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[LESSON PLAN]

AI Waste Classifier – Smart Recycling with Artificial Intelligence

Bundeshandelsakademie Wolfsberg
Austria

Darica İlçe Milli Eğitim Müdürlüğü
Turkey

Campus 02 Fachhochschule der Wirtschaft GmbH
Austria

Directorate of Secondary Education of Kefallinia
Greece

Jaunpiebalgas vidusskola
Latvia

Sucessos Criativos, Lda
Portugal

Sredno obshtoobrazovatelno uchilishte Lyuben Karavelov
Bulgaria

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Authors

Campus 02 AUS

Selver Softic
Safet Softic
Yevheniia Andriichenko
Berndt Jesenko
Ioan Turcin

Disclamer

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1. TITLE

Smart Recycling with Artificial Intelligence: Building an AI Waste Classifier

2. GRADE LEVEL

- × ISCED Level 2 – Lower Secondary Education (ages 12–15)
- × ISCED Level 3 – Upper Secondary Education (ages 15–18)

3. SUBJECT AREA

- × Sciences
- × Environmental Studies
- Geography
- Economics
- × Computer Science
- Mathematics
- × Technology and Design
- Arts and Music
- × Social Studies
- History
- Languages

4. TYPE

- × Lesson Plan
- Project

5. DURATION

- 1 x 40-50minute class
- 1 x 60-minute class
- 1 x 80-100-minute block
- × 2 x 45-minute classes
- 2 x 60-minute classes
- Double session (2 × 60 minutes) optional project-based homework.

6. LEARNING OBJECTIVES

By the end of the lesson, students will be able to:
O1 - Identify different categories of waste (plastic, paper, organic, metal, glass) and explain why correct sorting matters for sustainability.
O2 - Use a simple AI tool to train a small image classification model for waste recognition.
O3 - Evaluate the accuracy of an AI model using real-life test data and propose improvements.
O4 - Reflect on how AI technologies contribute to greener practices in schools and communities.

7. Key Competences Developed

- Literacy
- Multilingual competence
- × Mathematical competence and competence in STEM
- × Digital competence
- × Personal, social and learning to learn competence
- × Citizenship competence
- × Entrepreneurship competence
- Cultural awareness and expression competence

8. Prior Knowledge / Prerequisites

- Basic ability to use a smartphone or laptop
- No prior knowledge of AI required
- Recommended: basic understanding of recycling categories (can be introduced during Phase 1

9. Lesson/Project Outline

Phase 1 – Introduction (Engage & Contextualize)

Time: 10 minutes

Suggested Components:

1. Video Clip (2–3 min): Short video on recycling challenges in Europe (any open-source video / EU environmental campaign).
2. Photo/Diagram: Visual of common household waste types.

Guiding Questions:
- Why is recycling important?
- What happens if waste is sorted incorrectly?
- How can AI help with environmental problems?

Resource (name)	Link (to the folder on Teams)
Presentation, Slides: 2, 3, 4, 5	AI Waste Classifier – Smart Recycling with Artificial.pptx

Phase 2 – Exploration (Investigate & Compare)

Time: 25 minutes

Activity: How AI Sees Waste
Students explore a simple image classifier tool (Teachable Machine or similar).
Steps:
- Teacher shows 3–4 example images.
- Students discuss: Can AI recognize these objects?
- Short reading / infographic on how machine learning works (age-appropriate).
- Small groups select 2–3 waste categories to focus on.

Media:
Infographic "How Classifiers Work" (simple flowchart)
Optional short video (2–3 min) on AI in waste sorting systems

Resource (name)	Link (to the folder on Teams)
Presentation, Slides: 6, 7, 8, 9	AI Waste Classifier – Smart Recycling with Artificial.pptx

Phase 3 – Application (Hands-On Practice)

Time: 35 minutes

Hands-On Activity: Students build their own mini AI model.

Steps:
- Groups collect 10–12 photos of waste objects found in school/class.
- Upload photos into Teachable Machine (or similar tool).
- Train a small classifier with 2–3 categories:
    - Paper

- Plastic
- Metal
- Organic
- Glass

- Test the model with new objects.

Expected Outputs

✓ A trained AI model
✓ 3–5 screenshots for documentation
✓ Notes about accuracy: correct vs. incorrect predictions

Media:
Students record short clips or photos documenting training & testing.

Resource (name)	Link (to the folder on Teams)
Presentation, Slides: 10, 11	AI Waste Classifier – Smart Recycling with Artificial.pptx

Phase 4 – Reflection & Consolidation (Present & Connect)

Time: 20 minutes

Group Presentations (2–3 minutes per group)

Each group presents:
- Their AI model
- Accuracy results
- What confused the model?
- How to make it better?

Class Discussion

- Can AI replace humans in waste sorting?
- What are the sustainability benefits?

Reflection Activity
Students respond to a reflection questionnaire

Resource (name)	Link (to the folder on Teams)
Presentation, Slides: 12, 13 Reflection Sheet	AI Waste Classifier – Smart Recycling with Artificial.pptx Reflection sheet - AI Waste Classifier.docx

10. Assessment Criteria

Assessment is based on:

✓ Performance-based
- Participation during group work
- Successful creation and testing of an AI model
- Quality of observations and accuracy analysis

✓ Portfolio (recommended)

Each group uploads:
- 3–5 photos/screenshots
- A short description of categories used
- Notes on performance and improvements

✓ Self-Assessment

Students rate:
- Their contribution
- Understanding of AI basics
- Awareness of sustainability impact

Resource (name)	Link (to the folder on Teams)
Assessment Criteria	Teacher Guide — Assessment Criteria.docx

11. Teaching Materials

Name	Type (Developed/Existing)	Link	Role in the lesson
Presentation "AI Waste Classifier"	pptx	AI Waste Classifier – Smart Recycling with Artificial.pptx	Main
Assessment Criteria	docx	Teacher Guide — Assessment Criteria.docx	Main
Link to AI tool	Tool	Teachable Machine	Main
Reflection template	docx	Reflection sheet - AI Waste Classifier.docx	Main

12. External Resources and References

Resource (name)	Link (external or to the folder on Teams)
EU Environment: Waste & Recycling	Waste and recycling - Environment - European Commission
Teachable Machine by Google	https://youtu.be/T2qQGqZxkD0
European Commission. (2023). Waste management in the EU.	Waste Framework Directive - Environment - European Commission
UNESCO. (2018). Issues and trends in education for sustainable development	Issues and trends in education for sustainable development - UNESCO Digital Library