

THE REVIVAL OF SERICULTURE IN PRIMARY SCHOOLS: CREATIVE LEARNING AND CLASSROOM IMPLEMENTATION IN GREECE

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Abstract

One of the seventeen Sustainable Development Goals is the promotion of open and sustainable industrialization and the encouragement of innovation. Inspired by Goal nine, we decided to implement a teaching scenario focusing on sericulture. Sericulture is the art of rearing silkworms for silk production and is considered a significant biological practice. This innovative program can be implemented in schools within the framework of Skills Labs or as part of School Activities programs. The purpose of this teaching scenario is to highlight the importance of silkworm breeding for producing silk threads or fabrics, to familiarize students with the concept of entrepreneurship, and to showcase its contribution to the rural development of our region. To develop this scenario, we employed the method of live observation of silkworm feeding and movement, group-based collaborative methods for creating silk cocoons by the students themselves, and focused on 21st-century skills. Additionally, theories of social learning and constructivism were applied. The implementation utilized visual, printed, and digital materials. It was concluded that, both during and after the scenario, students gained knowledge about sericulture, recognized its benefits on both a local and global scale, and developed a spirit of collaboration and healthy competition. They also enhanced their soft skills, which are essential for fostering a positive school environment.

Keywords: sericulture, silkworm, cocoon, entrepreneurship, biodiversity, education, primary school, STEAM, micro: bit in science education, programming

INTRODUCTION

Silkworm breeding is a branch of agriculture that has experienced both prosperity and decline throughout the centuries (Τζατζινάκης & Χαριζάνης, 2011). More specifically, it is a branch of agriculture that belongs to animal husbandry and deals with the breeding of silkworms, the production of cocoons, and the creation of silk.

The known species that produce silk are only 400-500, of which very few are usable by humans (Δούπας, 2018). The most well-known type of silk comes from the cocoons of the silkworm *Bombyx mori* (Δούπας, 2018) and is internationally referred to as "mulberry silk" (Valentine Riley, 2023).

The history of silk is ancient and lost in the depths of the centuries. Evidence of the appearance of silk comes even from the Old Testament. Its existence was known on the western shores of the Asian continent during the so-called "Biblical Era" (Δούπας, 2018). In the Chinese empire, it appears around 4000-3000 BC. Emperors kept the method of its production a closely guarded secret for centuries. Silk fabrics adorned only the garments of emperors, and the penalty for revealing the secret was death (Παπανουμ, 1950).

During the reign of Justinian, in 551 AD, two Syrian monks introduced silkworm eggs and mulberry leaves into Byzantium, hiding them in the hollow canes. In this way, the art of sericulture was transmitted to Europe and became a source of wealth and culture (Δούπας, 2018).

This way opened the famous "Silk Road" to the whole world. In Greece, its cultivation expanded mainly in Thrace, Peloponnese, Attica, and the Cyclades. Today, the silk industry is unique, as it is a circular economy, environmentally friendly, sustainable, and contributes to several goals of Sustainable Development (Ζακυνθινού, 2024).

In this educational scenario, an effort was made to capture the importance of silkworm breeding in silk production, as well as to highlight the mulberry tree, since the starting point of the sericulture industry begins there, given that the larvae feed on its leaves.

Research Scenario

The study, titled "The Revival of Sericulture in Primary Schools: Creative Learning and Classroom Implementation in Greece," was conducted at the primary school level with students aged 6–8 (1st and 2nd grade). The cognitive areas involved include Language, Mathematics, Environmental Studies, History, Geography, ICT, English, and Skills Workshops. The duration of the study was four months (from March to June 2024).

Purpose of the scenario

The main objective of the educational program for sericulture is as follows:

Building positive relationships among students: Through collaborative group activities, students will enhance their cooperation and interaction, developing social skills. The pleasant and positive atmosphere within the classroom will create the appropriate conditions for learning, development, and participation.

Development of an environmental consciousness: The goal is to cultivate environmental awareness among students. Through the program, students will understand the importance of protecting natural resources and sustainability, so that as future citizens, they can actively contribute to the protection and management of the environment.

Sericulture, as an educational topic, offers a rich field for the development of these goals, combining practical learning with environmental responsibility.

Learning Objectives

Learning objectives at the knowledge level are specified below.

At the level of knowledge

Recognition of the biology of the silkworm: Students will learn about the life cycle of the silkworm, from the egg to silk production, and will understand its developmental stages.

Learning traditional sericulture: They will be informed about the techniques of silkworm breeding and silk production, a practice with deep roots in Greek tradition and history.

Understanding the importance of sericulture for the economy: Students will examine how silk production affects the local and international economy and sustainable development.

Connection of sericulture with sustainability: They will understand how sericulture can contribute to the sustainable management of natural resources by using natural and renewable materials.

Environmental awareness and biological resources: They will understand the waste of natural resources that unsustainable material production entails and the need for recycling and reusing materials.

At the level of attitudes

Learning objectives at the level of attitudes are specified below.

Development of a positive attitude towards nature: Through the observation and care of the silkworm, students will develop respect for animals and nature in general, understanding the value of biological cycles.

Strengthening interest in traditional professions: Students will develop a positive attitude towards traditional professions, such as sericulture, seeing them as viable solutions for the future.

Conscious participation in environmental actions: Through experiential activities and programs related to sustainability, students will actively engage in actions for the protection of natural resources.

Critical thinking about consumer behavior: They will learn to analyze the advantages and disadvantages of overconsumption of single-use products compared to natural and recyclable materials, such as silk.

At the skills level

Learning objectives at the skills level are specified below.

Development of communication and collaboration skills: Students will participate in group activities for the care of silkworms and the production of silk products (cocoon), paper crafts, poster making, enhancing their communication and collaborative skills.

Development of critical thinking: They will practice critical thinking through the comparison of traditional and modern material production and the understanding of sustainability.

21st Century Digital Skills: They will utilize digital tools for recording and monitoring the development of silkworms, developing digital learning skills such as digital communication, collaboration, and creativity. With the use of computers, the internet, and software related to sericulture (such as AR, BeeBot, Arduino R2, Micro:Bit, StoryJumper, CmapTools, ChatterKid, and Google Maps).

METHOD

Methodology of the Teaching Scenario

The teaching program for sericulture was implemented over a period of four months, incorporating the hours of the ICT course and the Skills Laboratory. The aim was to connect theory and practice through experiential learning, where students actively participated.

Constructivism

Based on the theory of constructivism, the program promoted active student engagement. Through activities such as caring for silkworms and cultivating mulberry trees, students connected new knowledge with their pre-existing perceptions, fostering critical thinking and creative problem-solving.

Collaborative Learning

The students worked in groups to care for the silkworms and organize the cultivation, enhancing social skills and cooperation. This group approach promoted socialization and democratic participation, as all students contributed equally to the learning process.

The Five "E" Model

The five "E" instructional model (Engage, Explore, Explain, Elaborate, Evaluate) was also applied, which facilitates student engagement at each stage of learning:

Engage: The students were introduced to the topic through questions and images that piqued their interest in the biology of the silkworm and the significance of silk.

Explore: They actively participated in activities such as mulberry cultivation and observing the developmental stages of silkworms.

Explain: Through discussions, they analyzed and explained the life cycle of silkworms and the process of silk production.

Elaborate: They delved into the environmental and economic aspects of sericulture and understood its contribution to sustainability.

Evaluate: Finally, they evaluated the knowledge and skills they acquired, as well as their teamwork.

Detailed steps for developing the teaching scenario

"Detailed steps for developing the teaching scenario" are listed below.

Month – March

1st Week

The students accepted to get involved in the program and to receive the applications so that their guardians could fill them out, as is customary in all European programs. Subsequently, a record will be drafted and approved by the school's teaching staff so that the program can commence (Figure 1)

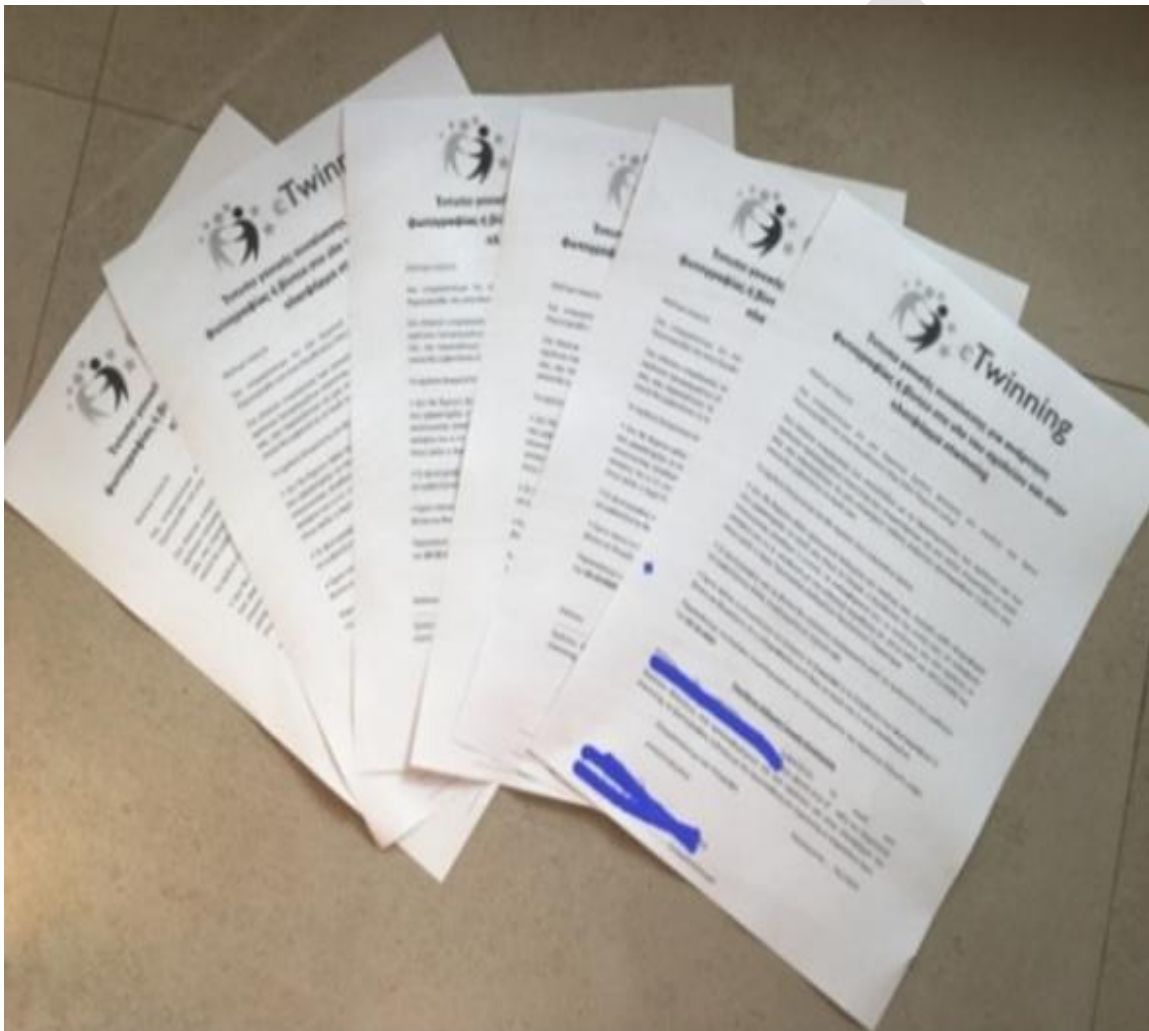


Figure 1. Guardian Consent (Primary School Philippi Kavala, Permission papers, Karagianni Anastasia)

2nd Week

Activity 1

The students watched an educational video about the life of the silkworm ([Relevant YouTube link](#)), after which they completed an activity sheet with the life stages of the butterfly and the silkworm (Figure 2).

The writers enthusiastically searched for cocoons to create crafts and observe the chrysalis. Our school collaborated with “KOUKOULI” in Serres, Greece (KOUKOULI) acquiring 200 cocoons, as

well as with the “ Silk Art Museum in Soufli, Evros, Greece (Museum) from which we secured 400 cocoons.



Figure 2. Activity understanding butterfly cycle

These cocoons were shared with the Kindergarten of Datou – Polystilo, so that the young students could also participate in the process. The Silk Art Museum offered us, in addition to the cocoons, a few silkworm eggs, giving us the opportunity to observe their entire life cycle. This activity brought them closer to the silkworm's life cycle, combining theory with practice and creativity.

Activity 2

The students are divided into groups and create the program's poster. They sing the song "A Beautiful Butterfly"(in greek language) and it is recorded with the help of a tablet on the site Vocaroo (<https://vocaroo.com/13Z4y10hWOsN>).

3rd Week

The students are divided into groups and start creating the poster for the program they will implement. The ideas are exciting as they begin to think about the plot of the digital story they will create (Figure 3).



Figure 3. Poster Construction

Month – April

4th WEEK

The writers receive the first cocoons from “KOUKOULI” in Serres, Greece. The first impression of the children when they take the cocoons in their hands is to shake them to see what's inside. They pull and squeeze the cocoon, and after a while, they realize that the cocoon is quite difficult to cut, so they take their little scissors. When they cut it, they notice that inside the cocoon there was a bug, the Chrysalis. With great joy, the school offers them cocoons to paint and examine at home.



Figure 4. The children are painting cocoons

5th Week

The students took on the task of painting themselves in the form of a butterfly, combining imagination and creativity with the concept of transformation. This activity had a symbolic character, as the butterfly represents change and growth, elements that are associated with the learning process.

The students took on the task of painting themselves in the form of a butterfly (Figure 5), combining imagination and creativity with the concept of transformation. This activity had a symbolic character, as the butterfly represents change and growth, elements that are associated with the learning process.

At the same time, the students painted scenes from a digital story, using their artistic skills to depict moments and characters from the narrative. Through this activity, they had the opportunity to express themselves creatively and connect painting with storytelling. The activity enhanced their imagination and promoted interaction with digital narration, combining artistic expression with technology.



Figure 4. The children are drawing themselves as butterflies

6th Week

Activity 1

As part of this activity, the students created drawings depicting themselves, with the aim of "bringing them to life" and making them speak in English. For the implementation of the activity, they utilized their knowledge of English, their personal drawings, as well as technological tools such as tablets and the ChatterKid app. This activity boosted the students' confidence in using the English language, fostered creativity, and integrated technology in a pleasant and educational way ([Relevant YouTube link](#)). On the map, they identify the countries participating in the program ([Link](#)).

Activity 2

In the context of this activity, students understand the step-by-step nature of an algorithmic process. They are presented with a video of making a paper butterfly using the origami technique ([Relevant YouTube link](#)). A visual showing the process of making paper butterflies using the origami technique is presented in Figure 6.



Figure 5. Butterfly with origami

Month – May

7th Week

The students learn experientially about the stages of the silkworm through a holistic approach to learning. In the classroom, they participate in activities related to sericulture, observing the changes from egg to butterfly. Discussions and group projects encourage them to discover the details of the process.

On weekends, the students extend this learning at home. They bring the cocoons and eggs they have received and observe them in their daily lives. Thus, they combine theory with practice, experiencing the process of transformation ([Related link](#)).



Figure 6. Sericulture begins

8th Week

The students, excited, use their tablets to create their own butterflies. With simple clicks and touches, they choose colors, patterns, and details, letting their imagination run wild.

Once they finish their creations, the butterflies magically appear next to them in augmented reality (AR) ([Related link](#)). The students smile, impressed as they see their butterflies flying around them, moving gracefully and lighting up the room with their colors. With enthusiasm, they share their creations and discuss the different butterflies they designed, simultaneously discovering the beauty of biodiversity.



Figure 7. The students with their butterflies in AR

9th Week

Activity 1

The students are excited as they use the BeeBot robot on an online platform (<https://beebot.terrapinlogo.com/>) to explore the transformation process of the silkworm. Through the game, they are called to program the BeeBot to follow a path that represents the stages of the silkworm: from the egg to the caterpillar, then to the cocoon, and finally to the butterfly. They create algorithms to direct the robot, thereby developing algorithmic thinking.

Each stage is accompanied by discussions where students analyze the changes in the life of the silkworm. The activity combines robotics and biology, enhancing collaboration, critical thinking, and making learning fun and experiential.



Figure 8. The butterfly cycle with BeeBot on an online platform



Figure 9. The butterfly cycle with BeeBot really

Activity 2

The students use the Arduino R2 in combination with tablets to explore the stages of the silkworm, creating interactive models that depict its transformation. Through Arduino programming, they design different indicators for the stages of the life cycle.

After completing the activity, they present their projects in class, explaining the process and the technologies they used. In this way, they combine robotics with biology, enhancing their technological and communication skills.



Figure 10. The butterfly with Arduino R2

Month – June

10th Week

The students use the micro:bit and their computers to study the living conditions of the silkworm in class. With the micro:bit, they measure the temperature, noise, and brightness of the environment, gaining practical experience of the conditions that affect its growth. During the day, they record the measurements and compare them with the ideal conditions for the proper development of the silkworm.

This activity helps students understand microclimates and the importance of environmental parameters in the lives of organisms, while simultaneously enhancing critical thinking, collaboration, and the connection between technology and biology.



Figure 11. micro:bit and sericulture



Figure 12. The graph from the micro:bit

11th Week

By creating an electronic storybook, children have the opportunity to better understand the life stages of the silkworm. In this interactive book, students create pages that depict each stage of the transformation, from the egg to the butterfly.

Using digital tools and applications, students add sounds, animations, and images that bring the story to life. Each page can include information about each stage, as well as questions or activities that promote reader engagement ([Related link](#)).

12th Week**Activity 1**

The students express their creativity by making silk jewelry for their mothers, using materials from the sericulture process. With the guidance of their teachers, they learn how to process the silk and apply techniques such as weaving and sewing, creating unique jewelry.

This activity combines art and natural sciences, offering students the opportunity to express their love through handmade creations. At the same time, it provides them with a valuable lesson on silk production, while mothers feel proud of their children's work, enhancing the sense of satisfaction among the students.



Figure 13. Jewelry with silk

Activity 2

Creating a song with the help of artificial intelligence AI (<https://suno.com/>) is an exciting experience! With the theme of the butterfly and the participating countries of the program, students can collaborate to compose lyrics that combine the magic of the butterfly with the cultural aspects of the participating countries.

They can use the AI platform, such as Suno, to edit the music and vocal performance of the song. The process not only enhances creativity but also promotes collaboration and understanding of cultural differences, while students gain practical knowledge in using technology and art ([Relevant YouTube link](#)).

Application and Implementation

Materials and Resources

The materials used were in accordance with the capabilities of our school unit and included (Table 1):

Table 1. Materials used in the project

Silkworm eggs	Mulberry leaves	Cocoons
Paper	Cardboard	Markers
Acrylic paints	Computer	Tablet
Projector	BeeBot	Arduino R2
Micro:bit	Jewelry making materials	

Class Organization

The classroom was arranged to facilitate student activities and interaction.

- The students worked in groups, and the groups changed with each activity.
- There was a group that collected the leaves, another that washed the leaves, and three groups that fed the silkworms.

This organization not only promoted collaboration and communication but also the active participation of students in the learning process. Through various activities, students developed skills such as responsibility, teamwork, and creativity.

Evaluation

The evaluation of the sericulture program was formative and continuous, using assessment rubrics, worksheets, and questionnaires with closed-ended questions. The process included three phases: self-assessment, group assessment, and peer assessment among the students. The dissemination of the results took place at our school's final celebration and in the local press. The dissemination of the results took place at our school's final celebration and in the local press ([Related link](#)).

At the same time, silkworms were distributed to schools in the Kavala region (17th Primary School of Kavala, 16th Primary School of Kavala, 25th Primary School of Kavala, Ofrynio Kavala Primary School, 17th Kindergarten of Kavala, on the school's website, on social media, and at the conference held at the 2nd International Conference in Kastoria (Education”).

In conclusion, the diverse activities related to sericulture and recycling during the evaluation, as well as after the completion of the program, contributed to the improvement of relationships among the students. Conflicts were significantly reduced, and a democratic and pleasant atmosphere was created in the classroom. This was, after all, the main purpose of the didactic intervention through the sericulture educational program, promoting the understanding of nature and the value of cooperation.

Feedback and Improvement

Students should understand how the silkworm works to produce silk, as well as the importance of its sole food source, which is mulberry leaves. Through experiential activities, they will observe the process of silkworm cultivation, learning about its needs and the significance of proper nutrition.

Through these activities, students will gain a comprehensive understanding of the silkworm's life cycle and the value of its natural food, while simultaneously enhancing their awareness of nature and ecology.

Summary

The project begins with a significant challenge: to inspire young people to pursue careers in science, technology, and ecological consciousness, ensuring that efforts in this direction yield results in the future. At the same time, we have the opportunity to educate a new generation of scientifically literate European citizens while enhancing artistic skills in an eco-friendly manner.

Additionally, the project contributes to reducing school failure by promoting diversity and developing skills in English. A key aspect is to highlight the achievements of this work, which include methodological approaches, the integration of the STEAM framework, the enhancement of competencies, and the collaboration of various societal structures.

Funding

This project was funded by private silk processing companies “KOUKOULI” in Serres, Greece (KOUKOULI) and “ART OF SILK MUSEUM” in Soufli, Evros, Greece (Museum).

Ethics and Conflict of Interest

All ethical rules were observed at each stage of the research. The author declares that he acted in accordance with ethical rules in all processes of the research. The author declares that they do not have any conflict of interest with other persons, institutions or organizations.

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In the near future, the project aims to design each stage with the collaboration of additional countries. This fosters cultural interconnection and proposes Greece as the starting point to address this challenge.

Data Availability

The data that support the findings of this study are available on request from the author.

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