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STEAME ACADEMY

TEACHING FACILITATION LEARNING & CREATIVITY PLAN (L&C PLAN) - LEVEL 1 STUDENT TEACHERS

TITLE: SOUND-PROOF PANELS FROM REUSED POLYESTER FABRIC WASTE

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1. Overview

Title	Sound-Proof Panels From Reused Polyester Fabric Waste		
Driving Question or Topic	-Can we Reuse and Recycle plastic found in fabrics (polyester)? -Can we improve the sound of an indoors space?		
Ages, Grades, ...	12-15 year old students	Middle School	(Gymnasium)
Duration, Timeline, Activities	60 hours	2 months	Various Combined Activities between Disciplines

Curriculum Alignment

In Mathematics: Units of measure, 2D and 3D Geometry (Metric Units and Shapes), Introduction to statistics, Probabilities and Combinatorics.

In Physics: Waves Theory (Sound travels in waves. These waves can be longitudinal or transverse, but sound waves in air are longitudinal. This means the particles in the medium (air in this case) vibrate back and forth in the same direction as the wave propagation), Frequency (The frequency of the sound wave determines its pitch. High frequencies correspond to high-pitched sounds, and low frequencies correspond to low-pitched sounds), Amplitude (The amplitude of the sound wave determines its loudness. High amplitudes correspond to loud sounds, and low amplitudes correspond to quiet sounds), Sound Absorption (Sound absorbing materials convert sound energy into thermal energy. Common sound absorbing materials include fiberglass, rockwool, and acoustic foam. These materials have many small pores that trap the sound waves and cause the energy to be converted to heat through friction), Sound Transmission Loss -STL (This is a measure of how much sound is reduced by a material. It is typically measured in decibels (dB). A higher STL indicates greater soundproofing effectiveness).

In Chemistry: Polymers, Functional Groups (they are specific arrangements of atoms within a molecule that influence the chemical properties of the molecule. The repeating unit in polyester contains an ester functional group, which is why it's called a polyester), Condensation

Reactions (they are a type of chemical reaction in which two molecules combine, and a small molecule, often water, is eliminated. Polyester is produced via a condensation reaction between a diol (an alcohol with two hydroxyl groups) and a dicarboxylic acid (an acid with two carboxylic acid groups). In the case of most polyesters, the diol is ethylene glycol and the dicarboxylic acid is terephthalic acid) and Polyesters (the chemistry chapter discussing polymers might touch upon polyesters in general, including their basic structure, the different types, and their manufacturing processes.

In Biology: Living organisms and the natural world, Synthetic fabrics and synthetic fibers, Polymers (large molecules formed by linking smaller units together. Synthetic fibers, like polyester, are made by polymerizing chemicals derived from petroleum). Materials science or textiles in a home economics or fashion design class. Properties of different polymers and how they are used to create fabrics with specific characteristics.

In Computer Science: Excel sheets, Statistical analysis of data, Webpage design, building and monitoring.

In Technology/Engineering: Fabrics, Polyester, Plastic Fibers and Petroleum. Cutting soft materials like fabric, cartons. Properties of various glues.

In Arts: Creating sound panels that fits the modern houses or studios. Company logos, design and print.

In Entrepreneurship: Introduction to Business and Economics (this chapter typically lays the groundwork by explaining the nature of businesses, the role of the entrepreneur, and the different forms of business ownership: sole proprietorship, partnership, corporation), Chapters on Microeconomics: Microeconomics focuses on individual decision-making by consumers, firms, and markets. Supply and Demand (this fundamental principle dictates how prices are determined based on consumer willingness to pay (demand) and producer willingness to sell (supply). Understanding this is vital for setting prices for your product or service, Market Structures (Knowing the different market structures (perfect competition, monopoly, monopolistic competition, oligopoly) helps you understand how your company will compete in the marketplace, Production and Cost Analysis (this explores how firms convert resources into outputs, considering factors like fixed costs, variable costs, and economies of scale. This knowledge helps you optimize production and pricing strategies, Chapters on Entrepreneurship (some economics textbooks might have dedicated chapters on entrepreneurship, which would directly address), Identifying a Market Opportunity (this involves recognizing a customer need that isn't being adequately met and building a business around fulfilling that need, Business Planning (this chapter would discuss creating a business plan, a roadmap outlining your company's goals, strategies, target market, financial projections, and how you'll secure funding.

	In Languages and Culture: Essay writing, Research and Survey writing, contacting and drawing conclusions.
Contributors, Partners	Clothing companies and factories of the area that can provide their fabric waste
Abstract - Synopsis	Learning through a Project Based Activity. Students will perform research on recyclable and non-recyclable fabrics and the amount of plastic used inside polyester. In order to reuse fabric waste from local clothing factories, they will explore ways they can create sound-proof panels. Various types of glues and panel sizes will be tested. With their final product the students will be able to create their own small scale business (start-up), entering an eco-friendly entrepreneurship world and discovering the basic principles of marketing. A complete STEAME+ Learning Approach that involves Mathematics, Physics, Chemistry, Biology, Technology, Engineering, Computer Science (STEM), Arts (A), Entrepreneurship (E), as well as Language and Culture (+).
References, Acknowledgements	The steps for performing our PBL procedure we written following a revised approach from the book “Project Method: Organising and Developing Cross-Thematic and Multi/Inter/ Intra- Disciplinary Projects” by Dr Chrysoulla Hadjichristou, Ministry of Education, Sport and Youth, Pedagogical Institute – Curriculum Development Unit, Cyprus.

2. STEAME ACADEMY Framework

Teachers' Cooperation	<p> Teacher 1 (Mathematics) Teacher 2 (Physics) Teacher 3 (Chemistry) Teacher 4 (Biology) Teacher 5 (Computer Science) Teacher 6 (Technology/Engineering) Teacher 7 (Arts) Teacher 8 (Economics/Marketing) Teacher 9 (Languages/Culture) </p> <p>T3 cooperates with T4 regarding the general research on fabrics, reusable and non-reusable fabrics, the amount of plastic inside polyester fabrics, natural decomposition and chemical decomposition of materials.</p> <p>T1 cooperates with T2 and T6 regarding the dimensions of the sound-proof panel and the parameters of its construction.</p> <p>T5 cooperates with T7 and T9 regarding the artistic side of the sound-proof panel, history of fabric and clothing in our city, colors and dimensions of the panel, webpage/ Facebook/ Instagram profile creation for advertising the product as well as taking orders by clients.</p> <p>T1 cooperates with T5 regarding the analysis of various data, sound measuring data, as well as various questionnaires' results. Creation and manipulation of Excel sheets.</p> <p>T1 cooperates with T7 and T8 for facilitating the creation of a small business for the pupils' product. Name, Slogan, Logo, Structure of the Board (CEO, Marketing Director, Sales Director, Media Manager etc.)</p> <p>T6 cooperates with T2 to be able to construct various sound-proof panels of different sizes and examine their sustainability and durability over time.</p>
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<p>STEAME in Life (SiL) Organization</p>	<p>-Meeting with Clothing Factory owners / Using their fabric waste, especially the polyester or other plastic related fabrics.</p> <p>-Meeting with Sound studios for testing the Sound-proof panels using professional equipment as well as the professionals' experience and advice.</p> <p>-Entrepreneurship – STEAME in Life (SiL) Days: Creation of a small business for their product. Name, Slogan, Logo, Structure of the Board (CEO, Marketing Director, Sales Director, Media Manager etc.)</p>
<p>Action Plan Formulation</p>	<p><u>Preparation (by teachers)</u></p> <ol style="list-style-type: none"> 1. Relation to the Real World – Reflection Reuse and Recycle of fabric Creating a more eco-friendly product for soundproof solutions 2. Incentive – Motivation Fabric materials that cannot be recycled Creating a start-up small business Learning how to promote a product (marketing techniques) 3. Formulation of a problem resulting from the above <p><u>Development (by students) – Guidance & Evaluation (in 9-11, by teachers)</u></p> <ol style="list-style-type: none"> 4. Research / Gather Information on reusable and non-reusable fabrics 5. Research on Polyester fabrics, natural and chemical decomposition 6. Designing of panels, research on already available panel designs in the market. Identifying additional materials that can be used (Cartons, Glues, Spikes) for creating the panels. Discovering and making contact with factories that produce clothing and also significant fabric waste. 7. Construction of various types of panels - Experiment - Implementation of the panels. 8. Observation of the final products - Experimentation on their durability and soundproofing properties - Initial Conclusions 9. Documentation of results – Crash tests, Sound proofing tests - Explanation based on Existing Physics Theories and / or Empirical Results 10. Gathering of results / information based on points 7, 8, 9 11. First group presentation by students <p><u>Configuration & Results (by students) – Guidance & Evaluation (by teachers)</u></p> <ol style="list-style-type: none"> 12. Configure STEAME models to describe / represent / illustrate the results 13. Studying the results in 9 and drawing conclusions, using 12 14. Applications of the Sound-proof panel in Everyday Life - Suggestions for Developing 9 (Entrepreneurship - SiL Days) <p><u>Review (by teachers)</u></p> <ol style="list-style-type: none"> 15. Review the problem and review it under more demanding conditions (e.g. sport stadiums, where it should be more durable) <p><u>Project Completion (by students) – Guidance & Evaluation (by teachers)</u></p> <ol style="list-style-type: none"> 16. Repeat steps 5 through 11 with additional or new requirements as formulated in 15 17. Investigation - Case Studies - Expansion - New Theories - Testing New Conclusions 18. Presentation of Conclusions and the final product - Communication Tactics

3. Objectives and Methodologies

Learning Goals and Objectives

In General: The very definition of STEAME+ Education, the pupil to be able to research on a topic that involves all physical sciences, art, entrepreneurship as well as languages and culture and be able to combine knowledge and skills to deliver the final product/project, draw conclusions about the result, discuss feedback, remedies. The essence of metacognition, the process of thinking about one's own thinking and learning.

In Mathematics: To be able to manipulate numbers, measurements as well as calculation of various surface areas and volumes. To be able to perform basic probability and combinatorics knowledge and skills as well as in Statistics. Collect and refine raw data, be able to analyze data, make assumptions, perform various tests and draw conclusions. The pupil should be able to use broad mathematical skills to face any problem that arises during the whole learning and creating procedure.

In Physics: The pupils should understand and apply basic principles of sound waves and be able to perform simple sound-measuring tests. Have a full understanding of plastic fabrics' durability and be able to perform pressure tests to the materials involved.

In Chemistry: Satisfactory research on plastic materials, origin and composition of petroleum as well as be able to identify natural and synthetic fabrics and their components.

In Biology: The pupils will be able to demonstrate experiments on fabric decomposition. They will have full understanding on how bacteria and other microorganisms act in nature.

In Computer Science: The pupils will be able to conduct a full survey, record the results in Excel sheet and perform basic statistical analysis, drawing conclusions and presenting them in graphs. They will also be able to design a webpage for their company or to advertise/sell their product.

In Art: Ability to use appropriate colors and shapes for best promoting their business or logo. Create various artistic styles for the product so that all customers' needs are met and the product is successful.

In Greek Language and Culture: A complete research on the history of the fabrics and gowns/dresses of old times, the present and a forecast for the fabrics and materials used in the future. Detailed analysis on eco-friendly fabrics and other materials as well as reusable and sustainable solutions.

In Technology/Engineering: To be able to construct various sound-proof panels of different sizes and examine their sustainability and durability over time.

In Entrepreneurship: The pupil to be able to work as a team and cooperate with other classmates to identify the need for a product, create a basic business plan, create/design a smart logo for his product,

Learning Outcomes and
expected Results

think/write a unique company name and a clever/commercial slogan, create/agree on a board of directors and apply the four basic principles of marketing (product, price, place and promotion).

In General: The pupil will get to improve certain STEAME+ skills, such as Problem Solving, Metacognitive Practices, Creativity, Collaboration, Communication, Critical Thinking, Demonstration of STEAM knowledge, Development of an understanding of the variety of STEM careers related to different fields of study, Application of science process/engineering process/product development process, Digital Literacy and other STEM tools - Demonstrating in class and afterschool records for student assessment, Active engagement and focus during learning activities, Active inquiries into STEAM topics, concepts, or practices. In few words, the essence of metacognition, the process of thinking about one's own thinking and learning.

In Mathematics: Easily manipulate numbers and functions, perform measurements as well as calculation of various surface areas and volumes. To be able to perform basic probability and combinatorics knowledge and skills as well as in Statistics. Collect and refine raw data, be able to analyze data, make assumptions, perform various tests and draw conclusions. The pupil should be able to use broad mathematical skills to face any problem that arises during the whole learning and creating procedure.

In Physics: Understand and apply basic principles of sound waves and perform simple sound-measuring tests. Have a full understanding of plastic fabrics' durability and be able to perform pressure tests to the materials involved.

In Chemistry: Satisfactory research on plastic materials, origin and composition of petroleum as well as be able to identify natural and synthetic fabrics and their components.

In Biology: Perform experiments on fabric decomposition. Understand on how bacteria and other microorganisms act in nature.

In Computer Science: Contact and run a full survey, record the results in Excel sheet and perform basic statistical analysis, drawing conclusions and presenting them in graphs. They will also be able to design a webpage for their company or to advertise/sell their product.

In Art: Ability to use appropriate colors and shapes for best promoting their business or logo. Create various artistic styles for the product so that all customers' needs are met and the product is successful.

In Greek Language and Culture: Research on the history of the fabrics and gowns/dresses of old times, the present and a forecast for the fabrics and materials used in the future. Detailed analysis on eco-friendly fabrics and other materials as well as reusable and sustainable solutions.

In Technology/Engineering: To be able to construct various sound-proof panels of different sizes and examine their sustainability and durability over time.

In Entrepreneurship: Pupils work as a team and cooperate with other classmates to identify the need for a product, create a basic business plan, create/design a smart logo for his product, think/write a unique company name and a clever/commercial slogan, create/agree on a board of directors and apply the four basic principles of marketing (product, price, place and promotion).

Prior Knowledge and Prerequisites

In General: Basic STEAME+ Education skills at a lower level, from the elementary school (primary education)

In Mathematics: Number manipulation, basic measurements with a ruler, basic surface areas and volumes. Simple probability and combinatorics skills. Broad mathematical skills to face any problem that arises during the whole learning and creating procedure.

In Physics: Skills from simple sound-measuring tests.

In Chemistry: Basic knowledge about the origin and composition of petroleum as well as be able to identify natural and synthetic fabrics and their components.

In Biology: Waste decomposition. Reusing and recycling materials.

In Computer Science: Basic knowledge on Word and Excel programs.

In Art: Create various artistic expressions using watercolors, pastels, as well as programs on the PC.

In Greek Language and Culture: Essay writing, Creating simple polls on paper or online (Google Forms, Microsoft Forms etc.).

In Technology/Engineering: Basic construction skills, cutting and gluing various materials.

In Entrepreneurship: Teamwork skills, decision making at a lower (primary education) level.

Motivation, Methodology, Strategies, Scaffolds

- Project Based Learning/Activity that involves all Sciences, Mathematics, Art, Entrepreneurship and Languages (Greek) and Culture. Gamification on the same topic may follow as a very interesting extension.

-Instruction differentiation for students' needs (learning styles, multi-modal representations, roles to students etc.)

-Active students' engagement, individual-team-classroom work, entrepreneurship skills, fabric craftsman techniques, style.

4. Preparation and Means

Preparation, Space Setting, <i>Troubleshooting Tips</i>	<p>Material preparation:</p> <ul style="list-style-type: none">- Collection of fabric waste from clothing factories of our area (Outdoor activity), cut them in stripes, separate the colors and the different textures.- Various glues and other bonding material, water, buckets for mixing the glues with water or petrol etc.- Cartons for creating the base, recyclable egg cartons <p>Computer lab for manipulating data in Excel sheets.</p>
Resources, Tools, Material, Attachments, Equipment	Internet, Laptops, Projector, Padlet platform for organizing the project and communicating ideas/ brainstorming.
<i>Health and Safety</i>	Some glues that are not water based can be harmful. Special health and safety measures should be used by both teachers and pupils, like rubber gloves.

5. Implementation

Instructional Activities, Procedures, Reflections	<p>General research on fabrics, reusable and non-reusable fabrics, the amount of plastic inside polyester fabrics, natural decomposition and chemical decomposition of materials. Measuring the dimensions of the sound-proof panel and the parameters of its construction. Exploiting the artistic side of the sound-proof panel, history of fabric and clothing in our city, colors and dimensions of the panel, webpage/ Facebook/ Instagram profile creation for advertising the product as well as taking orders by clients. Analysis of various data, sound measuring data, as well as various questionnaires' results. Creation and manipulation of Excel sheets. Testing various glues and how they apply on various fabrics, concluding on the final/optimal selection and preparing the mix of glue and fabric to be applied on the carton base.</p>
Assessment - Evaluation	<p>Project-based learning (PBL) thrives on a strong foundation of assessment and formative evaluation. An approach/system to effectively measure student abilities in PBL is provided further below. PBL goes beyond rote memorization.</p> <p>We assess a combination of skills and knowledge acquisition:</p> <ul style="list-style-type: none">•Content Knowledge: Ensure students grasp the core concepts explored in the project.•21st Century Skills: Assess critical thinking, problem-solving, collaboration, communication, and creativity throughout the project.•Project Management Skills: Evaluate how students plan, organize, manage time, and adapt during the project.•Learning Process: Reflect on how students approach challenges, learn from mistakes, and demonstrate self-directed learning. <p>Formative Evaluation Strategies for PBL:</p> <ul style="list-style-type: none">•Checklists & Progress Reports: Provide ongoing feedback with checklists outlining key milestones and rubrics for specific tasks. Students complete progress reports reflecting on their contributions and challenges.•Peer Reviews & Group Discussions: Facilitate peer reviews where students analyze each other's work based on rubrics. Organize group discussions to share ideas, troubleshoot, and refine approaches.

- **Exit Tickets & Minute Papers:** Use short exit tickets or minute papers at the end of each session to gather student understanding of concepts covered and identify areas needing clarification.

Rubrics are crucial for PBL as they translate project goals into clear expectations. Here's a breakdown for a science project on water quality:

Criteria	Exceeds Expectations	Meets Expectations	Needs Improvement
Content Knowledge	Demonstrates a deep understanding of sound waves and fabric recycling/reuse concepts, citing relevant data and scientific principles.	Shows a solid grasp of sound waves and fabric recycling/reuse concepts, applying them correctly in the project.	Understanding of sound waves and fabric recycling/reuse concepts is limited, with some inaccuracies in application.
Collaboration & Communication	Works effectively within the team, actively participating in discussions, delegating tasks, and resolving conflicts constructively. Communicates ideas clearly and concisely, both verbally and in writing.	Contributes to the team, listens to others, and helps manage tasks. Communicates ideas with some clarity, but may require prompting.	Struggles to collaborate effectively, hindering the team's progress. Communication is unclear or infrequent.
Problem-Solving & Critical Thinking	Identifies and analyzes problems effectively, proposing creative solutions and adapting strategies when needed. Demonstrates critical thinking by questioning assumptions, evaluating evidence, and drawing sound conclusions.	Identifies and solves problems with some guidance. Uses critical thinking to a moderate extent.	Has difficulty identifying or solving problems. Limited use of critical thinking skills.
Project Management	Meets all deadlines, manages time effectively, and stays organized throughout the project. Adapts to unforeseen challenges and adjusts the plan accordingly.	Completes most tasks on time, demonstrates decent organization. May need some reminders to stay on track.	Frequently misses deadlines due to poor time management and organization. Struggles to adapt to challenges.
Learning Process & Reflection	Demonstrates strong self-directed learning skills, actively seeking and utilizing resources. Reflects deeply on the learning experience, identifying strengths, weaknesses, and areas for personal growth.	Shows initiative in learning, utilizing available resources. Reflects on the experience, acknowledging learning gained.	Limited self-directed learning. Reflection on the experience is shallow or absent.

Presentation -
Reporting
- Sharing

Essays from pupils on their whole experience, Microsoft PowerPoint Slides showing all their journey (construction and entrepreneurship section), Padlet platform containing all the initial brainstorming and further discussions, ideas and actions, documents, outputs, artifacts, products produced by the students with references, web links etc.), for sharing to media. Photo albums of the procedure and final product.

<https://padlet.com/yiannislazarou/ixos>

Extensions -
Other

Participate in various national and international competitions on Junior Achievement, or Recycling and Sustainability.

Resources for the development of the STEAME ACADEMY Learning and Creativity Plan Template

In the case of learning through project-based activity

STEAME ACADEMY Prototype/Guide for Learning & Creativity Approach Action Plan Formulation

Major steps in the STEAME learning approach:

STAGE I: Preparation by one or more teachers

1. Formulating initial thoughts on the thematic sectors/areas to be covered
2. Engaging the world of the wider environment / work / business / parents / society / environment/ ethics
3. Target Age Group of Students - Associating with the Official Curriculum - Setting Goals and Objectives
4. Organization of the tasks of the parties involved - Designation of Coordinator - Workplaces etc.

STAGE II: Action Plan Formulation (Steps 1-18)

Preparation (by teachers)

19. Relation to the Real World – Reflection
20. Incentive – Motivation
21. Formulation of a problem (possibly in stages or phases) resulting from the above

Development (by students) – Guidance & Evaluation (in 9-11, by teachers)

22. Background Creation - Search / Gather Information
23. Simplify the issue - Configure the problem with a limited number of requirements
24. Case Making - Designing - identifying materials for building / development / creation
25. Construction - Workflow - Implementation of projects
26. Observation-Experimentation - Initial Conclusions
27. Documentation - Searching Thematic Areas (AI fields) related to the subject under study
– Explanation based on Existing Theories and / or Empirical Results
28. Gathering of results / information based on points 7, 8, 9
29. First group presentation by students

Configuration & Results (by students) – Guidance & Evaluation (by teachers)

30. Configure STEAME models to describe / represent / illustrate the results
31. Studying the results in 9 and drawing conclusions, using 12
32. Applications in Everyday Life - Suggestions for Developing 9 (Entrepreneurship - SIL Days)

Review (by teachers)

33. Review the problem and review it under more demanding conditions

Project Completion (by students) – Guidance & Evaluation (by teachers)

34. Repeat steps 5 through 11 with additional or new requirements as formulated in 15
35. Investigation - Case Studies - Expansion - New Theories - Testing New Conclusions

STAGE III: STEAME ACADEMY Actions and Cooperation in Creative Projects for school students

Title of Project: _____

Brief Description/Outline of Organizational Arrangements / Responsibilities for Action

STAGE	Activities/Steps Teacher 1(T1) Cooperation with T2 and student guidance	Activities /Steps By Students Age Group: _____	Activities /Steps Teacher 2 (T2) Cooperation with T1 and student guidance
A	Preparation of steps 1,2,3		Cooperation in step 3
B	Guidance in step 9	4,5,6,7,8,9,10	Support guidance in step 9
C	Creative Evaluation	11	Creative Evaluation
D	Guidance	12	Guidance
E	Guidance	13 (9+12)	Guidance
F	Organization (SIL) STEAME in Life	14 Meeting with Business representatives	Organization (SIL) STEAME in Life
G	Preparation of step 15		Cooperation in step 15
H	Guidance	16 (repetition 5-11)	Support Guidance
I	Guidance	17	Support Guidance
K	Creative Evaluation	18	Creative Evaluation