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STEAME ACADEMY
TEACHING FACILITATION LEARNING & CREATIVITY PLAN (L&C PLAN) - LEVEL 2
SERVICE TEACHERS: Smart eco-agriculture

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1. Overview

Title	**Smart eco-agriculture**		
Driving Question or Topic	*How to use technology in studying plant development?* *How can technology help grow plants?* *Can IoT help track plants development?*		
Ages, Grades, …	*12-15 years old*	*6-9 grades*	
Duration, Timeline, Activities	15 lessons	15 lessons	15 lessons
Curriculum Alignment	What is ecological and precision agriculture? How to track plant development through IoT sensor data and analyze it. Applications.		
Contributors, Partners	*Organic farming companies. Parents who have experience in growing and gathering vegetables.*		
Abstract - Synopsis	*Initially, students are taught together by the biology teacher, who introduces them to the importance of organic farming and the need for precision irrigation and fertilization. Then, with the assistance of the school management, a meeting is organized with representatives of ecological farming companies in the area, as well as with parents who are engaged in growing vegetables. With the support of the school management, a small experimental greenhouse is provided in the school yard and they decide what vegetables will be planted. The students are divided into small groups of 3-4 people each, who study the technology of growing individual vegetables – tomatoes, cucumbers, cabbage, etc. Together with the biology teacher and the support of the parents, separate groups of students plant the vegetables in the greenhouse.* *In parallel, with the computer science teacher, the students are introduced to the possibilities of sensor devices through which they can observe the development of plants. Appropriate temperature and humidity sensors are provided and placed in appropriate locations in the greenhouse with the vegetables.* *In the next stage, the informatics teacher helps the students to use an appropriate online environment to receive and analyze the data received from the sensors. Together with the biology teacher, the data from the sensors is summarized and analyzed. Conclusions are made about the need for watering, fertilizing, spraying or other agro technical activities related to increasing the efficiency in the technology of growing vegetables. Together with the entrepreneurship teacher, individual groups of students design, predict and*		

References, Acknowledgements	*report the economic effect of precision agriculture. They analyze costs and plan potential revenues. In the final stage, students present the results of their work. The work on the topic lasts 15 hours (about 4 months) in a period suitable for the vegetation of vegetables.* https://www.facebook.com/groups/595271940651575/media?locale=bg_BG https://www.researchgate.net/publication/358900643_Integration_of_STEM_Centers_in_a_Virtual_Education_Space https://youtu.be/WhAfZhFxHTs - precise agriculture

2. STEAME ACADEMY Framework*

Teachers' Cooperation	***Teacher 1: Computer Science and Technology Teacher*** *- this teacher introduces the theoretical aspects of applying IoT sensors to solve real-world problems. Assists students in reading and analyzing sensor data, and preparing and presenting results.* ***Teacher 2: Biology teacher*** *- introduces students to the importance of organic and precious farming. Assisted in organizing a meeting with representatives of local businesses and parents, organized the creation of the small experimental greenhouse, planting and growing the vegetables. It helps students analyze sensor network information and prepare their final presentations.* ***Teacher 3: Entrepreneurship teacher*** *- This teacher will help groups of students calculate the costs of growing vegetables and the possibilities of optimizing them using sensor information for precision agriculture. In this way, the theoretical knowledge of entrepreneurship will be applied in solving specific practical problems.*
STEAME in Life (SiL) Organization	*Meeting with business representatives; Creation of an experimental greenhouse in the school STEAME center*
Action Plan Formulation	***Step 1. Acquisition of theoretical knowledge:*** *Clarifying the importance of organic and precise farming by the biology teacher. The IT teacher presents the capabilities of various sensors for dynamic monitoring of changes in the environment. The following example task "What sensors are needed to monitor plant development" is defined. The entrepreneurship teacher helps groups of students calculate the costs of growing vegetables and the possibilities of optimizing them using sensor information for precision agriculture.* ***Step 2. Getting the assignment and applying the knowledge:*** *Together with the IT, biology and entrepreneurship teachers, the students organize a meeting with representatives of local organic farming companies and with parents who have an interest and knowledge of growing vegetables. They study the technology of growing different types of vegetables and their economic importance.* ***Step 3. Confirmation and analysis of acquired knowledge:*** *Consolidation and analysis of acquired knowledge: With the biology teacher, the small learning greenhouse in the school yard is formed. Students in groups plant several different types of vegetables. The necessary sensors- IoT (for temperature, humidity) are selected and placed with the IT teacher. Appropriate IT means are used to receive and process the information received from the sensors. The income and expenses of growing the vegetables are planned with each group of students together with the entrepreneurship teacher.* ***Step 4. Application of knowledge to solve the problem and present the results*** *Together with the teachers of information technology and biology, the received sensor data are analyzed and compared with the results of the observations. Conclusions are made for optimizing the technology of growing vegetables, based on the data analysis. Each group processes, prepares and presents the*

	results of growing the particular vegetable (tomatoes, cucumbers, cabbage, etc.). Results are presented to other students and teachers. ***Step 5. Evaluation.*** *Each teacher follows the assessment level methodology ie. assesses students' teamwork, research and knowledge, presentation and communication skills.*

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

3. Objectives and Methodologies

Learning Goals and Objectives	*After completing the training, students should know:* - *What is organic farming and why are they important to people* - *Why it is important to collect and process sensory information and how it can make agriculture precision by optimizing the use of water and fertilizers.* - *What it means to find an improved technology for growing plants.*
Learning Outcomes and expected Results	*Students understand the need to use sensors (IoT) to collect information and analyze it to solve specific problems in everyday life, such as ecological agriculture.* *Acquisition of skills for project-based learning and teamwork*
Prior Knowledge and Prerequisites	***They should be able to:*** - *They solve simple problems by using of IoT* - *To work in a team* - *To cooperate in solving practical tasks* - *To conduct research* - *To plan and organize meetings* - *To communicate with business partners* - *To analyze the received information* - *To prepare presentations and video clips* - *To be creative and generate new ideas* - *To present to an audience* ***Expected results:*** - *Presentations with analysis and results of finding improved technologies for growing vegetables.* - *Final conclusions on the need to use sensor information for precision ecological agriculture.* - *Real-world application of topics studied in computer science and science classes.* - *Improving knowledge of teamwork*
Motivation, Methodology, Strategies, Scaffolds	*A key task in the plan is to experiment with a new approach to studying the complex topic of using IT and IoT (including AI) to solve meaningful real-world problems - for example, conserving water, soil and air and producing environmentally friendly food. Defining specific tasks and applying appropriate approaches and algorithms to solve them (such as receiving, storing, processing and analyzing sensory information) reduces abstractness and allows students to understand the meaning of this knowledge.*

4. Preparation and Means

Preparation, Space Setting, *Troubleshooting Tips*	*At different stages of the work, teachers change their leading role. In the initial period, the lead teacher is the biology teacher. He/she motivates the students, presents the new knowledge and helps the teams to apply it. The IT teacher supports the work of the teams by participating in setting the tasks and configuring the small experimental greenhouse in the school yard. After planting the plants, the IT teacher becomes the leader. He/she assists in the selection of appropriate sensors and assists in determining the appropriate software platform to acquire and analyze the information. The entrepreneurship teacher assists in the realization of the project in all stages of work. All teachers (each according to their competencies) collaborate with students in solving their problems, thus demonstrating the interdisciplinary nature of project-based learning.* *Instructional sources and digital material with the related references needed for the implementation of the learning plan.*
Resources, Tools, Material, Attachments, Equipment	*Students work in the classroom, on the greenhouse in the school STEAME center, or in a computer lab while acquiring new knowledge. They work as a team to solve the problem in a STEAM center or other secure environment with their teachers. Teachers should have appropriate learning resources such as presentations, video files, practical examples, etc.* ● *Intelligent farming - https://www.youtube.com/watch?v=Rf_knQPKKl8* ● *IoT in agriculture - https://www.youtube.com/watch?v=_tijHjup-qM and https://www.youtube.com/watch?v=pY_9TxAg95M* ● *Precise agriculture - https://youtu.be/WhAfZhFxHTs* ● *communication and collaboration platform - Google Meet, Google Classroom, Zoom, Skype, etc.* ● *e-learning platform - Google classroom, Moodle, etc.*
Health and Safety	*Students and teachers work in a healthy and safe environment.*

5. Implementation

Instructional Activities, Procedures, Reflections	*This plan is developed with an emphasis on classes in Computer Modeling and IT, Biology and Entrepreneurship and technology or in a STEAME interest club.* *Covers the subjects of study:* *- Computer Sciences* *- Science* *- Engineering* *- Entrepreneurship* *- Presentation and communication skills* *- English* *Teachers plan their activities in Google Calendar as part of the curriculum.* *Students are actively engaged through hands-on experience and research conducted as independent work that can be discussed in class.* *There are 15 study hours based on a 40-minute lesson. All classes are held once a week with a curriculum for 15 consecutive weeks.* *T1 and T2 teachers participate in all lessons:* *- 2-hour introduction to organic and precision farming and the importance of growing ecologically clean food* *- 2 hours - participation in a meeting with eco-agricultural companies and parents and setting the tasks* *- 2 hours - creating a small orangery in the school yard (or in the school STEAME center) and planting different types of vegetables* *- 2 hours of training on the need to use IoT in precision agriculture. Selection of suitable sensors and their placement in the experimental greenhouse*

Assessment - Evaluation	*- 2 hours - training for working in an online environment for receiving and storing the information from the sensors* *- 2 hours of analysis of the results and preparation for their presentation.* *- 2 hours of evaluation, planning and accounting of the economic indicators in growing vegetables.* *- 1 hour for final presentations and feedback sessions, which are organized during the last lesson on the topic and a presentation to a jury, including teachers and all students from grades 5, 6, 7 and 8.* *Teacher T3 participates in all activities related to the assessment of economic and financial indicators.* *The presentation of the final results takes place in front of: a jury from IT and science teachers, classmates, external experts, parents. The main components of the presentations are: the results of the conducted studies, the results of the implementation of the project activities and the proposals for improving the technology of ecological cultivation of the vegetables. An important part of the performance of each group is the reporting of financial indicators and the optimization of consumption through precision IoT farming.*
Presentation - Reporting - Sharing	*The final conclusions and results of the students are a key success factor. Their own opinion and final recommendations are the main focus so that they can analyze and defend their opinion.*
Extensions - Other Information	*All presentations with the results of the work of individual groups are uploaded to the school website and information is published on social media. The projects can be further developed into case studies and students and teachers can use them in their classes as teaching materials and/or be further developed as individual projects.*

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:**
   Organic farming and the cultivation of vegetables and fruits with the help of IT, IoT and AI is a relevant and important field for the modern world. The economical and optimal use of resources - water, preparations and fertilizers - is the main task of precision agriculture. In the course of training, students have to solve a specific problem – tracking the development of vegetables in a controlled environment in an experimental greenhouse through direct observations and analysis of data from sensors and finding appropriate technology for their precise cultivation. In the final stage, students prepare a presentation of the obtained results.
2. **Engaging the world of the wider environment / work / business / parents / society / environment/ ethics:**
   Not only the students and their computer science and biology teachers participate in the training, but also partners from the eco-agriculture business, parents and school management.
3. **Target Age Group of Students - Associating with the Official Curriculum - Setting Goals and Objectives**
   The theme is intended for students in grades 6-8 of secondary school. Training can take place in a STEAME club of interest. It can also be organized as part of IT, entrepreneurship and science studies using additional extra-curricular activities and independent study.
4. **Organization of the tasks of the parties involved - Designation of Coordinator - Workplaces etc**.
   The teachers organize the training and support the work of the teams; the motivate the students and set a real task to fulfill; the school management supports the organization of meetings with business partners, the extracurricular organization of the work, as well as the presentation of the results to an appropriate audience.

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

Preparation (by teachers)

1. **Relation to the Real World – Reflection**
   Presentation of a real problem - tracking the individual periods in the development of vegetables and analyzing dynamically incoming sensory information to determine an optimal plan for their cultivation.
2. **Incentive – Motivation**
   Together with the IT and Biology teachers, the students meet representatives of local eco-agribusinesses and complete tasks to grow specific vegetables. Posing a real problem motivates students. The entrepreneurship teacher assists in determining the economic benefits of precision agriculture.
3. **Formulation of a problem (possibly in stages or phases) resulting from the above**
   The students are divided into groups and look for technologies for ecological and precise cultivation of vegetables, applying the acquired theoretical knowledge. Together with their teachers, they plant, grow, observe, receive and analyze sensory information. Finally, they prepare a presentation and present the results to a critical audience.

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

4. **Background Creation - Search / Gather Information:**
   New knowledge applied when solving specific tasks, searching for additional information about different vegetables and their cultivation; for the appropriate sensors and the possibilities of processing the incoming information.
5. **Simplify the issue - Configure the problem with a limited number of requirements**
   The task is clearly stated with the necessary information
6. **Case Making - Designing - identifying materials for building / development / creation**
   The task that the individual groups receive is clearly defined
7. **Construction - Workflow - Implementation of projects**
   Introductory training with relevant examples - Posing a real problem - Additional training - Finding a solution to the problem - Presenting the results
8. **Observation-Experimentation - Initial Conclusions**
   Tracking the entire process of plant development, repeatedly analyzing the information received from the sensors and comparing with personal observation.
9. **Documentation - Searching Thematic Areas (AI fields) related to the subject under study – Explanation based on Existing Theories and / or Empirical Results**
   Students have the necessary theoretical information and examples.
10. **Gathering of results / information based on points 7, 8, 9**
    At each step, the teacher-moderators report the progress of each group in solving the problem
11. **First group presentation by students**
    Students present the results of their work

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**
    It is required to study the development process of plants and propose an approach for their more ecological cultivation.

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: **Smart eco-agriculture**

Brief Description/Outline of Organizational Arrangements / Responsibilities for Action

STAGE	**Activities/Steps** Teacher 1(T1) Cooperation with T2, T3 and student guidance	**Activities /Steps** **By Students** Age Group: 12-15	**Activities /Steps** Teacher 2 (T2) Cooperation with T1, T3 and student guidance	**Activities /Steps** Teacher 3 (T3) Cooperation with T1, T2 and student guidance

A	Preparation of steps 1,2,3		Prepatation in step 1,2,3	Cooperation in step 1,2,3
B	Guidance in step 9	4,5,6,7,8,9,10	Support guidance in step 9	Support guidance in step 9
C	Creative Evaluation	11	Creative Evaluation	Creative Evaluation
D	Guidance	12	Guidance	Guidance
E	Guidance	13 (9+12)	Guidance	Guidance
F	Organization (SIL) STEAME in Life	14 Meeting with Business representatives	Organization (SIL) STEAME in Life	Organization (SIL) STEAME in Life
G	Preparation of step 15		Preparation in step 15	Cooperation in step 15
H	Guidance	16 (repetition 5-11)	Guidance	Support Guidance
I	Guidance	17	Guidance	Support Guidance
K	Creative Evaluation	18	Creative Evaluation	Creative Evaluation