Title: Biowaste management

Author of the teaching scenario: Petar Rajaković
Subject title: Renewable Energy Sources
Grade: 3rd or 4th grade
Level of performance complexity: medium

Teaching method: problem-based

Key words:
renewable energy sources, biomass, biowaste, waste management, EU Green Deal

Correlations, interdisciplinarity and cross-curricular topics (CCT):
Power Electronics, Power Engineering, CCT: Learning to Learn, Personal and Social Development, Use of ICT and Sustainable Development

Learning outcomes:
- identify the potential of biowaste as an energy source (A, B, C)
- determine the benefits of biowaste management (A)
- research of possible solutions in biowaste collection and achievement of set EU goals (B, C)
- process the data obtained by the research (B)
- interpret the problems and research results on the problem task (B, C)

Cross-Curricular topics expectations:

Learn how to learn:
- Information management; The student independently seeks new information from various sources, transforms it into new knowledge and successfully applies it in solving problems.
- Precisely defines the problem and all its elements, 2. Applies and tests different strategies and selects those that will effectively lead to a

quality solution, 3. Critically analyses the problem-solving process and identifies opportunities to use newly acquired knowledge and skills in other situations.
- Planning; The student independently determines the learning goals, chooses the approach to learning and plans the learning.
- Self-evaluation / self-assessment; The student self-evaluates the learning process and its results, assesses the progress made and plans future learning based on that.

Personal and social development:
- He manages his educational and professional path.
- Collaborative learns and works in a team.
- Collaborates, organizes, performs its task, sets hypotheses, develops its role in the team, makes decisions.

Use of ICT:
- The student analytically decides on the selection of the appropriate digital technology.
- The student takes responsibility for their own security in the digital environment and the construction of a digital identity.
- The student independently conducts complex research with the help of ICT.
- The student independently and responsibly manages the collected information.
- The student independently or in collaboration with colleagues presents, creates and shares new ones.
- The student independently or in collaboration with others creates new content and ideas or reshapes existing digital solutions by applying different ways to encourage creativity.
- The student presents, creates and shares ideas and works on a complex topic with the help of ICT.

Sustainable development:
- He critically considers the connection between his own way of life and the impact on the environment and people.
- He thinks critically about the impact of our actions on Earth and humanity.
- It designs and uses innovative and creative forms of action with the aim of sustainability.
- It suggests ways to improve personal and general well-being.

Evaluations:

For learning:
- output card (A)
- supervision of students by teacher during work (A, B, C)
- presentation of research by students (C)

As learning:
- comparing other student's problem solutions with your own (B, C)
- assessment of one's own and others' work and team work (peer evaluation and self-evaluation) (B, C)
- discussion of students with other students and the teacher (A, B, C)

Learned:
- analysis of students' research work on the problem task (B, C)
- presentation skills of students (C)

Activity description:

A Biowaste management

The teacher starts discussion with the students on the topic of waste management, its potential and challenges. It introduces them to the story of the importance of changing consumer habits, thinking about packaging and raising awareness about waste in general.

Asks the following questions:

What is biowaste?

Do you collect biowaste?

Students write their answers via LINO digital tool (http://en.linoit.com/). The teacher, in collaboration with the students, sorts and corrects the wrong answers (evaluation for learning). Based on the answers given, the teacher asks students who collect biowaste to describe how they do it.

If it is not possible to use LINO digital tool, sticky papers and boards can be used. The teacher describes his collection of biowaste if there are no students doing it.

He asks the following question:

What can be achieved with the collected biowaste?

Students can answer the question using the LINO digital tool. After that, with the prepared presentation, the teacher shows the possibilities of using biowaste. Students then classify their set answers into three categories (Table 1).

Table 1.

Today's biowaste recovery	Future biowaste recovery	Incorrect biowaste recovery

The teacher divides the students into several groups. For the task, they receive an EU biowaste report in order to perform an adequate, qualitative and quantitative analysis of the available data.

Link: https://www.eea.europa.eu/publications/bio-waste-in-europe

It is necessary to answer the problem question:

How can we increase biowaste collection and achieve the set EU goals?

At the end of the lesson, students are given an output card, where they can independently write answers based on what they have learned.

Output card:

1. **What is completely clear to me from today's lecture?**	
2. **What is unclear to me?**	
3. **What would I like to know more about?**	

The teacher analyses students' responses and provides timely feedback on their learning. The output card directs the teacher towards adequate adjustments in teaching. The card also provides feedback to students about their learning.

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B Biowaste discussion

After the introductory activities, the problem is redefined:
How can we increase biowaste collection and achieve the set EU goals?

The teacher asks the students to explain their solutions and discuss the possible solutions with the other students. Each solution is compared to Table 1. of the last lesson. After presenting all the possible solutions and arguments, teacher together with the students chooses one or several of them.

Students in groups are now asked to analyse one of the proposed solutions and also answer the following questions:
What does it take to implement your solution?
What can stop us from achieving it?

Students receive a WORK PLAN from the teacher who will help them in the realization of problem-based teaching. Students fulfil their work plan in different stages and agree on the course of work.

WORK PLAN		
Problem solution:		
Group members:		
1.	What do we intend to achieve?	
2.	What is our goal?	
3.	How will we organize the work?	

4.	How long will it take?	
5.	What digital tools will we use?	
6.	Who will represent the results?	

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C Analysis of results

A representative of each group of students with the help of the prepared materials presents the results of research for a given problem solution. The teacher monitors the course of the presentation and, based on the presented research results, evaluates the work in communication with the students (evaluation of what has been learned).

Students in a group during and after presenting the results of other groups perform evaluation as learning: self-evaluation, peer evaluation.
The teacher gives each team a sheet with different criteria according to which students will evaluate the oral presentation and the quality of work for the problem task.

Peer evaluation:

Group:	Very successful	Successful	Unsuccessful
… explained the given topic in his own words.			
… addressed the class.			
… expressed himself correctly and professionally.			
… had the presence and attention of other students.			
… encouraged discussion among students on a given topic.			
… knew how to answer students' questions.			
… made the most of his given time.			

Self-evaluation:
After presenting their research, students receive a link to a short self-assessment form via Office 365 or in paper form.

Group:	Completely	Partially	Needs refinement
We have successfully completed the problem task.			
Each member of the group gave the maximum contribution to the solution of the problem task.			
The problem task required the participation of all group members.			
All group members respected each other's opinions.			
I am satisfied with my personal contribution to the solution of the problem task.			
I like this way of learning and teaching.			
After this way of learning I can successfully describe what I learned in class.			
Write your suggestion for improvement.			

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Additional literature, content and links:
Students can be introduced to links with which they can learn more about how to successfully present their presentation, which include the following links:
- https://www.skillsyouneed.com/present/presentation-tips.html
- https://hbr.org/2013/06/how-to-give-a-killer-presentation
- https://thinkscience.co.jp/en/articles/effective-presentations
- https://www.skillsyouneed.com/present/presentation-tips.html

Support procedures
Before performing the activity, teacher will check students with disabilities if the understand and explain it again if it's necessary. With the agreement, students are provided with enough time to complete the task and are not limited in time in the presentation. Each student with disabilities gets on the team a gifted student who will have the role of mentor.

Gifted students who need less time for a given topic can be given an additional question to research, mentor role, and are presenting their results among the first. Such students can receive an additional grade in the activity for their effort and engagement.