuses on learning through experience, being in contact with nature and using creativity. Some of its ideas have inspired me, especially how it connects different subjects through projects and hands-on activities. I hope these principles can help make teaching in public primary schools more active, creative and connected to nature. This project aims not only to create an educational resource, but also to respond to current educational needs related to sustainability, experiential learning and interdisciplinary teaching in primary education.

Therefore, the online guide has been designed as an accessible and adaptable pedagogical tool that can support teachers in integrating outdoor learning into everyday school practice.

2. OBJECTIVES

The following table summarizes the main and specific objectives of this project. It shows what I aim to achieve with the creation of a dye plant garden in public primary schools and how these objectives will guide the design of the pedagogical guide.

GENERAL OBJECTIVE	
My main objective is to design an online pedagogical guide for the creation and educational use of a dye plant garden in public primary schools in Catalonia, as a tool to promote interdisciplinarity and connect with nature.	
SPECIFIC OBJECTIVES	
1	Analyze, through research, the educational potential of school gardens as interdisciplinary learning spaces in primary education.
2	Propose interdisciplinary learning activities based on the dye plant garden, aligned with the Catalan primary education curriculum.
3	Help pupils learn about the environment and sustainability while fostering creativity through hands-on, art-based activities that are enjoyable and meaningful.

2.1. Relationship between objectives and project development

OBJECTIVE	DEVELOPMENT	EXPECTED OUTCOME
Analyse the educational potential of school gardens (**SP 1**)	Review of literature on outdoor learning, experiential learning and biophilia	Theoretical justification of nature-based learning
Propose interdisciplinary activities (**SP 2**)	Design of activities connected to science, art and language	Online pedagogical guide

Connect the proposal to the Catalan curriculum (**SP 2**)	Adaptation of activities to curricular competences and learning areas	Curriculum-based activities included in the guide
Promote sustainability and creativity (**SP 3**)	Activities related to natural dyes, observation and artistic experimentation	Activities section of the website

3. THEORETICAL FRAMEWORK

3.1. Biophobia and biophilia

Biophobia and biophilia are two concepts that help explain the relationship between human beings and the natural world. As David Orr (2004) argues, biophobia refers to a highly common condition among individuals who have grown up in large urban environments, usually surrounded by technology, consumer spaces and artificial settings. In other words, it refers to fear, aversion or negative emotional responses toward nature or living organisms, such as insects, animals or wild environments. According to this perspective, biophobic individuals tend to privilege human-made constructions and technological artefacts over natural environments, often perceiving nature as dirty, threatening or dangerous.

On the other hand, Wilson (1984) introduces the concept of biophilia, defined as the innate human need to connect with other forms of life. Similarly, Erich Fromm later describes it as a passionate love for life and all living beings. Both perspectives agree that biophilia is an innate characteristic of the human species. In this sense, the biophilia hypothesis suggests that the human brain is biologically predisposed to establish meaningful relationships with other living organisms, including animals and plants. Furthermore, contact with other species may generate significant cognitive, emotional and physical benefits, contributing positively to human knowledge, health and well-being.

3.2. The consequences of children's disconnection from nature

Following the concepts of biophobia and biophilia, it is essential to consider the developmental consequences of children's growing disconnection from the natural world. According to Freire (2011), children today spend less time playing outdoors than they did three decades ago. This progressive decrease in contact with nature has important consequences for their physical, emotional and cognitive development.

Firstly, the absence of regular interaction with natural environments may affect children's spontaneity, joy and natural biological rhythms. The disruption of these rhythms often leads to alterations in vital cycles, both in children and adults. Moreover, limited sensory stimulation may result in what Freire (2011) describes as sensory fatigue, which can manifest in impulsive behaviour, agitation, irritability and difficulties in maintaining attention.

Secondly, this increasingly sedentary lifestyle has clear consequences for physical and mental health, including reduced physical well-being, increased concentration problems and a rise in aggressive or disruptive behaviours (Freire, 2011).

Finally, the growing distance from nature also implies the loss of an important cultural heritage. Traditional knowledge, customs, rituals, legends and popular narratives related to trees, plants, animals and rural life are disappearing as children become separated from the natural environment.

3.3. Nature, well-being and emotional regulation

Research supports the positive relationship between nature exposure and children's well-being. Outdoor activities in natural spaces reduce the risk of mental health difficulties and increase feelings of well-being and self-esteem. Freire (2011) refers to a study conducted by the University of Essex involving more than 1,200 participants, whose findings suggest that only five minutes a day spent walking in a park, cycling, gardening or being near a river can produce positive psychological effects.

Similarly, psychology has demonstrated the restorative effects of natural environments. Ulrich's (1983) work on affective responses to natural scenes suggests that visual exposure to green spaces promotes stress reduction and emotional regulation. Similarly, Kaplan's attention restoration theory (1989) argues that natural environments help restore attention and reduce mental fatigue.

These findings are particularly relevant in educational contexts, as exposure to green spaces may contribute to improved concentration, reduced anxiety and greater emotional stability among children.

3.4. Free play, sensory learning and experiential education

One of the key educational values of nature lies in its capacity to promote free play and experiential learning. Natural materials offer a richer sensory complexity than manufactured toys and encourage open-ended exploration. As Freire (2011) suggests, children intuitively seek contact with the basic elements of nature: earth, water, air and light.

Children can spend long periods playing with sand, water, soil, leaves or stones, engaging in exploratory forms of play that foster creativity, sensory awareness, problem-solving and emotional regulation.

This perspective strongly aligns with experiential learning theories. According to Kolb (1984), knowledge is constructed through the transformation of experience. In this sense, activities such as gardening, observing ecosystems, collecting natural materials or exploring outdoor spaces allow children to connect theory and practice through direct interaction with their environment. Similarly, nature-based education is aligned with constructivist approaches, particularly Piaget's view of the child as an active learner who constructs knowledge through action and interaction with the environment.

3.5. Outdoor learning and naturalised school spaces

Outdoor learning refers to the use of natural or semi-natural spaces as educational environments for structured learning experiences. Beyond recreation, outdoor environments support attention, engagement and meaningful learning processes (Chawla, 2015).

Activities such as outdoor lessons, school gardens, exploration tasks and interdisciplinary projects enable students to learn through direct interaction with real-world contexts, strengthening conceptual understanding and long-term retention (Kellert, 2005).

In this sense, the naturalisation of school spaces becomes particularly relevant. The integration of natural elements such as vegetation, natural light, soil, wood and organic materials into school environments supports emotional regulation and reduces stress. Research in environmental psychology shows that contact with such elements has restorative effects on attention and well-being (Ulrich, 1983).

School gardens, in particular, have been recognised as powerful interdisciplinary learning environments where science, language, mathematics and artistic expression can work together.

Recent reviews also highlight the importance of designing school environments that intentionally incorporate natural elements. Falzon and Conrad (2024) argue that nature-based learning spaces can support children's engagement, well-being, environmental awareness and active participation in learning processes, reinforcing the educational potential of naturalised school grounds.

3.6. Trust, autonomy and the role of risk

Freire (2011) also highlights fear as one of the main forces shaping contemporary parenting and educational practices. Excessive adult control often limits children's opportunities to develop essential skills related to autonomy, decision-making and self-protection.

Rather than constantly warning children to "be careful", educational approaches should encourage them to pay attention to their surroundings and trust their sensations, emotions and intuition. Outdoor environments naturally provide opportunities for measured risk-taking, responsibility and resilience.

This is especially relevant in school gardens and outdoor learning contexts, where children are encouraged to make decisions, solve problems and assume responsibility through direct experience. For instance, a group of children working in a school garden might be responsible for deciding what to plant in a small plot based on the season, available space, and the needs of the plants. They would need to negotiate as a group, justify their choices, and plan the steps required (preparing the soil, planting seeds, scheduling watering, etc).

3.7. The role of teachers in nature-based education

Teachers play a central role as facilitators and mediators of nature-based learning experiences. Their attitudes, beliefs and levels of comfort with the natural world significantly influence how children perceive and engage with outdoor environments (Kellert, 2005; Chawla, 2015).

Related to Freire's dialogic pedagogy (1968), teachers should adopt the role of guides and co-learners rather than only transmitters of knowledge. Through open-ended questioning, and dialogue, they can foster curiosity, confidence in children's interactions with living systems.

Moreover, the teacher's role is key because by modelling care for plants, animals and shared spaces, they contribute to the development of environmental responsibility, empathy and sustainable habits.

3.8. Education for love and respect for nature

Learning to love and respect nature requires regular and meaningful contact with it. As Freire (2011) argues, the most effective approach combines periods spent outdoors with the

presence of a caring adult who shares with the child the excitement and mystery of the surrounding world. Through these shared experiences, children are able to build emotional bonds with the natural environment, transforming nature from an abstract concept into a meaningful one.

This idea is particularly relevant to educational projects involving school gardens and outdoor artistic experiences, as these spaces simultaneously promote sensory exploration, emotional growth, creativity and ecological awareness. In addition, long-term contact with living environments allows children to observe natural cycles, develop patience and responsibility.

3.9. Waldorf pedagogy

Freire's perspective, seen in the previous section, is related to Waldorf pedagogy, which understands education as a process based on direct experience, rhythm and the child's relationship with the living world. In the Waldorf approach, regular outdoor play, seasonal observation and contact with natural materials are considered essential elements of child development, as they encourage imagination, emotional balance and a sense of respect for life. Rather than approaching nature only as curricular content, Waldorf education places it at the centre of the learning experience, encouraging children to engage with the world through their senses, movement and creative activity.

From this perspective, school gardens and outdoor learning spaces become pedagogical environments where cognitive learning, emotional development and ecological awareness are interdisciplinarily worked. These experiences contribute not only to environmental knowledge but also to the cultivation of care, empathy and respect for nature.

3.10. Benefits of a dye plant garden in a school

Recent educational research highlights the growing importance of school gardens as interdisciplinary learning environments that promote environmental awareness, collaborative learning and student engagement. Studies on outdoor learning suggest that garden-based education can positively influence children's academic motivation, well-being and connection with sustainability practices.

The implementation of a dye plant garden within the school context can therefore be understood as a pedagogical response to children's growing disconnection from nature.

Beyond its ecological value, this space offers meaningful opportunities for interdisciplinary learning, combining environmental education, artistic expression and emotional development.

Through the cultivation, observation and use of plants for natural dyeing processes, children engage in experiential learning that connects science, creativity and sustainability (Kolb, 1984; Kellert, 2005).

Moreover, this type of project fosters care, responsibility and a deeper emotional bond with the living world, promoting values of respect, curiosity and ecological awareness from an early age (Chawla, 2015; Freire, 2011).

To sum up, the dye plant garden becomes not only a learning resource but also an educational environment that supports children's development and strengthens their relationship with nature. Research on school gardens further supports their positive impact on interdisciplinary learning, motivation and environmental awareness.

3.11. ***Jardí de les TINTAcions*** **(UAB)**

The Garden of Dye Plants (*Jardí de les TINTAcions*), currently being developed at the Faculty of Education of the *Universitat Autònoma de Barcelona*, is an educational project where art and nature come together in the same space. The idea is to turn part of the campus, specifically *HortAula* (an initiative that promotes school gardens as learning spaces) into a garden of dye plants that also works as an open-air classroom.

Students can get directly involved with the plants by observing them, touching them and even experimenting with natural dye extraction. This makes learning much more hands-on and experiential, encouraging learning through direct experience and interaction with the environment.

Beyond the botanical side, the project is strongly linked to artistic creation. It brings back traditional Mediterranean plants that were historically used for pigments, such as woad (*Isatis tinctoria*), madder (*Rubia tinctorum*), and weld (*Reseda luteola*). In this way, it recovers old craft knowledge but places it within a modern, sustainable and educational context.

The garden also helps explore the connection between art and nature. It is a space where students can learn by doing, experiment and reflect at the same time, which leads to deeper

and more meaningful learning. This idea connects with Sara Torres Vega' perspective, as director of the initiative, on art education as a transformative and collective process in which artistic practice becomes a space for experimentation, reflection and shared learning (Torres-Vega & Woon, 2024).

It is also designed as a training space for future teachers, who can later apply similar approaches in schools. This project is connected to MAAAL (*Museu d'Art i Aprenentatge a l'Aire Lliure*), which reimagines the university campus as an open and shared museum. In this vision, art is not judged as simply "good" or "bad," but understood as a process of learning, expression and connection.

In my collaboration scholarship, these projects have helped me understand how alternative learning spaces can enrich teacher education. They show how learning doesn't have to stay inside the classroom, but can happen through experience, interaction with the environment and creative practice.

4. CONTEXTUALISATION

This Final Degree Project is designed to provide public schools in Catalonia a clear and practical guide on how to create their own dye plant gardens in their school. It is made for the Catalan education system, where schools follow a curriculum that focuses on inclusion, competences and development of students.

Public education in Catalonia is committed to inclusive education and to supporting students' overall development, not only in terms of academic learning but also emotional, social and ethical growth. In Catalonia, schools also try to use active and practical learning methods, so students can learn by doing and connect school learning with real life. For this reason, incorporating nature-based methodologies into primary education may contribute positively to the development of these competences and skills.

The Mediterranean climate of Catalonia has an important influence on how outdoor education can be developed. With rainy winters and hot and dry summers, this climate makes it possible to do outdoor activities during most of the school year (Britannica Editors, 2026). These conditions are especially good for using outdoor learning spaces such as school gardens or natural play areas.

On the other hand, this climate also brings some challenges. For instance, the lack of rain during the summer months or the need to choose plants that can survive dry conditions, such as lavender or rosemary (LizPlants, 2026). For this reason, these climate conditions need to be taken into account when designing school gardens so that they are both useful for learning and respectful of the environment.

Within this context, school gardens offer valuable opportunities for students to connect directly with nature, living systems and seasonal change. They can become outdoor classrooms where children learn through observation, hands-on experiences and collaborative exploration. These spaces encourage curiosity and creativity, while also promoting interdisciplinary learning across subjects such as science, language, mathematics, art and social studies.

To respond to this need, I have created an accessible website guide specifically focused on the Catalan context. It is an online resource for public schools in Catalonia that provides clear and step-by-step guidance for planning and creating a dye plant garden adapted to the Mediterranean climate, together with a collection of interdisciplinary activities.

The proposal was also designed taking into account the reality of Catalan public schools, including possible limitations related to available outdoor space, financial resources and teacher training. Therefore, the guide includes adaptable and flexible activities that can be implemented in different educational contexts.

5. METHODOLOGY

5.1. Methodology of the theoretical framework

The theoretical framework of this final degree project is based on a review of academic literature related to environmental education, school gardens and experiential learning in primary education.

The methodology of this project is descriptive and applied, as it analyses the current situation of public schools in Catalonia regarding outdoor spaces and the use of educational gardens, while simultaneously proposing concrete solutions through a web-based guide.

It is also qualitative, based on the collection and synthesis of scientific literature, educational documents, pedagogical approaches such as Waldorf pedagogy, school garden experiences and interdisciplinary activities. A qualitative methodology was selected because the purpose of the project was not to measure variables statistically, but rather to analyse educational literature, identify pedagogical principles and transform them into a practical educational resource. This approach was considered the most appropriate for addressing the research objectives.

This combination allows the research to be balanced in theory while producing practical, actionable resources for schools.

5.2. Methodology of the practical proposal

The practical proposal follows a design-based educational approach focused on the creation of an applied pedagogical resource, combining case study and experimental research, developed through my collaboration with the project in a real educational context, while also providing a practical perspective on possible interdisciplinary activities. The main outcome of the project is a pedagogical guide for the creation and educational use of a dye plant garden in public primary schools in Catalonia.

The design of the guide is based on four main elements. First, the theoretical framework developed through the literature review. Second, my personal experience during teaching internships and different jobs in public primary schools. Third, my participation in the *Hortaula* project at the *Universitat Autònoma de Barcelona (UAB)*, in collaboration with the *Departament de Didàctica de l'Expressió Musical, Plàstica i Corporal*.

The idea is that the guide includes interdisciplinary learning activities connected to the dye plant garden, combining areas such as science, art and language. Also, aligned with the Catalan primary education curriculum.

5.3. Design process of the online guide

The design of the online pedagogical guide was developed through four main phases.

Firstly, a literature review was conducted in order to identify the educational benefits of outdoor learning, experiential education, school gardens and nature-based pedagogies. This phase provided the theoretical basis of the project and helped establish the main educational principles of the proposal.

Secondly, different reference projects related to school gardens, natural dyes and outdoor education were analysed, including *Jardí de les TINTAcions* at the *Universitat Autònoma de Barcelona*. These experiences helped identify practical strategies, possible activities and organisational aspects that could be adapted to public primary schools.

Thirdly, the online guide was designed using Google Sites as a digital platform due to its accessibility and adaptability for educational contexts. The website was organised into different sections including information about dye plants, materials, interdisciplinary activities, implementation guidelines and curricular connections.

Finally, the proposed activities and resources were designed taking into account the Catalan primary education curriculum, the Mediterranean climate and the practical reality of Catalan public schools. Special attention was given to creating flexible and realistic activities that could be adapted to schools with different levels of resources and outdoor space.

6. RESULTS AND DISCUSSION

6.1. Structure of the online guide

The main result of this Final Degree Project is the creation of an online educational guide for designing and using a dye plant garden in Catalan public primary schools. The guide was developed as an interdisciplinary educational resource that combines environmental education, artistic expression and experiential learning through direct contact with nature.

The online guide was organised into different sections in order to facilitate its practical use in schools. These sections include information about dye plants, recommendations for garden design, step-by-step implementation guidelines and interdisciplinary educational activities. Moreover, the website was designed to be visually accessible, intuitive and adaptable to different school contexts.The following table summarises the main sections included in the guide and their educational purpose.

SECTION	CONTENT	EDUCATIONAL PURPOSE
Introduction	Presentation of the project and objectives	To provide teachers with an overview of the proposal
Dye plants	Information about dye-producing plants suitable for Catalonia	To support environmental and scientific learning
Garden creation	Step-by-step instructions for creating the garden	To facilitate implementation in schools
Activities	Nature and interdisciplinary activities linked to the curriculum	To promote meaningful and experiential learning

Another important result is the creation and adaptation of interdisciplinary activities aligned with the Catalan curriculum. These activities show that the garden can be integrated into different subjects instead of being limited only to art or science lessons. For instance, students can work on mathematical concepts by measuring plant growth, develop language skills through descriptive writing and storytelling, or explore artistic expression through natural dyeing techniques.

6.2. Educational and interdisciplinary potential

The results obtained respond to the general objective of the project, which was to design a pedagogical guide capable of promoting interdisciplinarity and reconnecting children with nature through meaningful learning experiences.

Throughout the development of the proposal, it became clear that a dye plant garden can offer many educational possibilities beyond traditional classroom learning. The final guide integrates different curricular areas such as science, art and language while encouraging creativity, observation and hands-on learning.

The guide includes interdisciplinary activities connected to different curricular areas. This interdisciplinary potential is supported by recent educational research. Salvador Beltri et al. (2023) demonstrated that school gardens can successfully integrate scientific learning, mathematics and environmental education through meaningful hands-on experiences, allowing children to connect knowledge across different curricular areas.

For instance, students can observe plant growth and seasonal cycles in science lessons, measure and compare growth processes in mathematics, develop descriptive and reflective writing activities in language education and experiment with natural pigments through artistic creation. These activities aim to promote learning through direct interaction with natural materials.

Moreover, the project shows that dye plant gardens can become valuable interdisciplinary educational spaces. Through activities such as planting, observing plant growth, extracting natural pigments and creating artistic productions, students can connect scientific observation with creativity and sensory exploration. This result is closely related to experiential learning theories and Waldorf pedagogy, which understand learning as a process based on action, imagination and interaction with the environment.

6.3. Connection with theoretical perspectives

Firstly, the literature review confirmed the educational value of outdoor learning and school gardens as interdisciplinary learning spaces. Authors such as David Kolb (1984), Stephen Kellert (2005) and Louise Chawla (2015) explain that experiential and nature-based learning can improve children’s motivation, emotional well-being and conceptual understanding through direct experience.

These findings are consistent with the structure of the online guide, which prioritises experiential and interdisciplinary activities. However, unlike the studies reviewed, the present project has not yet been implemented in a real school setting.

The results also connect with Richard Louv's (2011) perspective on children's growing disconnection from nature. During my teaching internships and professional experiences in public schools, I observed that many learning activities still take place almost exclusively inside the classroom. This project responds to that reality by proposing an educational space where students can interact directly with living materials, natural processes and sensory experiences.

Similarly, research by Roger Ulrich (1983) and Rachel Kaplan and Stephen Kaplan (1989) explains that regular exposure to natural environments can reduce stress, improve concentration and promote emotional well-being. Therefore, the proposed garden is understood not only as an academic resource but also as a space that supports children's emotional and social development.

6.4. Practical viability of the proposal

When comparing these ideas with existing educational projects, important similarities can be observed. For example, the *Jardí de les TINTAcions* at the *Universitat Autònoma de Barcelona* also combines sustainability and artistic creation through the cultivation and use of dye plants. Similarly, projects such as the dye gardens developed by *Cornell University* or *Mendizabala Ikastola* highlight the importance of connecting ecological awareness with creative and hands-on learning experiences.

However, this project has a more specific focus on primary education and on the Catalan curriculum. While many school garden projects mainly focus on environmental education, this guide was designed to support interdisciplinary learning by connecting science, art, language and sustainability. In this way, the garden becomes more than an environmental project and can be used as a learning resource across different subjects.

In addition, the comparison with other projects highlights that the success of this proposal may depend on factors such as available outdoor space, teacher training, financial resources and support from the school. Although the guide was designed to be flexible and adaptable, each school would need to adjust it to its own context and possibilities.

Personally, I would like to see this project implemented in schools in the future. This would make it possible to analyse its effects on children's learning, creativity, connection with nature and environmental awareness, while also providing valuable feedback to further improve the guide.

Finally, this online pedagogical guide offers opportunities for students to connect with nature, develop creativity and participate in meaningful learning experiences while working on different curriculum areas.

6.5. Limitations of the project

Some limitations and challenges were identified during the development of this project. One of the main challenges was the limited time available to develop the proposal. Due to the time limits of a Final Degree Project, it was not possible to implement the guide in a real school setting or to collect data from students and teachers.

Because of this, it has not been possible to evaluate its real impact on students' motivation, learning or emotional development. The project is based on theory and on my observation in J*ardí de les TINTAcions*, but it would need to be implemented in a real Catalan primary classroom to better understand its effectiveness.

Moreover, one of the main difficulties is that not all schools have enough outdoor space, financial resources or teacher training to create and maintain a dye plant garden. This limitation is also found in other school garden projects in the literature, where long-term maintenance and school support are often mentioned as key challenges.

In addition, the Mediterranean climate of Catalonia requires careful selection of drought-resistant plants and the use of sustainable water management strategies to keep the garden working throughout the year.

6.6. Possible improvements

Despite these limitations, the project also suggests several realistic and innovative possibilities for future development. Schools could establish partnerships with local organisations, artists, museums or universities to design workshops and interdisciplinary learning experiences related to natural dyes. Such collaborations would not only facilitate access to materials and specialised knowledge, but also strengthen the connection between schools and their local communities. All the information could be collected and shared on the

website, providing ideas and inspiration for other schools interested in implementing similar projects.

Another possible improvement would be the adaptation of the project into flexible and scalable formats for schools with limited outdoor space, such as vertical gardens, container-based systems or indoor growing kits. This would make the proposal more inclusive and allow a higher number of schools to participate.

In addition, the website could be expanded with new educational resources, including videos, photographs, tutorials and additional interdisciplinary activities. These materials could provide teachers with further support and inspiration when implementing the project in their classrooms.

Finally, the project could evolve into a collaborative network where schools share activities, experiences and results related to their own dye plant gardens. This could encourage cooperation between teachers, promote the exchange of ideas and help create an educational community interested in outdoor learning, sustainability and creative methodologies.

It would also be interesting to implement the guide in real school contexts in the future in order to analyse its effects on children's learning, creativity, environmental awareness and emotional well-being, while identifying possible improvements based on practical experience.

6.7. Preliminary feedback from teachers

As a preliminary validation process, the online guide was shared with primary education teachers from my Practicum school in order to collect external feedback regarding its clarity, educational value and practical viability.

The teachers highlighted the interdisciplinarity of the proposal, the connection between art and environmental education and the accessibility of the activities. They also considered the guide useful for promoting experiential learning and creativity in primary education contexts.

Some suggestions for improvement included simplifying implementation explanations, adding more visual examples and incorporating adapted versions of activities for schools with limited outdoor space. This feedback also helped identify possible future improvements for the project.

To sum up, this Final Degree Project has developed an online educational guide for creating and using a dye plant garden in Catalan primary schools. The results show that this type of project can support interdisciplinary learning, creativity, emotional well-being and environmental awareness through hands-on and nature-based experiences.

7. CONCLUSION

7.1. Achievement of objectives

This Final Degree Project was developed with the aim of designing a pedagogical guide for creating and using a dye plant garden in Catalan public primary schools. Throughout the research process and the development of the practical proposal, it became evident that learning connected to nature can offer valuable opportunities for interdisciplinary, meaningful and experiential education.

The development of the online pedagogical guide suggests that the main objective of the project has been achieved. The proposal demonstrates that a dye plant garden can become an educational tool capable of connecting different curricular areas while promoting environmental awareness, creativity and hands-on learning experiences.

Regarding the specific objectives, the project also achieved important outcomes. Firstly, the educational potential of school gardens as interdisciplinary learning spaces was analysed through the theoretical framework and the study of reference projects related to outdoor learning and environmental education.

Secondly, interdisciplinary activities aligned with the Catalan primary education curriculum were designed. These activities integrate observation, experimentation, artistic creation and collaborative work in order to promote active and experiential learning.

Finally, the project aimed to promote environmental awareness and creativity through natural dyeing activities. Through processes such as planting, observing, extracting pigments and artistic experimentation, the proposal encourages students to connect sustainability, creativity and direct interaction with nature.

7.2. Main contributions of the project

One of the main contributions of this project is the creation of an interdisciplinary educational resource adapted to the Catalan public school context. The online guide combines environmental education, artistic expression and experiential learning through accessible and flexible activities connected to nature.

The research carried out during the project supports the idea that contact with natural environments can positively influence children’s cognitive, emotional and social

development. Educational perspectives related to experiential learning, biophilia and outdoor education helped support the theoretical basis of the proposal and reinforced the importance of creating meaningful learning experiences beyond the traditional classroom environment.

Another important contribution is the adaptation of the activities to different curricular areas such as science, mathematics, language and art. This interdisciplinary perspective responds to educational needs identified during teaching internships and practical experiences in Catalan public schools, where connections between subjects are limited.

Finally, the online pedagogical guide itself represents one of the most creative aspects of the project. Through its combination of educational content, practical resources and visual elements, the website aims to provide teachers with an accessible and engaging tool for implementing a dye plant garden in schools.

7.3. Limitations

However, this project also has some limitations. One of my main challenges has been time, as it has limited the development of the project. As I have explained more in depth in the results, the project has not yet been implemented in a real school setting, which makes it difficult to assess its effectiveness or its impact on students' motivation, learning outcomes and emotional development.

Moreover, differences in school resources, outdoor spaces, time availability and teacher training may also affect its viability. In addition, not all schools have enough space, funding or support to create and maintain a dye plant garden and the Mediterranean climate of Catalonia also requires careful plant selection and sustainable water management to ensure the garden can be maintained throughout the year.

7.4. Future lines of development

Despite these limitations, the project also opens many possibilities for future development.

Firstly, I would like to translate the online guide into Catalan and Spanish in order to make it more accessible to a wider educational community. As the proposal is specifically designed for the Catalan educational context, offering the guide in different languages could facilitate its use by teachers, schools and other educational professionals.

One interesting next step would be to implement the guide in real schools and collect feedback from teachers and students. This would allow the project to be improved and adapted according to real educational needs and experiences. It would also be interesting to study how this kind of project can influence students' motivation, creativity, environmental awareness or emotional well-being.

Thinking about the lines of continuity and collaboration between teachers and organisations, I also considered creating a collaborative network on the website where schools can share activities, experiences and results from their dye plant gardens. This could encourage cooperation among teachers and help build an educational community focused on outdoor learning. Additionally, workshops and collaborations between schools, universities and different organisations could help promote the exchange of ideas and experiences related to outdoor learning.

Furthermore, the online guide could be expanded with additional practical resources such as videos, photographs, tutorials and extra activities. These materials could provide teachers with more detailed guidance on the creation and maintenance of dye plant gardens, as well as ideas for implementing interdisciplinary activities in different educational contexts. Including visual examples and step-by-step tutorials could also make the guide more accessible and easier to use, particularly for teachers with little previous experience in outdoor learning or school gardening.

7.5. Personal and professional reflection

On a professional level, this Final Degree Project has contributed to the development of competences related to research, academic writing, educational planning and interdisciplinary thinking. The process of designing the pedagogical guide also reinforced the importance of creating meaningful learning experiences connected to sustainability, creativity and experiential education.

On a personal level, this Final Degree Project has been a very important learning experience for me. During the process, I improved skills related to research, academic writing, educational planning and interdisciplinary thinking. It has also helped me reflect more deeply on the kind of teacher I would like to become in the future.

At first, I thought this would just be another assignment and that I would not pay much attention to it, but working on this project has increased my interest in outdoor education,

experiential learning and creative teaching methods. This Final Degree Project has been strongly connected to my collaboration with projects such as *HortAula* and the *Jardí de les TINTAcions* at the *Universitat Autònoma de Barcelona* allowed me to better understand how learning outside the classroom can positively influence children's development and motivation. These experiences also helped me realise the importance of creating educational environments where children can explore, experiment and learn actively. This project has also reinforced my belief that education should not only focus on theoretical content, but also on emotional, sensory and creative experiences. I truly believe schools should offer more opportunities for children to connect with nature, work together and learn through direct experience.

In conclusion, this Final Degree Project highlights the educational potential of dye plant gardens as interdisciplinary learning spaces in primary education. Although the proposal still requires implementation and evaluation in real school contexts, the project demonstrates the value of integrating nature, creativity and experiential learning within educational practice. In educational contexts where children are increasingly disconnected from natural environments, initiatives such as this may contribute to creating more meaningful, sustainable and engaging learning experiences.

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9. ANNEXES

Below, you will find the link to my final project website. It is a step-by-step guide to creating a dye plant garden in public schools in Catalonia. The guide explains the main steps and shows the positive effects these gardens can have on young children's learning and development. It also includes activities related to nature and other subjects such as science and math, making it interdisciplinary.

Click here to see the website.

