MODULE III

Lesson Plan 5

Summary

Title	
Water management - Designing a tap flow reducer with 3D printing	
Duration	135 minutes
The age range of students	12-14

Summary of the theme

Water is an indispensable resource for life. Preventing water waste is important today and in the future. This task raises students' awareness of water consumption, encourages them to conserve water, and introduces them to possible technological tools for doing so.

Learning outcomes

Aim/Learning Objectives.

- Generate ideas on the protection, improvement, and use of water resources.
- Develop projects using water-saving technology.
- Developing 3D skills

Cross-cutting objectives

- Understand the effects of water consumption on the environment.
- Reflect on the importance of water use in everyday life.
- Ask about the conditions and problems of water consumption.
- Encourage others to act responsibly in water consumption.
- Collaborate with peers to identify action plans to reduce water consumption in their families, circles of friends, and schools.

Connecting Sustainable Development Goals

This theme is aligned with SDG 12 "Responsible consumption and production: ensuring sustainable consumption and production patterns".
- Goals:
12.2 By 2030, achieve sustainable management and efficient use of natural resources.
12.8 By 2030, ensure that people everywhere have the information and knowledge relevant to sustainable development and lifestyles in harmony with nature

12. Support developing countries in strengthening their scientific and technological capacity to move towards more sustainable patterns of consumption and production.

Implementation

Facilitation

- While the design is being printed, the printer should be checked periodically.
- It should be noted that the temperature settings of the printer are adjusted according to the type of filament used.
- Since the printer operates at high temperatures, it must not be interfered with during operation.

Resources / Materials needed

- Tap aerator and two buckets or similar containers.
- Tablet or computer.
- The TINKERCAD program (a free web application for 3D design) can be used to study the design.
- Ultimaker Cura is free and easy-to-use 3D printing software that allows users to fine-tune the 3D model for the best cutting and printing results.
- 3d printer
- Filament

Ideas to continue

Monitoring water consumption in your school, how much water you use, and how you can reduce it:

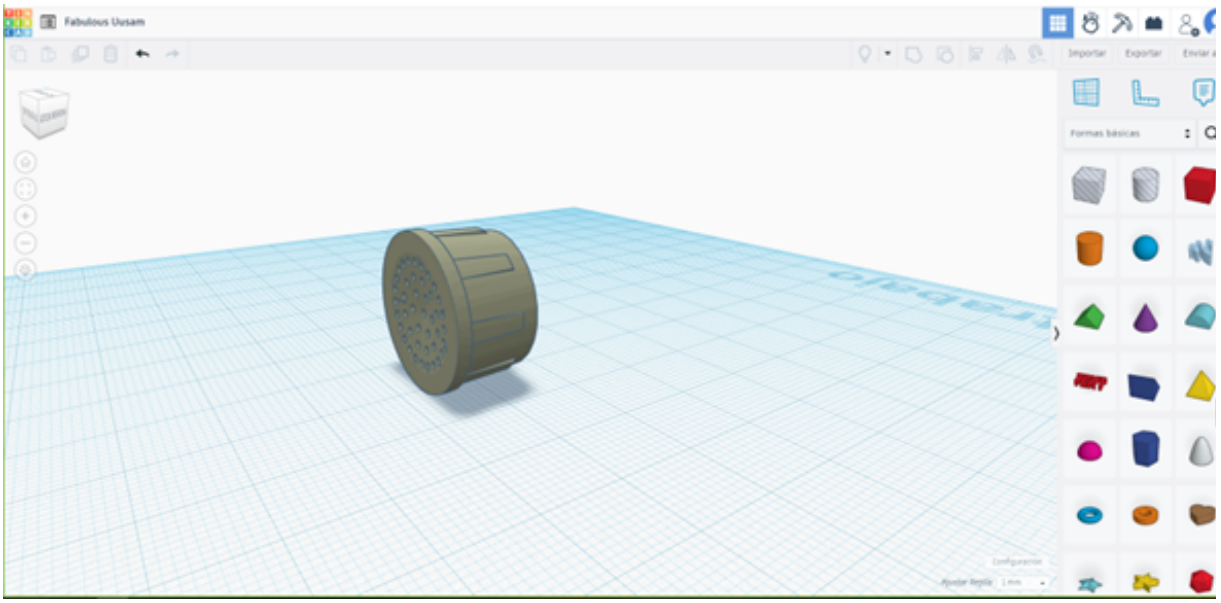
- Groups are formed to go around the school, counting and recording all water consumption points.
- Students can investigate how much water each device uses and develop ideas to reduce it.
- All results are presented in tables and graphs and/or on a poster.
- If possible, the posters created should be displayed in a busy and visible place in the centre.

Students can observe how much water they use in everyday life.
They can investigate other technological systems that reduce water consumption, such as sensors.

Source / Classroom materials and preparation
https://www.bcn3d.com/full-walkthrough-3d-printing-workflow/ 3D printers: https://www.youtube.com/watch?v=Llgko_GpXbI https://www.youtube.com/watch?v=C4HAJ5HLuB4 Training programs and resources: https://www.tinkercad.com/ https://ultimaker.com/es/software/ultimaker-cura/ Fitting a tap aerator: https://www.youtube.com/watch?v=yvIdvq-nYO0 The process from design and modelling to 3D printing: https://www.instructables.com/Introduction-to-3D-Modeling-and-3D-Printing/

Topic outline

Timing	Step-by-step instructions
15'	The issue of water consumption will be introduced, and a group discussion will be held on the current problems.
10'	Questions to the group on modelling and 3D printing: - What does 3D mean? Differences between working in 2D and 3D - Have you done 3D modelling before? What programs have you used? What is a 3D printer, and how does it work?
5'	Video about 3D printers
10'	The function and characteristics of the part to be printed are as follows: tap aerator.
10'	Choose a place in the school that has a tap. Pour all the water that comes out into a container for 1'.
15'	Place the aerator on the tap and repeat the operation using the same container as before.
10'	We measure the amount of water in both containers to quantify the savings.
15'	We propose the free software Tinkercad for 3D design. On its website, you will find the necessary tutorials and resources for students to familiarise themselves with the program. Basic notions for its use are given.

10'	The file with the aerator model (provided in the appendix) is imported to study the part from different points of view. (Figure 3.5.1)  *Figure 3.5.1 View of the piece in the program*
5'	We show the finished piece.
30'	Make a portfolio of the task and share what has been learned.

Formative evaluation

Class observation, oral questions, and participation in group discussions will support the assessment of the assignment.
Students will make a portfolio in groups describing the different phases of the task and the tools used, concluding with their proposals to reduce water consumption.
This can be used to consider adjusting instructions to address specific needs or difficulties.

Feedback

Net Promoter Score (NPS) is a widely used tool to measure the loyalty and satisfaction of customers or, in an educational context, students. It measures the likelihood that students will recommend the subject or course to others.
How to analyse and apply NPS is explained below:
Development of the NPS question:

- Main question: "On a scale of 0 to 10, how likely are you to recommend this topic to other students?
- Follow-up questions: "Why did you select this score?" and "How can we improve this issue?

Collection of responses:

- Digital surveys: Use online tools such as Google Forms, SurveyMonkey, or Typeform to collect student responses.

- Paper surveys: Paper questionnaires are distributed at the end of the lesson for students to complete. A template for collecting responses with paper surveys is shown in the Annex.
- Interactive applications: Interactive applications such as Quizziz, Mentimeter, or Kahoot! are used to collect answers in real-time.

Classification of responses:

- Promoters (Score 9-10): Students are very satisfied and likely to recommend the subject.
- Passive (score 7-8): Satisfied, but not enthusiastic students; they could easily change their minds.
- Detractors (Score 0-6): Dissatisfied students who are unlikely to recommend the subject; they could provide constructive criticism.

Calculation of NPS:

- Formula: NPS = % of promoters - % of detractors.
- Score interpretation: NPS ranges from -100 to +100. A positive score (above 0) is generally good, and a score above 50 is excellent.

Analysing and using comments:

- Review the comments to understand the reasons behind the scores.
- Identifies patterns and specific areas for improvement among detractors and passives.
- Use the promoters' positive comments to reinforce the positive aspects of the issue.

Annexes

Tap aerator archive

QUESTIONNAIRE TO COLLECT FEEDBACK ON THE TOPIC

On a scale of 0 to 10, how likely would you recommend this subject to other students?

0	1	2	3	4	5	6	7	8	9	10

Not likely at all — Extremely likely

Why did you choose that score?

How could this issue be improved?