## STEAME ACADEMY
## TEACHING FACILITATION LEARNING & CREATIVITY PLAN (L&C PLAN) - L.2 TEACHERS
## Eco-Innovation: Designing a Sustainable Product using Chat GPT

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## 1. Overview

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| 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? |
| Ages, Grades, … | 12-15          8th-9th grade (Gymnasium) |
| Duration, Timeline, Activities | 20 hours          10 sets of 2X45-50 minutes lessons     >=10 activities |
| Curriculum Alignment | **Sciences:**<br>-ecology<br>-climate change<br>- sustainability<br>**Technology:**<br>-informatics<br>-artificial intelligence<br>**Engineering:**<br>-Design<br>**Arts:**<br>-Design<br>**Mathematics:**<br>- algebra (calculations<br>- statistics (basic data analysis)<br>**Entrepreneurship:**<br>-product placement |
| Contributors, Partners | - Manufacturing company (plant visit – production line)<br>- Mechanical engineer (product features design)<br>- Marketing company (product placement in market)<br>- International Institute for Sustainable Development (IISD) (expert advice) |
| Abstract - Synopsis | The learning and creativity plan refers to an intervention where students, acknowledging the importance for the preservation of the environment of |

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| References, Acknowledgements | environmentally sustainable products, try to develop a sustainable product by using chat GPT in the design process of the product.<br>https://www.bcg.com/publications/2023/six-strategies-to-lead-product-sustainability-design<br>https://www.youtube.com/watch?v=jfsWI8XgQyo<br>https://www.youtube.com/watch?v=8u2M0b6sFXM<br>https://www.youtube.com/watch?v=5cjlWAWIp0Q<br>https://www.youtube.com/watch?v=0lk5yZQuntk<br>https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52022DC0140&qid=1649112555090<br>https://www.mdpi.com/1996-1073/14/12/3469<br>https://www.oecd.org/innovation/green/toolkit/oecdsustainablemanufacturingindicators.htm |

## 2. STEAME ACADEMY Framework*

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| Teachers' Cooperation | **Science teacher (T1)**<br>● Coordination of the project<br>● Presentation of sustainability and environment preservation concepts<br>● Investigation with students and other teachers the sustainability parameters of the product to be designed<br><br>**Informatics teacher (T2)**<br>● Presentation of chat GPT use and affordances and support to the students in the use of chat GPT during the design process<br>● Collaboration with the other teachers on technical matters during the design process<br>● Supporting the students and teachers in the use of the applications used for calculations and presentations<br><br>**Arts teacher (T3)**<br>● Supporting students on the aesthetic design and the incorporation of product features in an appealing way while maintaining the sustainability features<br>● Collaboration with the other teachers and students on the results of the proposed design<br><br>**Mathematics teacher (T4)**<br>● Coordination of all the calculations related activities for assessing the environmental impact of the proposed product<br>● Providing assistance and guidance to the students related to calculation methods<br>● Close collaboration with the science teacher on calculations and evaluation of impact and with the other teachers on using applications for calculations.<br><br>T1 cooperates with T4 and T2 on the measurements that will have to take place and the applications that will be used for the measurements and for the implementation design process and especially for the role of chat GPT in the process<br>T1 cooperates with T3 and T4 on the aesthetic aspects of the product to be developed by the students and the way to maintain the ecologic neutrality of the features of the product identified<br>T1 cooperates with T4 on the analysis of the data regarding the sustainability of the product to be designed |

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| | T1 cooperates with T3 on the final details of the presentation of the product (name, logo, coloring etc) |
| STEAME in Life (SiL) Organization | <ul><li>Visit to a manufacturing company to get information on the actual production line of a product</li><li>Meeting with an external mechanical engineer to get information about usability and user focused design of products</li><li>Meeting with an external marketing company to get information on the placement of a product in the market and the presentation of a product</li><li>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.</li></ul> |
| Action Plan Formulation | **Step 1: Theoretical background knowledge (2 hours)**<ul><li>Science teacher explains to the students the basic concepts of sustainability and of sustainable products</li><li>Science teacher coordinates the meeting with the representative of the International focusing on sustainable products and their features and on the impact of products on the environment</li></ul>**Step 2: Extension of theoretical knowledge and connection with the real world (5 hours)**<ul><li>Science teacher coordinates a meeting with the external mechanical engineer for the clarification of a product's design for usability and functioning and user experience of use and the parameters that need to be taken into account.</li><li>Science teacher coordinates a meeting with a marketing specialist for analysing basic concept of the introduction of a product in the market and it's presentation to the potential target group of buyers.</li><li>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</li><li>Informatics teacher explains the use of Chat GPT</li></ul>**Step 3: Formulation and definition of the project (5 hours)**<ul><li>Summing up all the information, the objective of the project to design a product that is sustainable is formulated</li><li>The parameters to be investigated and calculated are agreed and the analysis of the workplan is formulated together with the students and the teachers</li><li>Applications that will be used are agreed between the students and the teachers and methods of measurement and analysis are set up</li><li>Product to be designed is agreed with the students and the teachers</li></ul>**Step 4: Application of knowledge and implementation (12 hours)**<ul><li>Students analyze and list the materials that will be used on the product that they are designing and the quantities that will be necessary</li><li>Students with the support of the science teacher define which materials will be new and which recycled</li><li>Students gather information on the ecological impact of the resources to be used on the product</li><li>Students with the support and guidance of the science teacher and the maths teacher and the informatics teacher by using chat GPT calculate</li></ul> |

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 with the support of the science teacher and the arts teacher decide on the presentation and packaging features of the project and with the support of all the teachers calculate the impact of the product presentation features
- Students calculate the overall environmental impact once with all the materials as new and once with the recycled materials and calculate and elaborate on the differences.
- Students work with the arts teacher and the informatics teacher in chat GPT to produce a final image of the product and with the science teacher to develop a final presentation of the product and its impact

Step 5: Results presentation and evaluation **(2 hours)**
- Students assess the sustainability of the product 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 |
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| Learning Goals and Objectives | Learning goals of the project:<br>**LG#1:** Introduce students to the concept of sustainable products<br>**LG#2:** Present and familiarize the students with the methods and approaches of sustainability measurement<br>**LG#3:** Analyze the connection between sustainability and product design<br>**LG#4:** Familiarize students with the use of chat GPT<br>**LG#5:** Elaborate further the interconnection between all the actors and components of product design, manufacturing and market placement<br><br>Learning objectives<br>**LO#1**: Students will understand the concept of sustainable products<br>**LO#2**: Students will know about the approaches for measuring product environmental sustainability<br>**LO#3**: They will know how to use Chat GPT to get information on products and materials<br>**LO#4:** They will conceptualize the way components of a product impact its environmental characteristics |
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| Learning Outcomes and expected Results | After completing the project students should:<br>**Knowledge**<br>● Know the three main domain of sustainability of products<br>● Understand the main ways a product can be environmentally sustainable<br>● Mention the main approaches of evaluating the sustainability of products<br>● Know how to use chat GPT to retrieve information on the sustainability of products<br>● Understand how to compose a product and its features<br><br>**Skills**<br>● Use chat GPT for gathering information<br>● Perform mathematical calculations using spreadsheet software |

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|  | <ul><li>Make assessments by comparing numerical data</li><li>Use presentation software to create presentations</li><li>Use chat GPT features to produce images</li></ul>**Attitudes**<ul><li>Develop interest in preservation of the environment</li><li>Raise awareness on sustainable production and sustainable products</li><li>Develop interest in product design</li><li>Develop interest on actual economy and product placement</li></ul> |
| Prior Knowledge and Prerequisites | **Prior knowledge-skills:**<ul><li>Basic use of spreadsheet software for calculations</li><li>Basic mathematical calculations</li><li>Basic use of office applications suite</li><li>Communication and cooperation skills</li><li>Basic use of the internet for information search</li><li>Teamwork skills</li><li>Basic understanding of ecology and eco-preservation</li></ul>Prerequisites:<ul><li>Laboratory with access to the internet</li><li>Teleconference platforms</li><li>Access to chat GPT</li><li>Access to office suite applications</li><li>Presentation equipment</li><li>Access to printing equipment</li></ul> |
| Motivation, Methodology, Strategies, Scaffolds | **Motivation**<ul><li>Preservation of the environment</li><li>Product design</li><li>Real world connection</li><li>Entrepreneurship</li></ul>**Methodology**<br>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.<br><br>**Strategies**<br>Project based learning<br>Autonomous work<br>Teamwork<br>Guided discovery<br>Brainstorming<br><br>**Scaffolds**<br>Guidance and consultancy from teachers<br>Additional information from experts<br>Support during lab work from teachers |

## 4. Preparation and Means

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| Preparation, Space Setting, *Troubleshooting Tips* | **Preparation**<br>The teacher in charge of the project is the science teacher. Initially he/she discusses with the other teachers the goals of the project and the actions to be taken for its implementation. The teacher reviews the initial sources of information, the resources to be used and discusses with the informatics teacher the use of chat GPT throughout the project. 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.<br>The science teacher makes a preliminary contact with the external actors involved in the project to identify their availability. The informatics teacher checks on the availability of the computer laboratory and all the needed applications and platforms.<br>The science teacher takes care of all the documentation and paperwork needed for the approval of the on-site visit to the manufacturing site and the safety measures to be followed.<br><br>**Space setting**<br>The implementation of the project requires the following settings:<br>Computer laboratory with internet access where students can work in pairs on data analysis, presentation software and chat GPT<br>Classroom, where students can work collaboratively in big 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.<br><br>**Troubleshooting/tips**<br>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**<br>Teachers can use the resources mentioned in the references section supplemented by additional custom developed materials focusing on sustainability design<br>**Tools and equipment**<br>The implementation of the project requires basic equipment and software namely<br><ul><li>Computer laboratory with access to the internet</li><li>Office suite applications (word, excel, PowerPoint)</li><li>Presentation equipment in classroom</li><li>Chat GPT account with access to DALL-E also or another AI image generator</li><li>Teleconference platform</li><li>Classroom where teleconferences can be held</li></ul> |
| *Health and Safety* | Provisions must be made for assuring the health and safety of students during the visit to a manufacturing plant<br>If students during the project bring materials in physical form additional precautions for their health and safety during the handling of materials must be taken (e.g. for toxic materials, very small materials etc) |

## 5. Implementation

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| Instructional Activities, Procedures, Reflections | The project is implemented extending to 20 study hours separated in 10 lesson blocks of 2 study hours each. Classes are held once a week in the context of |

additional activities in secondary 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), Teacher 4 – T4 – Arts 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**
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
20 minutes, presentation of participation to the project
-motivation of students
T1, T2, T3, T4
15 minutes, explanation of learning activities
-description of activities and agreement with the students
T1
15 minutes, evaluation process
-Discussion with students and agreement on the project evaluation methods and explaining about the personal journal that they will have to keep for their experience
T1
15 minutes, initial presentation of sustainability concepts

**Lesson block 2**
T1
25 minutes, presentation of the concepts related to sustainable products and sustainable products design
T1, T3
20 minutes, setting and explanation of basic measurements for the products that will be applied
T1, T2
25 minutes, presentation and showcasing of Chat GPT and its use (prompting, retrieving information, evaluating information)
20 minutes brainstorming on the sustainability metrics that will be used in the context of the project.
**Lesson block 3**
T1, T2
45 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, T3, T4
45 minutes, meeting with mechanical engineer to extend knowledge on product design for sustainability
**Lesson block 4**
T1, T2
20 minutes, brainstorming and decision on the product to be designed
25 minutes, online research on the components/ingredients of the product
T1, T2
45 minutes gathering information online on the nature of the components of the product through chat GPT and verification of the information from a second source
**Lesson block 5**
T1, T2, T3

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| | 45 minutes, research online about the amount of materials that will be needed for the production of one unit of the product, the percentage of wasted materials during their handling in the production process and data entry of the quantities in a spreadsheet.<br>T1, T2, T3<br>45 minutes, research through chat GPT for the environmental impact of the materials of the product and calculation of its overall footprint in the spreadsheet used<br>**Lesson block 6**<br>T1<br>2X45 minutes, visit to product manufacturing business to deepen information on production processes and the way actual businesses handle matters of sustainability of the products they produce.<br>**Lesson block 7**<br>T1, T4<br>45 minutes meeting with marketing expert for gathering information on the placement of products in the market (packaging, secondary packaging, display features, etc.)<br>T1, T4, T2<br>45 minutes, packaging and aesthetic design features, identifying eco-information of packaging materials through web search with the use of chat GPT and data entry to the spreadsheet of the other components of the product.<br>**Lesson block 8**<br>T1, T4, T2<br>45 minutes, calculation of the total environmental impact of the product and brainstorming and decision on the alternative/recyclable materials that could be used.<br>T1, T2, T3, T4<br>45 minutes, identification of the environmental parameters of the alternative materials using Chat GPT and data entry to the spreadsheet.<br>**Lesson block 9**<br>T1, T2, T3, T4<br>45 minutes, recalculation of the environmental impact of the product in the multiple variations created during the design process and drawing of conclusions<br>T1, T3<br>45 minutes, finalization of the conclusions and preparation of presentation of the final product<br>**Lesson block 10**<br>T1<br>45 minutes finalization of presentation and of the results achieved<br>T1, T2, T3, T4<br>25 minutes evaluation of the results<br>25 minutes presentation of results in other peers in school |
| Assessment - Evaluation | Evaluation of the project and its results is performed mainly in two different contexts.<br>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<br>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<br>1. A report in word format containing the calculations related to the designed product<br>2. A presentation of the designed product and its features |

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| | 3. A brief personal log of participation and personal experience from each student |
| *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 |
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| 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 |