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Exploring Energy Efficiency through Augmented Reality with smart homes

BIOS4YOU AR 2.0

BIO-INSPIRED STEM TOPICS FOR ENGAGING YOUNG GENERATIONS THANKS TO THE USE OF AUGMENTED REALITY

Project Number: KA220-BW-23-30-126516

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Introduction

The purpose of this document is to create guidelines to help the project staff that are dealing with school children, 14-19 aged, to create and re-adapt exercises using Augmented Reality technology.

To this end, a series of templates have been created that define exercises from a methodological, pedagogical and technological point of view.

A good written description, along with images, videos or sketches of the exercise is very important for experts to understand the idea. This will be part of the “General Information” template.

On the other hand, it will be important to define what STEM topic/subject each exercise is intended for and how AR technology can help students or staff or people interested in it when they use these exercises. In addition, people interested in the exercise can understand the usefulness of augmented information, and it will be necessary to explain the benefits.

During the process of defining the augmented information that each exercise will offer, staff working with teachers will be able to develop innovative ideas that make it easier to learn teaching concepts in an easier way.

All students will be able to view the contents explained by professionals projected in the real world in the form of text, 3D model, image, video, sound... This will help them focus their attention on exercise and more easily assimilate the associated concepts.

This document consists of the following points:

- Information about AR technology
- How to define AR exercise thanks to the template:
    - General information
    - Pedagogical specifications
    - Technical specifications

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General information

In this part it will be necessary to report the generic information of the exercise so that it can be recognised.

Name of the exercise:	Exploring Energy Efficiency through Augmented Reality with smart homes
Description of the exercises:	This AR-based activity is designed for high school students aged 17–19 and aims to demonstrate how home automation can significantly reduce energy consumption and promote sustainable living. Students enter a virtual environment where they can interact with various smart devices such as: • Smart thermostats • Motion-sensor LED lighting • Automatic blinds • Integrated solar panels • Central home automation hubs
Participants:	The activity can be carried out individually or in small groups (2–3 students). Group collaboration encourages discussion, problem-solving, and shared interpretation of AR content. However, the task is

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	also effective as an individual learning experience, especially in self-paced exploration mode.
Participants' age range:	Minimum age: 17, Maximum age: 19 Students should already have basic digital literacy and an introductory understanding of energy-related topics from physics or environmental science. No advanced technical skills are required, but curiosity and willingness to explore are essential.
STEM subject and specific topic:	Energy efficiency, smart technologies, home automation systems The core pedagogical aim is to simplify and contextualize the abstract concept of energy efficiency through real-world applications. The exercise tackles the following challenges: • Understanding how different devices contribute to energy savings • Visualizing the interconnection between systems (e.g., blinds + thermostat) • Comprehending passive vs. active energy management • Interpreting data and feedback (like consumption graphs or automation schedules) This approach makes complex energy dynamics tangible, memorable, and easier to apply in real-life situations.
Gamification process:	The exercise integrates **exploration-based gamification** with elements of **progression and feedback**: • Students unlock each smart device as they move through the AR space • Each device provides a mini quiz or interaction (e.g., "What happens if blinds stay open during summer?") • Feedback is immediate, reinforcing correct choices and

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	suggesting improvements • A final score or progress tracker encourages replay and deeper engagement Optional: Leaderboards or team-based challenges for group sessions.
Written or graphic description of Augmented info:	• **Information overlay**: pop-up texts with technical descriptions and data • **Virtual 3D objects**: realistic models of devices placed in the environment • **Animations**: showing energy flow, temperature changes, or sunlight interaction • **Voice narration**: explaining how each device works and why it matters This mixed approach ensures accessibility and engagement for different learners. The AR can be viewed via tablet, smartphone, or AR headset.
External (or extra) tools required	AR-enabled devices (smartphones/tablets with camera) Internet connection (if content is web-based) Paper and pen (for taking notes or completing handouts) Optional: printed QR codes for triggering each device scenario
Links (video, images, text online and so on).	-

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Pedagogical specifications

Here we will collect information on how to use the exercise in the learning session and the results and benefits of using it, from a pedagogical perspective.

How can this augmented information be used to address a STEAM topic in a more interesting way for students?

Augmented Reality transforms abstract STEAM (Science, Technology, Engineering, Arts, and Mathematics) concepts into **visually immersive, interactive experiences**, making learning more engaging and tangible. In this scenario:

- **Science and Technology** are made visible through the virtual functioning of smart devices (e.g., how a thermostat senses temperature and communicates with a heating system).
- **Engineering** concepts are explored by understanding system design and energy flow.
- **Mathematics** is involved in analyzing energy consumption data and calculating savings.
- **Art** enters through the design of user interfaces, animations, and sustainability-driven aesthetics.

AR allows students to **"see the invisible"**—like energy consumption or heat flow—making complex systems easier to grasp and far more stimulating than static textbook diagrams or lectures.

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Which pedagogical objectives are addressed through this scenario?

Cognitive Objectives: Understand principles of energy efficiency, renewable energy, and automation. Learn how interconnected systems (e.g., sensors, apps, energy flows) work together in smart environments.

Procedural Objectives: Develop digital skills by interacting with AR interfaces and navigation. Analyze data outputs (e.g., energy savings before/after using automation) and interpret graphs and feedback.

Which results are expected to be reached with its use?

Recognize key smart home technologies and explain their contribution to energy efficiency.

Understand the impact of human behavior on energy consumption and how automation can optimize it.

Make informed decisions in simulations and draw data-driven conclusions. Be able to relate scientific concepts (energy, electricity, environment) to real-world applications.

Improve digital literacy, especially in interacting with AR tools, scanning markers, and interpreting visual feedback.

Which benefits are expected to be reached with its use?

This AR experience increases **student engagement and motivation** by turning abstract concepts into **interactive, visual learning**. Through hands-on exploration, students can better **understand and retain complex topics** like energy efficiency and home automation.

AR promotes **autonomy**, letting learners explore at their own pace, while also creating **real-world connections** between everyday technology and global challenges like energy waste and climate

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Technical specifications

In this part it is necessary to specify whether the exercise was designed to be implemented with AR technology. This part is fundamental for the translation process. Please include text, audio text and all the necessary materials.

AR INFORMATION

Technology	Delightex https://edu.delightex.com/
If it's needed a marker, description of the marker	AWP URU

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Hardware and software needed:	pc, smartphone, tablet, camera.
Type of Augmented data	Images; Text; Video; Audio; 3D models.
Written description of the AR data	The exercise uses Augmented Reality to simulate a smart home environment, allowing students to interact with virtual devices that control lighting, heating, and energy consumption. Through realistic 3D models and data visualizations, learners explore how automation improves energy efficiency. The AR experience is non-interactive in terms of object movement, focusing on information overlays and scenario-based exploration.
If Image	 

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If Text	Smart Thermostat A smart thermostat that enables remote control and automation of your home temperature. Automatic Roller Shutters Motorised roller shutters that automatically adjust to sunlight to improve thermal insulation. Integrated Solar Panels The sun's energy is captured and used to power your home. In some cases, you can even feed unused energy back into the grid.
If video	-
If audio	-
If 3D model	obj,. stl, .glb,

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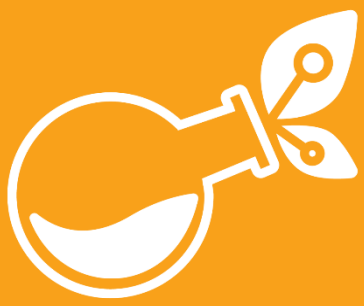

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