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STEAME TEACHER ACADEMY

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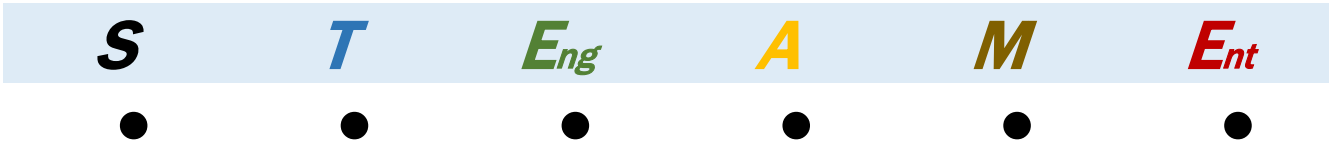
STEAME ACADEMY
TEACHING FACILITATION LEARNING & CREATIVITY PLAN (L&C PLAN)
L.1 STUDENT TEACHERS
Eco-Innovation: Designing a Sustainable Product using Chat GPT



1. Overview

Title	Eco-Innovation: Designing a Sustainable Product using Chat GPT		
Driving Question or Topic	Environmental degradation is one of the major contemporary problems. Utilizing sustainable products is a big step towards the preservation of the environment. How can we design sustainable products? How can we use AI applications to assist us in designing such a product? Why is it important to develop sustainable products.		
Ages, Grades, …	11-12 years	5^{th}-6^{th} grade	
Duration, Timeline, Activities	15 hours	15 x 45-50 minutes lessons	>=6 activities
Curriculum Alignment	**Sciences:** -ecology -climate change - sustainability **Technology:** -informatics -artificial intelligence **Mathematics:** - algebra (calculations - statistics (basic data analysis) **Entrepreneurship** - product design		
Contributors, Partners	- International Institute for Sustainable Development (IISD) - Manufacturing company (plant visit – production line)		
Abstract - Synopsis	The learning and creativity plan refers to an intervention where students, working in teams, develop a wider understanding of sustainability and its importance, and a better understanding of the use of AI during the process of designing a sustainable product by using also chat GPT.		
References, Acknowledgements	https://www.bcg.com/publications/2023/six-strategies-to-lead-product-sustainability-design		

	https://www.youtube.com/watch?v=jfsWI8XgQyo https://www.youtube.com/watch?v=8u2M0b6sFXM https://www.youtube.com/watch?v=5cjlWAWIp0Q https://www.youtube.com/watch?v=0lk5yZQuntk https://www.mdpi.com/1996-1073/14/12/3469 https://www.oecd.org/innovation/green/toolkit/oecdsustainablemanufacturingindicators.htm https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=OJ:L_202401781 https://commission.europa.eu/energy-climate-change-environment/standards-tools-and-labels/products-labelling-rules-and-requirements/sustainable-products/ecodesign-sustainable-products-regulation_en https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52022DC0140&qid=1649112555090

2. STEAME ACADEMY Framework*

Teachers' Cooperation	**Science teacher (T1)** ● Coordination of the project ● Presentation of sustainability and environment preservation concepts ● Investigation with students and other teachers the sustainability parameters of products **Informatics teacher (T2)** ● Presentation of chat GPT use and affordances and support to the students in the use of chat GPT during the design process ● Collaboration with the other teachers on technical matters during the design process ● Supporting the students and teachers in the use of the applications used for calculations and presentations **Mathematics teacher (T3)** ● Coordination of all the calculations related activities for assessing the environmental impact of the proposed product ● Providing assistance and guidance to the students related to calculation methods ● Collaboration with the science teacher on calculations and evaluation of impact and with the other teachers on using applications for calculations. T1 cooperates with T2 and T3 on the measurements that will have to take place, the sustainability parameters to be taken into account and the applications that will be used for the measurements T1 cooperates with T2 and T3 on the analysis of data and the way to maintain the ecologic neutrality of the product to be designed T1 cooperates with T3 on the analysis of the data regarding the sustainability of the product T1, T2, T3 cooperate to formulate the final reports and presentations.
STEAME in Life (SiL) Organization	● Visit to a manufacturing company to get information on the actual production line of a product ● Meeting with a representative from an international organization, namely the International Institute for Sustainable Development (IISD) to get more information on sustainability and ecological sustainable products.
Action Plan Formulation	**Step 1: Theoretical background knowledge (2 hours)**

- The science teacher explains to the students the basic concepts of sustainability and of sustainable products
- The science teacher explains the basic dimension of sustainable products according to the new regulation.

Step 2: Extension of theoretical knowledge and connection with the real world (4 hours)

- The science teacher coordinates the meeting with the representative of the international organization focusing on sustainable products and their features and on the impact of products on the environment and on economy, focusing on the sustainability dimensions
- The Informatics teacher explains the use of Chat GPT in the project for the acquisition of information.
- The science teacher coordinates a visit to a manufacturing company so that students understand better how products are manufactured in a production line and the challenges that actual production involves

Step 3: Formulation and definition of the project (2 hours)

- Summing up all the information, the objective of the project to re-design a product that will be sustainable is formulated
- The parameters to be investigated from the EU regulation framework are identified and through brainstorming are decided, together with the calculation methods
- Applications that will be used are agreed between the students and the teachers and methods of measurement and analysis are set up

Step 4: Application of knowledge and implementation (6 hours)

- Students with the support of their teachers analyze the life cycle of the product (from production to disposal)
- Teams are formed to assess sustainability on a set of dimensions
- Students with the support of informatics and science teachers search information on the sustainability dimensions the have undertaken to analyze, through Chat GPT
- Materials used in the product are listed and chat GPT is used to gather ecological foot print data for the calculation of the environmental impact.
- Students with the support of the science teacher define which materials will be changed in the design of their product
- Students gather information on the ecological impact of the new resources to be used
- Students with the support and guidance of the science teacher and the maths teacher and the informatics teacher by using chat GPT calculate the impact of the product in the case of using only new materials. Informatics teacher is supporting on providing useful and appropriate prompts to get the desired results
- Students calculate the overall environmental impact once with all the materials as new and once with the changed material and calculate and elaborate on the differences.
- Students supported by all the teachers work on the presentation of the results of the project

Step 5: Results presentation and evaluation (2 hours)

- Students assess the sustainability of the product and finalize their presentation working in plenary
- Students and present their results to the teachers or other peers.

	● Teachers evaluate the implementation and result of the project.

[*] *under development the final elements of the framework*

3. Objectives and Methodologies

Learning Goals and Objectives	Learning goals of the project: **LG#1:** Introduce students to the concept of sustainable products **LG#2:** Present and familiarize the students with the methods and approaches of sustainability measurement **LG#3:** Analyze the connection between sustainability and product design **LG#4:** Familiarize students with the use of chat GPT Learning objectives **LO#1**: Students will understand the concept of sustainable products **LO#2**: Students will know about the approaches for measuring product environmental sustainability **LO#3**: They will know how to use Chat GPT to get information on products and materials **LO#4:** They will conceptualize the way components a product can de designed (re-designed) to be sustainable
Learning Outcomes and expected Results	After completing the project students should: **Knowledge** ● Know the three main domain of sustainability of products ● Understand the main ways a product can be environmentally sustainable ● Mention the main approaches of evaluating the sustainability of products ● Know how to use chat GPT to retrieve information on the sustainability of products ● Describe the EU framework for sustainable products ● Know how to design more sustainable products **Skills** ● Use chat GPT for collecting information and data ● Perform mathematical calculations using spreadsheet software ● Make assessments by comparing numerical data ● Use presentation software to create presentations **Attitudes** ● Develop interest on sustainable development ● Raise awareness on sustainable production ways and sustainable products ● Develop interest in product design ● Develop a critical view about the products they consume and their impact on the environment
Prior Knowledge and Prerequisites	**Prior knowledge-skills:** ● Basic use of spreadsheet software for calculations ● Basic mathematical calculations ● Basic use of office applications suite ● Communication and cooperation skills ● Basic use of the internet for information search

	● Teamwork skills ● Basic understanding of ecology and eco-preservation Prerequisites: ● Laboratory with access to the internet ● Teleconference platforms ● Access to chat GPT ● Access to office suite applications ● Presentation equipment ● Access to printing equipment
Motivation, Methodology, Strategies, Scaffolds	**Motivation** ● Preservation of the environment ● Product design ● Real world connection ● Entrepreneurship **Methodology** Project based approach that involves the collaboration between teachers of Science, Mathematics, Informatics and Arts and the collaboration of the group of students during all the phases of the design of a sustainable ecologically product. **Strategies** Project based learning Autonomous work Teamwork Guided discovery Brainstorming **Scaffolds** Guidance and consultancy from teachers Additional information from experts Support during lab work from teachers

4. Preparation and Means

Preparation, Space Setting, *Troubleshooting Tips*	**Preparation** The science teacher is the coordinator of the project. During preparation all the teachers together review the information sources and discuss their participation in the project. The informatics teacher assures that all the students will have access to chat GPT. All the teachers together formulate an initial document for the presentation of the concept to the students. All the teachers take care to identify what will be needed for their part of the intervention in terms of materials, resources and infrastructures. The science teacher makes a preliminary contact with the external actors involved in the project to identify their availability and performs all the actions needed for the approval of the field trip outside of the school, and the safety measures to be taken during the trip. **Space setting** The implementation of the project requires the following settings: Computer laboratory with internet access where students can work at least in pairs on data analysis, presentation software and chat GPT

	Classroom, where students can work collaboratively in teams. The classroom has to be equipped also with presentation equipment (computer, projector and office applications) and have a connection to the internet for the online meetings with the external experts. **Troubleshooting/tips** Special care has to be taken regarding the field trip of the students in order all the necessary permits to be taken and the safety of the students while visiting a manufacturing plant to be ensured.
Resources, Tools, Material, Attachments, Equipment	**Educational resources and materials** Teachers can use the resources mentioned in the references section supplemented by additional custom developed materials focusing on design for sustainability **Tools and equipment** The implementation of the project requires basic equipment and software namely ● Computer laboratory with access to the internet ● Office suite applications (word, excel, PowerPoint) ● Presentation equipment in classroom ● Active Chat GPT accounts ● Teleconference platform ● Classroom where teleconferences can be held
Health and Safety	Provisions must be made for assuring the health and safety of students during the visit to a manufacturing plant to assure their's and other people's health and wellbeing

5. Implementation

Instructional Activities, Procedures, Reflections	The project is implemented extending to 16 study hours. Classes are held once a week in the context of additional activities in primary education. The leading teacher (Teacher 1 – T1 - Science Teacher) participates in all the activities and the other teachers (Teacher 2 – T2 - Informatics teacher), (Teacher 3 – T3 – Mathematics teacher), are involved in specific parts of the project where their participation has been scheduled. The Informatics teacher (T2) has more extended participation than the other teachers. **Lesson block 1 (2 X 50 minutes)** T1 25 minutes, presentation of the project to students -motivation of students -presentation of basic parameters and goals of the project T1, T2, T3, T4 25 minutes, presentation of participation to the project -motivation of students T1, T2, T3, T4 15 minutes, explanation of learning activities -description of the intended activities and agreement with the students on the general workplan T1, T2, T3, T4 15 minutes, evaluation process -Discussion with students and agreement on the project evaluation methods and criteria T1 20 minutes, initial presentation of sustainability concepts

- introduction to sustainability

Lesson block 2 (2 X 50 minutes)

T1

25 minutes, presentation of the concepts related to sustainable products and sustainable products design

T1

25 minutes, presentation of the sustainability framework

-presentation of the European framework for sustainable products

T1, T2, T3

50 minutes, analysis of the framework and indices setting

- teachers analyze further the indices of the framework and students brainstorm and decide with the support of the teachers on the indices to be used throughout the project.

Lesson block 3 (1 X 50 minutes)

T1, T2, T3

20 minutes, presentation and showcasing of ChatGPT and its use (prompting, retrieving information, evaluating information)

30 minutes, familiarization with Chat GPT.

- students work in pairs in the computer lab, with the support of the informatics teacher and the guidance of the science teacher gathering information on sustainability and sustainable products using ChatGPT

Lesson block 4 (2 x 50 minutes)

T1, T2, T3

50 minutes, meeting with representative from an international organization, namely the International Institute for Sustainable Development (IISD) to extend the knowledge about sustainable products and their impact

T1

50 minutes, visit to products manufacturing business

- students visit the manufacturing plant to get more information on the production process and the relationship between production and sustainability.

Lesson block 5 (2 x 50 minutes)

T1, T2, T3

100 minutes, collection of sustainability data

-students with the support of their teachers use ChatGPT to gather data on the footprint of the product under analysis, ChatGPT is used both as primary source of data (prompting directly for the data) and as a secondary source, pointing to sources and databases

Lesson block 6 (2 X 50 minutes)

T1, T2, T3

50 minutes, calculation of indices

- students with the support of their teachers, and especially of the mathematics teacher, calculate the sustainability indices decided

T1, T2, T3

25 minutes, compilation of results

- students work in teams, and each team compiles the calculation in a single report

25 minutes, formulation of results

- students work in plenary session to compile a single report of the results about the product

Lesson block 6 (2 x 50 minutes)

T1, T2, T3

50 minutes, product design

- students brainstorm and decide on the design (redesign) of the product taking into account the already analyzed measurements and decide on it

T1, T2, T3

50 minutes, product design

	- students work in the collection of data for the new product for the evaluation of its sustainability **Lesson block 7 (2 x 50 minutes)** T1, T2, T3 50 minutes, final analysis of sustainability of the product - students finalize their calculations and start compiling the final report for the new designed (re-designed) sustainable product working firstly in teams and then in plenary session T1, T2, T3 50 minutes, finalization of final report - students work in plenary session with the support of all the teachers in the finalization of the report and of the presentation of the project **Lesson block 8** T1, T2, T3, 50 minutes, finalization of presentation and of the results achieved T1, T2, T3, T4 25 minutes, presentation of the final results of the project 25 minutes, evaluation of the project
Assessment - Evaluation	Evaluation of the project and its results is performed mainly in two different contexts. a) the level of participation, involvement and contribution of each student is evaluated. This evaluation is based in direct observation by the teachers where a rubric can be used or a journal of observations b) the final result is evaluated judging by the presentation and the arguments with which they supported their decisions and their final outcome. In the evaluation participate all the teachers that were involved.
Presentation - Reporting - Sharing	The final expected results of the project are 1. A report in word format containing the calculations related to the designed product 2. A presentation of the designed product and of its features, accompanied by the estimation about its impact on the environment
Extensions - Other Information	The project can be extended to the actual production and testing of a sustainable product, by implementing the design.

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)

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

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

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

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

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

Review (by teachers)

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

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

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 - Communication Tactics.

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

Title of Project: Eco-Innovation: Designing a Sustainable Product using Chat GPT
Brief Description/Outline of Organizational Arrangements / Responsibilities for Action

STAGE	**Activities/Steps** Teacher 1(T1) Cooperation with other teachers and student guidance	**Activities /Steps By Students** Age Group: 12-15	**Activities /Steps** Teacher 2 (T2) Cooperation with other teachers and student guidance	**Activities /Steps** Teacher 3 (T3) Cooperation with other teachers and student guidance	**Activities /Steps** Teacher 4 (T3) Cooperation with other teachers and student guidance
A	Preparation of steps 1,2,3	-	Cooperation in step 3	Cooperation in step 3	Cooperation in step 3
B	Guidance in step 9	4,5,6,7,8,9,10	Support guidance in step 9	Support guidance in step 9	Support guidance in step 9
C	Creative Evaluation	11	Creative Evaluation	Creative Evaluation	Creative Evaluation
D	Guidance	12	Guidance	Guidance	Guidance
E	Guidance	13 (9+12)	Guidance	Guidance	Guidance
F	Organization (SIL) STEAME in Life	14 Meeting with representatives + visit a manufacturing plant	Organization (SIL) STEAME in Life	Organization (SIL) STEAME in Life	Organization (SIL) STEAME in Life
G	Preparation of step 15		Cooperation in step 15	Cooperation in step 15	Cooperation in step 15
H	Guidance	16 (repetition 5-11)	Support Guidance	Support Guidance	Support Guidance
I	Guidance	17	Support Guidance	Support Guidance	Support Guidance
K	Creative Evaluation	18	Creative Evaluation	Creative Evaluation	Creative Evaluation