D4.4 Implementation of R8: Digital Learning Materials

Related WP4

Virtualware

Report

Public

Reviewers: ENG, BCN, SGI

Version	Date	Description of main changes	Author
V0	30/11/2018	First version	Virtualware
V1	31/01/2019	Mobile games updates	Virtualware
V3	11/02/2019	Digital Project updates	Virtualware
V4	10/04/2019	Global revision and Analytics	Virtualware
V5	28/05/2019	Reviewers' input	Virtualware

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Executive summary

This document describes the work done under Task 4.2 Learning materials within WP4 CREATION OF INNOVATIVE SOCIAL ACTIONS which main responsible is Virtualware with the contribution and help of Fundación DEUSTO, ZAMUDIOko Udala, National Technical University of Athens - NTUA, University of PATRAS and Agencia d'ecologia Urbana de Barcelona (BCN) partners.

The main objective of this task is

O4.2. Design innovative learning methods to foster the empowerment of citizen and stakeholder (Result R8).

For this purpose, the envisaged materials to be developed are:

- 6 digital project scenarios
- 4 digital STEAM lessons
- 4 mobile location-based games

This deliverable contains final educational materials describing;

The 6 Digital Projects and 4 Mobiles Games.

In previous deliverable - D4.3 Implementation of R8: STEAM Lessons – 4 STEAM Lessons were released with associated Digital Projects: Digital Project 1 and Digital Project 2, about "Waste Prevention and Reuse" and "Source Separation and Recycling" respectively.

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Glossary

CEPM: Circular Economy Planning Module

Digital Project or DP: A sequence of teaching units and activities with the aim of acquiring a series of specific skills and knowledge based on using technology as a learning facilitation tool, contents and online references to reinforce knowledge and free digital tools for the creation of new contents. With a double objective; on one hand, allowing to know how to look for information from reliable sources to improve knowledge about different subjects and on the other hand, learning how to use this information and the information generated by each person to create new quality content

Mobile Game or MG: A mobile game is a game designed for mobile devices, such as smartphones, feature phones, pocket PCs, personal digital assistants (PDA), tablet PCs and portable media players. Mobile games range from basic (like Snake on older Nokia phones) to sophisticated (3D and augmented reality games).

STEAM: A variation of STEM (science, technology, engineering and maths) is STEAM, which includes an 'A' for art and design. The arts animate learning because they are inherently experiential and because of their potential to develop creative and critical thinking skills in students. Artistic design is becoming an important part of STEM education since creativity is an essential part of innovation. Many STEM lessons involve building models and simulating situations. A good STEM lesson ensures that students understand the connection to the real world. This way, STEM learning materials evolve to STEAM lessons (STEM plus arts).

USW: urban solid waste

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1 Introduction

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The work performed in this task is directly related with WP1, WP2 (T2.4- Long Term Planning and T2.5 - Incentive System Planner to Foster Circular Economy) and WP4 (T4.1 - Generation of the pilots' social programme.). On the other hand, information provided in deliverables D1.1- Pilots Planning documentation, D1.3 – Sustainability Assessment Models, D2.7- Technical Documentation of R3: Planning Module; D2.10 - Implementation of R4: Circular Economy Planning Module and D4.1 - Implementation of R17: Non ICT Innovative Social Actions - is a value added input for the work to be performed in this task.

The objective of WP4 is to develop contents and innovative methodologies to foster behavioural changes in waste producers, according to the objectives and goals of the project.

In this context, one of the foreseen outcome deliverables are:

- D4.3 Implementation of R8: STEAM Lessons
- D4.4 Implementation of R8: Digital Learning Materials

The main objective of these materials is - O4.2. Design innovative learning methods to foster the empowerment of citizen and stakeholder (Result R8).

These materials have been developed during the T4.2 Digital learning materials, outcomes are divided in the following way:

- 6 digital project scenarios
- 4 digital STEAM lessons
- 4 mobile location-based games

This deliverable contains final educational materials describing the six Digital Projects and the four Mobiles Games.

In previous deliverable - D4.3 Implementation of R8: STEAM Lessons – 4 STEAM Lessons were released with associated Digital Projects: Digital Project 1 and Digital Project 2, about "Waste Prevention and Reuse" and "Source Separation and Recycling" respectively.

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2 Digital Project scenarios

Digital project scenarios are one of the main outcomes of the task T4.2 Digital learning materials. They are based in innovative learning methods to foster the empowerment of citizen and stakeholder. They have a project idea, plan, outcome, and a description of all the steps to complete the project.

2.1 Digital Project Repositories

The digital project scenarios are, apart from described in this deliverable, also available in the project web page http://waste4think.eu/ecosolutions and in the next open teaching and learning material repositories:

- **Scientix**: Scientix promotes and supports a Europe-wide collaboration among STEM (science, technology, engineering and maths) teachers, education researchers, policymakers and other STEM education professionals. http://www.scientix.eu/

- **OER Commons**: Open Educational Resources (OER) are teaching and learning materials that you may freely use and reuse at no cost, and without needing to ask permission. Unlike copyrighted resources, OER have been authored or created by an individual or organization that chooses to retain few, if any, ownership rights. https://www.oercommons.org/

Materials	Scientix	OER COMMONS
Digital project 1	http://www.scientix.eu/resources/details?resourceId=23044	https://www.oercommons.org/courseware/module/43658
Digital project 2	http://www.scientix.eu/resources/details?resourceId=23045	https://www.oercommons.org/courseware/module/43659
Digital project 3	http://www.scientix.eu/resources/details?resourceId=23040	https://www.oercommons.org/courseware/module/43660
Digital project 4	http://www.scientix.eu/resources/details?resourceId=23041	https://www.oercommons.org/courseware/module/51092
Digital project 5	http://www.scientix.eu/resources/details?resourceId=23042	https://www.oercommons.org/courseware/module/51093
Digital project 6	http://www.scientix.eu/resources/details?resourceId=23043	https://www.oercommons.org/courseware/module/51094

Table 1. Digital project links to open repositories

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2.2 Digital project 1

DIGITAL PROJECT 1

NAME	**After the concert**
AGE GROUP	**Basic Education (primary and secondary)**
MAIN SUBJECT	**Prevention & waste reuse**
PROJECT DESCRIPTION	Detective game. There is a big party at the village. You went down to the main square to participate in a theatre workshop that is organized in this time period. When you arrive, you find a lot of "garbage". The workshop has been cancelled. You and your group of friends have decided to investigate and solve this case. As the good detective you are, you should: **Analyse the "crime" scenario** **Collect clues and look for the guilty ones** **Identify how it could have been avoided** **Look for solutions** **Communicate what has happened to other citizens**
DURATION	**6 HOURS**

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RESOURCES	• Work scenario 1: Internet connection available: Internet connection, paper or PDF materials. • Work scenario 2: There is no internet connection: Materials on paper, photocopies, cardboards, scissors, markers and glue.
WORKING METHODOLOGY	Work by projects. Inductive thinking. Propose a hypothesis, analysis and presentation of results. Team work.  **3 TEAM MEMBERS**
SPECIFIC OBJECTIVES	• Being able to search and correctly recognize the basic terminology on waste and its management. • Identifying people as the origin of the generation and management of urban solid waste (USW). • Acquiring the necessary knowledge for the correct identification and classification of USW. • Developing the analysis capacity to identify the necessary resources for the correct management of USW in your city. • Being able to devise, search, present, identify preventive measures that reduce waste.
GENERAL COMPETENCES	• Competence for verbal, non-verbal and digital communication. • Mathematics, Science and Technology. • Digital competence. • Initiative and entrepreneurial spirit. • Learn to learn.
CONTENTS	• Basic terminology on waste and its management. • Prevention measures in the generation of MSW. • Identification and classification of waste. • Identification of necessary resources for the management of RSU.

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	• Appropriate waste management for the generation of quality resources • People as agents of change.

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EVALUATION CRITERIA TRANSVERSAL BASIC COMPETENCES	

	• Communicating in a mother tongue and foreign language (EU). Competence for verbal, non-verbal communication.
	  ○ Know how to communicate
	  ○ Communicate, orally and in writing, with fluency, autonomy, creativity and effectiveness.
	  ○ Use, in an integrated and harmonious way, the basic codes of body language, arts and maths.
	  ○ Interpret, in a critical way, the socio-communicative reality of the society and the world and participate responsibly and with an ethical sense in the communicative processes of its context.
	
	• Digital competence (EU). Competence for digital communication.
	  ○ Interpret and evaluate, in a critical way, the messages of the social media.
	  ○ Use ICT resources appropriately, effectively and responsibly, for designing and planning a task, managing information, creating digital productions, cooperating and communicating results.
	
	• Learning to learn (EU). Competence to learn to learn and to think.
	  ○ Search select and record information from various sources (printed, oral, audio-visual, digital ...).
	  ○ Understand and memorize information (comprehensive thinking).
	  ○ Interpret and evaluate information (critical thinking).
	  ○ Create and select ideas (creative thinking)
	  ○ Use cognitive resources strategically, mobilizing and transferring learning to other situations.
	
	• Social and civic competences (EU). Competences to live together.
	  ○ combining the satisfaction of their own and others' desires, assertively expressing their own feelings, thoughts and desires, while actively listening and considering the feelings, thoughts and desires of others.
	  ○ Learn and work in groups, assuming their responsibilities and acting cooperatively in the tasks of common objective, recognizing the richness of the diversity of people and opinions.
	  ○ Behaving in accordance with the ethical principles that derive from human rights and in accordance with social norms that derive from the basic social conventions for coexistence.

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	○ Find a solution to conflicts, through dialogue and negotiation. • Sense of initiative and entrepreneurship (EU). Competence for initiative and entrepreneurship. ○ Generation of new ideas and solutions and suggesting alternatives to improve reality with a critical spirit, solidarity and from social responsibility. ○ Execute the planned actions and adjust when necessary. ○ Evaluate the actions carried out and make suggestions for improvement.
EVALUATION CRITERIA. BASIC DISCIPLINARY COMPETENCES	• Communicating in a mother tongue and foreign language (EU). Competence in linguistic and literary communication. ○ including oral and written texts, in different supports, of different genre from the fields of use of interpersonal relationships, media, learning. Recognizing the global meaning and selects the information relevant to the proposed objective. ○ Producing, in a guided way, oral or written texts, in different supports. Belonging to areas of use such as interpersonal relationships, media, learning. ○ Participating in the interactive situations of the classroom and in the centre, respecting the rules of communicative exchange. ○ Using ICT in a guided manner in the recovery, selection, processing and communication of information to answer to the needs of the activity. • Mathematical, scientific and technological competence (EU). Mathematical competence ○ Developing and cultivating appropriate personal attitudes inherent to the mathematical task in the search for solutions to research and problems. Identifying and posing simple problems of daily life that can be solved using different mathematical contents. ○ Solving and formulating simple problems related to objects, facts and situations of daily life, selecting the operations and using the corresponding basic algorithms or

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	other resolution procedures, including calculator, and orally expressing the process carried out. ○ Solving open problematic situations and simple mathematical investigations and small work projects on numbers, calculations, measurements and geometry, using different strategies, collaborating • Mathematical, scientific and technological competence (EU). Scientific competence Natural Sciences. ○ Performing with the help of a script, research and field or laboratory practices applying the scientific methodology, assessing its execution and interpreting its results. ○ Applying strategies of scientific work in the realization of tasks and projects. ○ Using digital tools and Internet to manage information and create new content. ○ Linking scientific ideas with technological advances and in other fields, recognizing that they allow an improvement in the quality of life. ○ Suggesting, from examples of daily life, some of the main uses that people make of natural resources, pointing out advantages and disadvantages and making proposals for their conservation. • Mathematical, scientific and technological competence (EU). Technological competence Technology. ○ Accessing services for the exchange and publication of digital information under criteria of security, privacy and responsible use. ○ Preparing and publishing contents on the web that integrate textual, numerical, sound and graphic information adequately. • Social and civic competences (EU). Social and civic competence ○ Obtaining relevant and concrete information about facts or phenomena previously delimited, using different sources, both direct and indirect. ○ Developing responsibility, effort, perseverance and reflection on the learning process itself. ○ Value group work, showing attitudes of cooperation and responsible participation, accepting differences and tolerating the ideas and contributions of others in the dialogues and debates. ○ Developing creativity and entrepreneurial spirit, increasing the capacities and competences to using multiple information to obtain innovative conclusions in different situations.

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	○ Making a responsible use of nature's assets, contributing to preserving the environment by understanding and interpreting events, analysing causes and predicting consequences. ○ • Cultural awareness and expression (EU). Consciousness and cultural expression ○ Applying in visual and musical productions, techniques and resources appropriately to their own needs for expression and communication, arguing the reason for the choice.
EVALUATION METHODOLOGY	Rules for self-evaluation, individual and / or group evaluation.
STEAM	**STEAM 1** **WHAT HAS HAPPENED?** HYPOTHESIS: Analysis of a situation. Acquisition of knowledge in a targeted manner (basic concepts on urban waste). DESCRIPTION: The village is having a great party. You go down to the main square to participate in the theatre workshops that are organized. When you arrive you find a lot of "garbage". The workshops have been cancelled. You and your group of friends have decided to investigate and solve this case. DETECTIVE GAME What happened? Who has been responsible for this disaster? How can we prevent it from happening again? ASSOCIATED SUBJECTS: waste as a resource, planning and prevention, separation and management for the generation of quality resources.

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MATERIALS

Material 1

Could this situation have been avoided?

PREVENTION: Analysis of the situation. Starting from data available, think and decide mechanisms to prevent this situation.

How could it have been avoided? What resources are necessary? Exploration, resources to manage, ideas to reduce, quantify.

DESCRIPTION: Research team has compiled all the necessary clues, it seems that among them are the clear evidences of the crime and who the suspicious persons could be.

How this situation could have been avoided?

Work in groups of 3 people

ASSOCIATED CONCEPTS: Prevention in waste generation.

Material 2

How can we fix it?

MANAGEMENT. The waste must be properly managed in order to recover the celebration in the main square.

DESCRIPTION: The research team, together with a neighbourhood group, separates waste and makes decisions about what to do with

them. Will waste be thrown into the container? Will it be given a new life? Which are the main factors to take a decision?

ASSOCIATED CONCEPTS: Waste separation, identification of necessary resources, resources vs waste ... quantification of generated waste.

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	# Material 3 **How can we avoid it to happen again?** ACTION. Report what has happened, using real data from the researched performed and the measures taken is a good way to prevent it from happening again. Take a step forward for awareness. Create an awareness campaign for the agents identified as main key players. ASSOCIATED CONCEPTS: Types of waste, prevention and management actions. Responsibilities.
MOBILE GAME	# MOBILE GAME 1 **0WASTE** Use the mobile game from de Waste4Think project called 0Waste to reinforce the classification concepts and compare the type of recycling and amount of it among the students. • Android: https://play.google.com/store/apps/details?id=com.virtualware.w4tzerowaste • iOS: https://itunes.apple.com/es/app/zero-waste/id1448990110?mt=8

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	PC: https://virtualwaregroup-my.sharepoint.com/:f:/p/mmadarieta/Euq7nBZY9P1BntszLLNrz70BZSwNd8JTBaOyWXWGSNBnXw?e=gxjOk8 # MOBILE GAME 4 ## WASTEQUEST Use the mobile game from de Waste4Think project called WasteQuest to work with dilemmas related with your municipality and try to solve them in teams. • Android: https://play.google.com/store/apps/details?id=com.virtualware.w4tgymkhana • iOS: https://itunes.apple.com/es/app/wastequest/id1455327407 • PC: not available
SERIOUS GAME	# SERIOUS GAME 3 ## VIRTUAL CITY Use the serious game from de Waste4Think project called Virtual City to reinforce the concepts. **Recommended for high school.** # SERIOUS GAME 4 ## MAYOR'S TABLE Use the serious game from de Waste4Think project called Mayor's Table to reinforce the concepts. **Recommended for secondary school**

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APPS	**APP 1-2** **CITIZEN AND LOCAL TRADE APP** Use the app from de Waste4Think project called Citizen and Local Trade to reinforce the concepts. **APP 3** **FOOD WASTE APP** Use the app from de Waste4Think project called Food Waste to reinforce the concepts.

Table 2. Digital Project 1

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2.3 Digital project 2

DIGITAL PROJECT 2

NAME	**Where is Wastey?**
AGE GROUP	**Basic Education (primary and secondary)**
MAIN SUBJECT	**WASTE SEPARATION AND RECYCLING**
PROJECT DESCRIPTION	Looking for the Treasure (the resources in the waste). You have just arrived at your classroom and realized that the trash can is overturned and there are remains of food on the floor. It seems that an animal has entered in the class. You and your group of friends have decided to investigate and look for it. As a highly skilled researcher, you must; **Analyse the scenario** **Collect tracks** **Identify how it could have been avoided** **Look for solutions** **Share/Communicate what happened**
DURATION	**6 HOURS**

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	Distributed in 3 weeks' time
RESOURCES	• Work scenario 1: Internet connection available: Internet connection, paper or PDF materials. • Work scenario 2: There is no internet connection: Materials on paper, photocopies, cardboards, scissors, markers and glue.
WORKING METHODOLOGY	Work by projects. Inductive thinking. Propose a hypothesis, analysis and presentation of results. Team work.  **3 TEAM MEMBERS**
SPECIFIC OBJECTIVES	• Being able to search and correctly recognize accumulated resources in the classroom or school • Identifying people as the origin of the generation and management of urban solid waste • Acquiring the necessary knowledge for the correct identification and classification of USW at the origin, as a first step for further good quality recycling • Internalize the concept of prioritization reducing, reusing and recycling in the circular economy • Developing the capacity to analyse and extract data from generated / managed waste in an approximate manner • Developing the analysis capacity of analyse to identify the necessary resources for the t management of USW in your city • Being able to create ideas, search, present and identify preventive measures for waste reduction • Being able to identify the value of the resources generated in the classroom
GENERAL COMPETENCES	• Competence for verbal, non-verbal and digital communication • Mathematics, Science and Technology • Digital competence • Initiative and entrepreneurial spirit • Learn to learn
CONTENTS	• Introduction: What is food waste?

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	• Monitoring of generated waste • Prevention measures in the generation of USW • People as agents of change

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EVALUATION CRITERIA TRANSVERSAL BASIC COMPETENCES	

- Communicating in a mother tongue and foreign language (EU). Competence for verbal, non-verbal communication.
    - Know how to communicate
    - Communicate, orally and in writing, with fluency, autonomy, creativity and effectiveness.
    - Use, in an integrated and harmonious way, the basic codes of body language, arts and maths.
    - Interpret, in a critical way, the socio-communicative reality of the society and the world and participate responsibly and with an ethical sense in the communicative processes of its context.

- Digital competence (EU). Competence for digital communication.
    - Interpret and evaluate, in a critical way, the messages of the social media.
    - Use ICT resources appropriately, effectively and responsibly, for designing and planning a task, managing information, creating digital productions, cooperating and communicating results.

- Learning to learn (EU). Competence to learn to learn and to think.
    - Search select and record information from various sources (printed, oral, audio-visual, digital ...).
    - Understand and memorize information (comprehensive thinking).
    - Interpret and evaluate information (critical thinking).
    - Create and select ideas (creative thinking)
    - Use cognitive resources strategically, mobilizing and transferring learning to other situations.

- Social and civic competences (EU). Competences to live together.
    - combining the satisfaction of their own and others' desires, assertively expressing their own feelings, thoughts and desires, while actively listening and considering the feelings, thoughts and desires of others.
    - Learn and work in groups, assuming their responsibilities and acting cooperatively in the tasks of common objective, recognizing the richness of the diversity of people and opinions.
    - Behaving in accordance with the ethical principles that derive from human rights and in accordance with social norms that derive from the basic social conventions for coexistence.

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	○ Find a solution to conflicts, through dialogue and negotiation. • Sense of initiative and entrepreneurship (EU). Competence for initiative and entrepreneurship. ○ Generation of new ideas and solutions and suggesting alternatives to improve reality with a critical spirit, solidarity and from social responsibility. ○ Execute the planned actions and adjust when necessary. ○ Evaluate the actions carried out and make suggestions for improvement.
EVALUATION CRITERIA. BASIC DISCIPLINARY COMPETENCES	• Communicating in a mother tongue and foreign language (EU). Competence in linguistic and literary communication. ○ including oral and written texts, in different supports, of different genre from the fields of use of interpersonal relationships, media, learning. Recognizing the global meaning and selects the information relevant to the proposed objective. ○ Producing, in a guided way, oral or written texts, in different supports. Belonging to areas of use such as interpersonal relationships, media, learning. ○ Participating in the interactive situations of the classroom and in the centre, respecting the rules of communicative exchange. ○ Using ICT in a guided manner in the recovery, selection, processing and communication of information to answer to the needs of the activity. • Mathematical, scientific and technological competence (EU). Mathematical competence ○ Developing and cultivating appropriate personal attitudes inherent to the mathematical task in the search for solutions to research and problems. Identifying and posing simple problems of daily life that can be solved using different mathematical contents. ○ Solving and formulating simple problems related to objects, facts and situations of daily life, selecting the operations and using the corresponding basic algorithms or other resolution procedures, including calculator, and orally expressing the process carried out. ○ Solving open problematic situations and simple mathematical investigations and small work projects on numbers, calculations, measurements and geometry, using different strategies, collaborating

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	• Mathematical, scientific and technological competence (EU). Scientific competence Natural Sciences.
	  ○ Performing with the help of a script, research and field or laboratory practices applying the scientific methodology, assessing its execution and interpreting its results.
	  ○ Applying strategies of scientific work in the realization of tasks and projects.
	  ○ Using digital tools and Internet to manage information and create new content.
	  ○ Linking scientific ideas with technological advances and in other fields, recognizing that they allow an improvement in the quality of life.
	  ○ Suggesting, from examples of daily life, some of the main uses that people make of natural resources, pointing out advantages and disadvantages and making proposals for their conservation.
	
	• Mathematical, scientific and technological competence (EU). Technological competence Technology.
	  ○ Accessing services for the exchange and publication of digital information under criteria of security, privacy and responsible use.
	  ○ Preparing and publishing contents on the web that integrate textual, numerical, sound and graphic information adequately.
	
	• Social and civic competences (EU). Social and civic competence
	  ○ Obtaining relevant and concrete information about facts or phenomena previously delimited, using different sources, both direct and indirect.
	  ○ Developing responsibility, effort, perseverance and reflection on the learning process itself.
	  ○ Value group work, showing attitudes of cooperation and responsible participation, accepting differences and tolerating the ideas and contributions of others in the dialogues and debates.
	  ○ Developing creativity and entrepreneurial spirit, increasing the capacities and competences to using multiple information to obtain innovative conclusions in different situations.
	  ○ Making a responsible use of nature's assets, contributing to preserving the environment by understanding and interpreting events, analysing causes and predicting consequences.

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	• Cultural awareness and expression (EU). Consciousness and cultural expression ○ Applying in visual and musical productions, techniques and resources appropriately to their own needs for expression and communication, arguing the reason for the choice.
EVALUATION METHODOLOGY	RULES FOR SELF-EVALUATION, INDIVIDUAL AND / OR GROUP EVALUATION.
STEAM	**STEAM 1** **WHAT HAS HAPPENED?** HYPOTHESIS: Analysis of a situation. DESCRIPTION: You have arrived to your class-room and you realize that the trash can is overturned and there are remains of food on the floor. It seems like an animal has entered in. You and your group of friends have decided to investigate and look for the animal. LOOKING FOR THE TREASURE What has happened? Work in groups of 3 or 5 people Generate the hypothesis based on real data. Select the best method for data collection. Identify if a correct waste management is carried out or not

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STEAM 2

HOW CAN THE GUILTY BEING FOUND?

DATA COLLECTION AND PROCESSING: Where is the animal who made this disaster? What resources are necessary? Exploration,
resources to manage, ideas to obtain data and quantify them. Resources to collect the method and being able to reproduce it.

DESCRIPTION:

It seems that the animal hides in the waste. We cannot empty the bins and neither put your hand in them. The animal could be scared and get aggressive.
We will have to find out where he is. To do that information about which is the standard weigh of bins is necessary and detect if any change of weight has happend.
How do we collect this data? What elements are needed? Remember to record, collect, write down and explain the method used.
Work in groups of 3 or 5 people

The idea is to think about how weight data can be collected (i.e. empty bins, filled up and so on, using different types of scales, sensors, etc..).

Properly write down and explain the working process followed (data capture of each type of bin, use of spreadsheet, formulas, tables, units of measurement, generation forecast, etc.) and (video of the execution, documentation, presentation, others.).

In addition, the hidden animal can be a stone, or a heavy element decorated in certain way that moves along the different classrooms participating in the project following a pattern (every week is in a different classroom, but following a logical movement prefixed by teachers: i.e. even week in an even classroom and odd week in an odd one).

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STEAM 3

WHICH INFORMATION IS SHOWN BY THE CLUES?

CONCLUSIONS AND DEBATE: Based on data obtained, get conclusions about generation in the classroom / hall / course. Where is waste generated? When is more / less waste generated? Which type of waste or resources (treasures) is generated? Is there valuable anything that cannot be reused?

Work in groups of 3 - 5 people.

As generation data are available, link them to concepts of prevention and reuse as well as separation at source for the correct waste recovery.

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MATERIALS	# MATERIAL 4 **Presentation of the working process followed and results discussion** ACTION: Create a graphical/text material that shows up the global path and the results obtained. Suggest actions or commitments of each group to improve individual and classroom / or plant management. Work in groups of 3 or 5 people. Summarize in a presentation the method used, the tools and resources, the conclusions and suggest improvements.
MOBILE GAME	# MOBILE GAME 1 **0WASTE** Use the mobile game from de Waste4Think project called 0Waste to reinforce the classification concepts and compare the type of recycling and amount of it among the students. • Android: https://play.google.com/store/apps/details?id=com.virtualware.w4tzerowaste • iOS: https://itunes.apple.com/es/app/zero-waste/id1448990110?mt=8

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PC: https://virtualwaregroup-my.sharepoint.com/:f:/p/mmadarieta/Euq7nBZY9P1BntszLLNrz70BZSwNd8JTBaOyWXWGSNBnXw?e=gxjOk8

MOBILE GAME 3

TREASURE MACHINE

Use the mobile game from de Waste4Think project called Treasure Machine to work with concepts related with waste valorisation.

- Android: https://play.google.com/store/apps/details?id=com.virtualware.w4tTreasureMachine
- iOS: https://itunes.apple.com/es/app/treasure-machine/id1447500492?mt=8
- PC: https://virtualwaregroup-my.sharepoint.com/:f:/p/mmadarieta/EjoAMtGadClFqiNl2lrVTkkB-jk_-kEr7HmJuTu3__XQDA?e=XEB7ji

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SERIOUS GAME	**SERIOUS GAME 1** **WASTE2SORT** Use the serious game from de Waste4Think project called Waste2Sort to reinforce the concepts. **SERIOUS GAME 3** **VIRTUAL CITY** Use the serious game from de Waste4Think project called Virtual City to reinforce the concepts. **Recommended for high school.** **SERIOUS GAME 4** **MAYOR'S TABLE** Use the serious game from de Waste4Think project called Mayor's Table to reinforce the concepts. **Recommended for secondary school**
APPS	**APP 1-2** **CITIZEN AND LOCAL TRADE APP** Use the app from de Waste4Think project called Citizen and Local Trade to reinforce the concepts associated to waste management.

Table 3. Digital Project 2

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2.4 Digital project 3

DIGITAL PROJECT 3

NAME	**Get ready for composting**
AGE GROUP	**Basic Education (primary and secondary)**
MAIN SUBJECT	**HOME COMPOST/FOOD WASTE**
PROJECT DESCRIPTION	Alphabet Game A set of experiences to learn about the composting process and the recovery of food waste. **Composting** **Food waste**
DURATION	 **6 HOURS** Distributed in 3 weeks' time
RESOURCES	• Work scenario 1: Internet connection available: Internet connection, paper or PDF materials. • Work scenario 2: There is no internet connection: Materials on paper, photocopies, cardboards, scissors, markers and glue.
WORKING METHODOLOGY	Work by projects. Inductive thinking. Propose a hypothesis, analysis and presentation of results. Team work.

WASTE 4think

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	 3 TEAM MEMBERS
SPECIFIC OBJECTIVES	• Be able to know different composting systems • Identify the elements that can be used to make a good compost • Acquire the necessary knowledge to make a good compost • To develop the analytical capacity to identify the resources necessary for the correct management of composting
GENERAL COMPETENCES	• Competence for verbal, non-verbal and digital communication • Mathematics, Science and Technology • Digital competence • Initiative and entrepreneurial spirit • Learn to learn
CONTENTS	• Compost • Food waste • Compost quality and problems • People as agents of change

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EVALUATION CRITERIA TRANSVERSAL BASIC COMPETENCES	• Communicating in a mother tongue and foreign language (EU). Competence for verbal, non-verbal communication. 1. Know how to communicate 2. Communicate, orally and in writing, with fluency, autonomy, creativity and effectiveness. 3. Use, in an integrated and harmonious way, the basic codes of body language, arts and maths. 4. Interpret, in a critical way, the socio-communicative reality of the society and the world and participate responsibly and with an ethical sense in the communicative processes of its context. • Digital competence (EU). Competence for digital communication. 1. Interpret and evaluate, in a critical way, the messages of the social media. 2. Use ICT resources appropriately, effectively and responsibly, for designing and planning a task, managing information, creating digital productions, cooperating and communicating results. • Learning to learn (EU). Competence to learn to learn and to think. 1. Search select and record information from various sources (printed, oral, audio-visual, digital ...). 2. Understand and memorize information (comprehensive thinking). 3. Interpret and evaluate information (critical thinking). 4. Create and select ideas (creative thinking) 5. Use cognitive resources strategically, mobilizing and transferring learning to other situations. • Social and civic competences (EU). Competences to live together. 1. combining the satisfaction of their own and others' desires, assertively expressing their own feelings, thoughts and desires, while actively listening and considering the feelings, thoughts and desires of others. 2. Learn and work in groups, assuming their responsibilities and acting cooperatively in the tasks of common objective, recognizing the richness of the diversity of people and opinions. 3. Behaving in accordance with the ethical principles that derive from human rights and in accordance with social norms that derive from the basic social conventions for coexistence.

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	4. Find a solution to conflicts, through dialogue and negotiation. • Sense of initiative and entrepreneurship (EU). Competence for initiative and entrepreneurship. 1. Generation of new ideas and solutions and suggesting alternatives to improve reality with a critical spirit, solidarity and from social responsibility. 2. Execute the planned actions and adjust when necessary. 3. Evaluate the actions carried out and make suggestions for improvement.

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EVALUATION CRITERIA. BASIC DISCIPLINARY COMPETENCES	• Communicating in a mother tongue and foreign language (EU). Competence in linguistic and literary communication. 1. including oral and written texts, in different supports, of different genre from the fields of use of interpersonal relationships, media, learning. Recognizing the global meaning and selects the information relevant to the proposed objective. 2. Producing, in a guided way, oral or written texts, in different supports. Belonging to areas of use such as interpersonal relationships, media, learning. 3. Participating in the interactive situations of the classroom and in the centre, respecting the rules of communicative exchange. 4. Using ICT in a guided manner in the recovery, selection, processing and communication of information to answer to the needs of the activity. • Mathematical, scientific and technological competence (EU). Mathematical competence 1. Developing and cultivating appropriate personal attitudes inherent to the mathematical task in the search for solutions to research and problems. Identifying and posing simple problems of daily life that can be solved using different mathematical contents. 2. Solving and formulating simple problems related to objects, facts and situations of daily life, selecting the operations and using the corresponding basic algorithms or other resolution procedures, including calculator, and orally expressing the process carried out. 3. Solving open problematic situations and simple mathematical investigations and small work projects on numbers, calculations, measurements and geometry, using different strategies, collaborating

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	• Mathematical, scientific and technological competence (EU). Scientific competence Natural Sciences. 1. Performing with the help of a script, research and field or laboratory practices applying the scientific methodology, assessing its execution and interpreting its results. 2. Applying strategies of scientific work in the realization of tasks and projects. 3. Using digital tools and Internet to manage information and create new content. 4. Linking scientific ideas with technological advances and in other fields, recognizing that they allow an improvement in the quality of life. 5. Suggesting, from examples of daily life, some of the main uses that people make of natural resources, pointing out advantages and disadvantages and making proposals for their conservation. • Mathematical, scientific and technological competence (EU). Technological competence Technology. 1. Accessing services for the exchange and publication of digital information under criteria of security, privacy and responsible use. 2. Preparing and publishing contents on the web that integrate textual, numerical, sound and graphic information adequately. • Social and civic competences (EU). Social and civic competence 1. Obtaining relevant and concrete information about facts or phenomena previously delimited, using different sources, both direct and indirect. 2. Developing responsibility, effort, perseverance and reflection on the learning process itself. 3. Value group work, showing attitudes of cooperation and responsible participation, accepting differences and tolerating the ideas and contributions of others in the dialogues and debates. 4. Developing creativity and entrepreneurial spirit, increasing the capacities and competences to using multiple information to obtain innovative conclusions in different situations. 5. Making a responsible use of nature's assets, contributing to preserving the environment by understanding and interpreting events, analysing causes and predicting consequences.

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	• Cultural awareness and expression (EU). Consciousness and cultural expression 1. Applying in visual and musical productions, techniques and resources appropriately to their own needs for expression and communication, arguing the reason for the choice.
EVALUATION METHODOLOGY	RULES FOR SELF-EVALUATION, INDIVIDUAL AND / OR GROUP EVALUATION.
LEARNING EXPERIENCES	**EXPERIENCE 1** **Mobile Game Sunflower** **Experience:** Know the composting process by using the Mobile Game, called Sunflower. **Teacher:** Use the MG sunflower in different platforms (smartphone, Tablet, PC) to know how it works and decide which one to use and how to apply it in the classroom. Use the user manual to understand its functionality. https://virtualwaregroup-my.sharepoint.com/:f:/p/mmadarieta/EkjwSThYSdlPip90lLGFTuAByfeYDyYx6iEt1wDccZQi8Q?e=SNzLTj **Evaluation:** Evaluation survey. https://docs.google.com/forms/d/e/1FAIpQLSdqUp9c6Wr-9JRJWQ3gxMlwN2E73EIdfMCMpBy0B8SmRcjOgg/viewform?usp=sf_link

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EXPERIENCE 2

Mobile Game 0Waste

Experience:

Know the food waste generated according to the data collected through the Mobile Game, called 0Waste. Using household and community data capture, compare the different waste generated and the difference of the different captures (at home, in the municipality, in the community), drawing conclusions.

Teacher:

Use the MG 0Waste in different platforms (smartphone, Tablet, PC) to know how it works and decide which one to use and how to apply it in the classroom. Use the user manual to understand its functionality.

https://virtualwaregroup-my.sharepoint.com/:f:/p/mmadarieta/Euq7nBZY9P1BntszLLNrz70BZSwNd8JTBaOyWXWGSNBnXw?e=ciQCHz

Evaluation:

Evaluation survey.

https://docs.google.com/forms/d/e/1FAIpQLSePvnr9KBhfrk4MimbhKnrQEHK2ATMX_v3SiJkgfsIDjK0row/viewform?usp=sf_link

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EXPERIENCE 3

Compost process

Experience:

Using the materials suggested below for teachers about composting and organizing participants into groups and depending on whether or not composter is available CREATE AN USER MANUAL.

If a composter is available:

- What is the procedure?
- Who manages it? What tasks do they perform? Why?
- What do you put in the composter? What don't you put?
- How much compost is generated per month, quarter, year?
- How long does it take to generate compost? What is done with it? What are its benefits?
- What happens with the temperature?
- What is the evolution of the humidity?
- When do “bugs” appear?

If you do not have a composter

- Which composter would be right for the community? Where would we locate it?
- Which procedure would be appropriate?
- Who would manage it? What tasks will they perform? Why?
- What is put in the composting plant? What is not put?
- What amount of compost is expected to be generated per month, quarter, year, taking into account the volume of waste we have?

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- What will be done with the compost generated? What are its benefits?

Teacher:

Create a user manual of the process used in the composter o in an imaginary composter.

Some examples:

http://www4.gipuzkoa.net/medioambiente/compostaje/down/Manual_compostaje.pdf

http://lezo.eus/sites/default/files/ikastaroalezo2014.pdf

http://www.ondarroa.eus/PublishingImages/gida.pdf

http://www.fao.org/3/a-i3388s.pdf

Use one or two of these videos, or similar ones to introduce the compost concept, depending on the age of the students

- Greek https://www.youtube.com/watch?v=JD4_UCeYqAM&feature=youtu.be
- Euskera https://www.youtube.com/watch?v=dM74tdn0os0
- https://www.youtube.com/watch?v=Q5s4n9r-JGU
- https://www.youtube.com/watch?v=dRXNo7Ieky8
- https://www.youtube.com/watch?v=TjnNOCbuoCA
- Story/poesy https://www.youtube.com/watch?v=mQvzuIiEsB4
- Peppa Pig https://www.youtube.com/watch?v=8PElbErayZg

Evaluation:

Auto evaluation survey.

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EXPERIENCE 4

Alphabet game

Experience:

Using the referenced material on composting, or searching the concepts on Internet, organise into groups, create an alphabet game and play it in teams

Teacher:

Decide which concepts will be part of the game: Compost phases, compost microorganisms, chemical issues, compostable and non-compostable elements.

Use the manual created in the previous experience or other manuals, such as next ones, to obtain the concepts:

http://www4.gipuzkoa.net/medioambiente/compostaje/down/Manual_compostaje.pdf

http://lezo.eus/sites/default/files/ikastaroalezo2014.pdf

http://www.ondarroa.eus/PublishingImages/gida.pdf

http://www.fao.org/3/a-i3388s.pdf

Use online tools to create the alphabet game or Spy Scape Game:

English https://www.educaplay.com/en/gallery/alphabet_game.htm

Spanish http://formadorestic.com/pasapalabra/indice.html

Scrach https://www.youtube.com/watch?v=vQfVa1Q5HbE

Examples: https://scratch.mit.edu/projects/3000559/

https://scratch.mit.edu/projects/38091982/

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Genially https://www.genial.ly/en

https://www.youtube.com/watch?v=fAeIcem_4mQ

https://geniallysupport.zendesk.com/hc/en-us/articles/360007787932-Editing-Spy-Escape-Game

Use one or two of these videos, or similar ones to introduce the compost concept, depending on the age of the students

- Greek https://www.youtube.com/watch?v=JD4_UCeYqAM&feature=youtu.be
- Euskera https://www.youtube.com/watch?v=dM74tdn0os0
- https://www.youtube.com/watch?v=Q5s4n9r-JGU
- https://www.youtube.com/watch?v=dRXNo7Ieky8
- https://www.youtube.com/watch?v=TjnNOCbuoCA
- Story/poesy https://www.youtube.com/watch?v=mQvzuIiEsB4
- Peppa Pig https://www.youtube.com/watch?v=8PElbErayZg

Evaluation:

Auto evaluation survey. (Annex)

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MOBILE GAME

MOBILE GAME 1

0WASTE

Use the mobile game from de Waste4Think project called 0Waste to reinforce the classification concepts and compare the type of recycling and amount of it among the students.

- Android: https://play.google.com/store/apps/details?id=com.virtualware.w4tzerowaste
- iOS: https://itunes.apple.com/es/app/zero-waste/id1448990110?mt=8

PC: https://virtualwaregroup-my.sharepoint.com/:f:/p/mmadarieta/Euq7nBZY9P1BntszLLNrz70BZSwNd8JTBaOyWXWGSNBnXw?e=gxjOk8

MOBILE GAME 2

SUNFLOWER

Use the mobile game from de Waste4Think project called Sunflower to work with concepts related with compost.

- Android: https://play.google.com/store/apps/details?id=com.virtualware.w4tsunflower
- iOS: https://itunes.apple.com/es/app/sunflower/id1448876219?mt=8
- PC: https://virtualwaregroup-my.sharepoint.com/:f:/p/mmadarieta/EkjwSThYSdlPip90lLGFTuAByfeYDyYx6iEt1wDccZQi8Q?e=Pap8wU

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	# MOBILE GAME 4 ### WASTEQUEST Use the mobile game from de Waste4Think project called WasteQuest to work with dilemmas related with your municipality and try to solve them in teams. • Android: https://play.google.com/store/apps/details?id=com.virtualware.w4tgymkhana • iOS: https://itunes.apple.com/es/app/wastequest/id1455327407 • PC: not available
SERIOUS GAME	# SERIOUS GAME 3 ### VIRTUAL CITY Use the serious game from de Waste4Think project called Virtual City to reinforce the concepts. **Recommended for high school.** # SERIOUS GAME 4 ### MAYOR'S TABLE Use the serious game from de Waste4Think project called Mayor's Table to reinforce the concepts. **Recommended for secondary school**

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APPS	**APP 3** **Food waste** Use the app from de Waste4Think project called Food Waste to reinforce the concepts.

Table 4. Digital Project 3

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2.5 Digital project 4

DIGITAL PROJECT 4

NAME	**Product life cycle**
AGE GROUP	**Basic Education (primary and secondary)**
MAIN SUBJECT	**PRODUCT LIFE CYCLE**
PROJECT DESCRIPTION	Set of **experiences** to know the life cycle of the different products
DURATION	**6 HOURS** Distributed in 3 weeks' time
RESOURCES	• Work scenario 1: Internet connection available: Internet connection, paper or PDF materials. • Work scenario 2: There is no internet connection: Materials on paper, photocopies, cardboards, scissors, markers and glue.
WORKING METHODOLOGY	Work by projects. Inductive thinking. Propose a hypothesis, analysis and presentation of results. Team work.

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	 **3 TEAM MEMBERS**
SPECIFIC OBJECTIVES	• Identify the value of waste for moving its definition from waste to resource. • Understand the importance of a good sorting at the origin to improve the way the society look to the resource management system. • Show the real value of the "waste".
GENERAL COMPETENCES	• Competence for verbal, non-verbal and digital communication • Mathematics, Science and Technology • Digital competence • Initiative and entrepreneurial spirit • Learn to learn
CONTENTS	• Waste as a resource • Product life cycle • Know how product life cycle • New product generation from “waste” elements • Eco-design • People as agents of change • Circular economy

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EVALUATION CRITERIA TRANSVERSAL BASIC COMPETENCES	

	• Communicating in a mother tongue and foreign language (EU). Competence for verbal, non-verbal communication.
	  ○ Know how to communicate
	  ○ Communicate, orally and in writing, with fluency, autonomy, creativity and effectiveness.
	  ○ Use, in an integrated and harmonious way, the basic codes of body language, arts and maths.
	  ○ Interpret, in a critical way, the socio-communicative reality of the society and the world and participate responsibly and with an ethical sense in the communicative processes of its context.
	
	• Digital competence (EU). Competence for digital communication.
	  ○ Interpret and evaluate, in a critical way, the messages of the social media.
	  ○ Use ICT resources appropriately, effectively and responsibly, for designing and planning a task, managing information, creating digital productions, cooperating and communicating results.
	
	• Learning to learn (EU). Competence to learn to learn and to think.
	  ○ Search select and record information from various sources (printed, oral, audio-visual, digital ...).
	  ○ Understand and memorize information (comprehensive thinking).
	  ○ Interpret and evaluate information (critical thinking).
	  ○ Create and select ideas (creative thinking)
	  ○ Use cognitive resources strategically, mobilizing and transferring learning to other situations.
	
	• Social and civic competences (EU). Competences to live together.
	  ○ combining the satisfaction of their own and others' desires, assertively expressing their own feelings, thoughts and desires, while actively listening and considering the feelings, thoughts and desires of others.
	  ○ Learn and work in groups, assuming their responsibilities and acting cooperatively in the tasks of common objective, recognizing the richness of the diversity of people and opinions.
	  ○ Behaving in accordance with the ethical principles that derive from human rights and in accordance with social norms that derive from the basic social conventions for coexistence.

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	○ Find a solution to conflicts, through dialogue and negotiation. • Sense of initiative and entrepreneurship (EU). Competence for initiative and entrepreneurship. ○ Generation of new ideas and solutions and suggesting alternatives to improve reality with a critical spirit, solidarity and from social responsibility. ○ Execute the planned actions and adjust when necessary. ○ Evaluate the actions carried out and make suggestions for improvement.
EVALUATION CRITERIA. BASIC DISCIPLINARY COMPETENCES	• Communicating in a mother tongue and foreign language (EU). Competence in linguistic and literary communication. ○ including oral and written texts, in different supports, of different genre from the fields of use of interpersonal relationships, media, learning. Recognizing the global meaning and selects the information relevant to the proposed objective. ○ Producing, in a guided way, oral or written texts, in different supports. Belonging to areas of use such as interpersonal relationships, media, learning. ○ Participating in the interactive situations of the classroom and in the centre, respecting the rules of communicative exchange. ○ Using ICT in a guided manner in the recovery, selection, processing and communication of information to answer to the needs of the activity. • Mathematical, scientific and technological competence (EU). Mathematical competence ○ Developing and cultivating appropriate personal attitudes inherent to the mathematical task in the search for solutions to research and problems. Identifying and posing simple problems of daily life that can be solved using different mathematical contents. ○ Solving and formulating simple problems related to objects, facts and situations of daily life, selecting the operations and using the corresponding basic algorithms or other resolution procedures, including calculator, and orally expressing the process carried out. ○ Solving open problematic situations and simple mathematical investigations and small work projects on numbers, calculations, measurements and geometry, using different strategies, collaborating

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	• Mathematical, scientific and technological competence (EU). Scientific competence Natural Sciences.
	  ○ Performing with the help of a script, research and field or laboratory practices applying the scientific methodology, assessing its execution and interpreting its results.
	  ○ Applying strategies of scientific work in the realization of tasks and projects.
	  ○ Using digital tools and Internet to manage information and create new content.
	  ○ Linking scientific ideas with technological advances and in other fields, recognizing that they allow an improvement in the quality of life.
	  ○ Suggesting, from examples of daily life, some of the main uses that people make of natural resources, pointing out advantages and disadvantages and making proposals for their conservation.
	
	• Mathematical, scientific and technological competence (EU). Technological competence Technology.
	  ○ Accessing services for the exchange and publication of digital information under criteria of security, privacy and responsible use.
	  ○ Preparing and publishing contents on the web that integrate textual, numerical, sound and graphic information adequately.
	
	• Social and civic competences (EU). Social and civic competence
	  ○ Obtaining relevant and concrete information about facts or phenomena previously delimited, using different sources, both direct and indirect.
	  ○ Developing responsibility, effort, perseverance and reflection on the learning process itself.
	  ○ Value group work, showing attitudes of cooperation and responsible participation, accepting differences and tolerating the ideas and contributions of others in the dialogues and debates.
	  ○ Developing creativity and entrepreneurial spirit, increasing the capacities and competences to using multiple information to obtain innovative conclusions in different situations.
	  ○ Making a responsible use of nature's assets, contributing to preserving the environment by understanding and interpreting events, analysing causes and predicting consequences.

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	• Cultural awareness and expression (EU). Consciousness and cultural expression ○ Applying in visual and musical productions, techniques and resources appropriately to their own needs for expression and communication, arguing the reason for the choice.
EVALUATION METHODOLOGY	RULES FOR SELF-EVALUATION, INDIVIDUAL AND / OR GROUP EVALUATION.

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LEARNING EXPERIENCES

EXPERIENCE 1

Treasure market

Experience:

Using elements considered as waste, create new elements with value an organize a market to sell them.

Teacher:

Determine the common criteria to create the new elements, for example the source of the waste elements (home, school, other) and the characteristics that the new elements must have: a new use or be usable and give them an economical value (if you would buy, how much would it cost?) Organize the market with the students deciding when, how and what to do with the collected money. Investigate second hand online webtools or apps.

Some examples to inspire teachers or students:

- https://www.youtube.com/watch?v=MW39e4r1IEA
- https://www.youtube.com/watch?v=XXTnJtSPdZI
- https://www.youtube.com/watch?v=ZQxJ1yyTI5Q

Evaluation:

Auto evaluation survey. (Annex)

EXPERIENCE 2

Visit a valorisation centre

Experience:

Visit in your country, municipality or region a valorisation centre.

Important! Don't visit a treatment of residual waste. Specially visit those related to reuse or the ones for preparation for reuse

Teacher:

Determine the centre to visit and organize the trip.

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	Some examples to inspire teachers: • http://www.koopera.org/ • http://garbiker.bizkaia.eus/es/ • http://www.zabalgarbi.com/es/

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EXPERIENCE 3

0Waste

Experience:

Know the waste generated according to the data collected through the Mobile Game, called 0Waste. Using household and community data capture, compare the different waste generated and the difference of the different captures (at home, in the municipality, in the community), drawing conclusions.

Teacher:

Use the MG 0Waste in different platforms (smartphone, Tablet, PC) to know how it works and decide which one to use and how to apply it in the classroom. Use the user manual to understand its functionality.

https://virtualwaregroup-my.sharepoint.com/:f:/p/mmadarieta/Euq7nBZY9P1BntszLLNrz70BZSwNd8JTBaOyWXWGSNBnXw?e=ciQCHz

Evaluation:

Evaluation survey.

https://docs.google.com/forms/d/e/1FAIpQLSePvnr9KBhfrk4MimbhKnrQEHK2ATMX_v3SiJkgfslDjK0row/viewform?usp=sf_link

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MOBILE GAME

MOBILE GAME 1

0WASTE

Use the mobile game from de Waste4Think project called 0Waste to reinforce the classification concepts and compare the type of recycling and amount of it among the students.

- Android: https://play.google.com/store/apps/details?id=com.virtualware.w4tzerowaste
- iOS: https://itunes.apple.com/es/app/zero-waste/id1448990110?mt=8

PC: https://virtualwaregroup-my.sharepoint.com/:f:/p/mmadarieta/Euq7nBZY9P1BntszLLNrz70BZSwNd8JTBaOyWXWGSNBnXw?e=gxjOk8

MOBILE GAME 3

TREASURE MACHINE

Use the mobile game from de Waste4Think project called Treasure Machine to work with concepts related with waste valorisation.

- Android: https://play.google.com/store/apps/details?id=com.virtualware.w4tTreasureMachine
- iOS: https://itunes.apple.com/es/app/treasure-machine/id1447500492?mt=8
- PC: https://virtualwaregroup-my.sharepoint.com/:f:/p/mmadarieta/EjoAMtGadClFqiNl2lrVTkkB-jk_-kEr7HmJuTu3__XQDA?e=XEB7ji

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	# MOBILE GAME 4 ### WASTEQUEST Use the mobile game from de Waste4Think project called WasteQuest to work with dilemmas related with your municipality and try to solve them in teams. • Android: https://play.google.com/store/apps/details?id=com.virtualware.w4tgymkhana • iOS: https://itunes.apple.com/es/app/wastequest/id1455327407 • PC: not available
SERIOUS GAME	# SERIOUS GAME 2 ### Eco-design Game Use the serious game from de Waste4Think project called Waste2Sort to reinforce the concepts. **Recommended for last level of secondary school** # SERIOUS GAME 3 ### VIRTUAL CITY Use the serious game from de Waste4Think project called Virtual City to reinforce the concepts. **Recommended for high school.**

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APPS	**APP 1-2** **CITIZEN AND LOCAL TRADE APP** Use the app from de Waste4Think project called Citizen and Local Trade to reinforce the concepts. **APP 3** **LOCAL TRADE** Use the app from de Waste4Think project called Citizen and Local Trade to reinforce the concepts.

Table 5. Digital Project 4

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement 688995

2.6 Digital project 5

DIGITAL PROJECT 5

NAME	**PAYT Pay as you throw**
AGE GROUP	**Basic Education (primary and secondary)**
MAIN SUBJECT	**PAYT**
PROJECT DESCRIPTION	Set of **experiences** to know the concept of PAYT
DURATION	**6 HOURS** Distributed in 3 weeks' time
RESOURCES	• Work scenario 1: Internet connection available: Internet connection, paper or PDF materials. • Work scenario 2: There is no internet connection: Materials on paper, photocopies, cardboards, scissors, markers and glue.
WORKING METHODOLOGY	Work by projects. Inductive thinking. Propose a hypothesis, analysis and presentation of results. Team work.

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	 **3 TEAM MEMBERS**
SPECIFIC OBJECTIVES	• Know the economic cost of each stage of waste management • Identify the waste tax system • Know the PAYT system
GENERAL COMPETENCES	• Competence for verbal, non-verbal and digital communication • Mathematics, Science and Technology • Digital competence • Initiative and entrepreneurial spirit • Learn to learn
CONTENTS	• PAYT • Waste taxes • Revenue • Collection cost • Treatment cost • People as agents of change

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement 688995

EVALUATION CRITERIA TRANSVERSAL BASIC COMPETENCES	

	• Communicating in a mother tongue and foreign language (EU). Competence for verbal, non-verbal communication.
	  ○ Know how to communicate
	  ○ Communicate, orally and in writing, with fluency, autonomy, creativity and effectiveness.
	  ○ Use, in an integrated and harmonious way, the basic codes of body language, arts and maths.
	  ○ Interpret, in a critical way, the socio-communicative reality of the society and the world and participate responsibly and with an ethical sense in the communicative processes of its context.
	
	• Digital competence (EU). Competence for digital communication.
	  ○ Interpret and evaluate, in a critical way, the messages of the social media.
	  ○ Use ICT resources appropriately, effectively and responsibly, for designing and planning a task, managing information, creating digital productions, cooperating and communicating results.
	
	• Learning to learn (EU). Competence to learn to learn and to think.
	  ○ Search select and record information from various sources (printed, oral, audio-visual, digital ...).
	  ○ Understand and memorize information (comprehensive thinking).
	  ○ Interpret and evaluate information (critical thinking).
	  ○ Create and select ideas (creative thinking)
	  ○ Use cognitive resources strategically, mobilizing and transferring learning to other situations.
	
	• Social and civic competences (EU). Competences to live together.
	  ○ combining the satisfaction of their own and others' desires, assertively expressing their own feelings, thoughts and desires, while actively listening and considering the feelings, thoughts and desires of others.
	  ○ Learn and work in groups, assuming their responsibilities and acting cooperatively in the tasks of common objective, recognizing the richness of the diversity of people and opinions.
	  ○ Behaving in accordance with the ethical principles that derive from human rights and in accordance with social norms that derive from the basic social conventions for coexistence.

WASTE 4think

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	○ Find a solution to conflicts, through dialogue and negotiation. • Sense of initiative and entrepreneurship (EU). Competence for initiative and entrepreneurship. ○ Generation of new ideas and solutions and suggesting alternatives to improve reality with a critical spirit, solidarity and from social responsibility. ○ Execute the planned actions and adjust when necessary. ○ Evaluate the actions carried out and make suggestions for improvement.
EVALUATION CRITERIA. BASIC DISCIPLINARY COMPETENCES	• Communicating in a mother tongue and foreign language (EU). Competence in linguistic and literary communication. ○ including oral and written texts, in different supports, of different genre from the fields of use of interpersonal relationships, media, learning. Recognizing the global meaning and selects the information relevant to the proposed objective. ○ Producing, in a guided way, oral or written texts, in different supports. Belonging to areas of use such as interpersonal relationships, media, learning. ○ Participating in the interactive situations of the classroom and in the centre, respecting the rules of communicative exchange. ○ Using ICT in a guided manner in the recovery, selection, processing and communication of information to answer to the needs of the activity. • Mathematical, scientific and technological competence (EU). Mathematical competence ○ Developing and cultivating appropriate personal attitudes inherent to the mathematical task in the search for solutions to research and problems. Identifying and posing simple problems of daily life that can be solved using different mathematical contents. ○ Solving and formulating simple problems related to objects, facts and situations of daily life, selecting the operations and using the corresponding basic algorithms or other resolution procedures, including calculator, and orally expressing the process carried out. ○ Solving open problematic situations and simple mathematical investigations and small work projects on numbers, calculations, measurements and geometry, using different strategies, collaborating

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	• Mathematical, scientific and technological competence (EU). Scientific competence Natural Sciences.
	  ○ Performing with the help of a script, research and field or laboratory practices applying the scientific methodology, assessing its execution and interpreting its results.
	  ○ Applying strategies of scientific work in the realization of tasks and projects.
	  ○ Using digital tools and Internet to manage information and create new content.
	  ○ Linking scientific ideas with technological advances and in other fields, recognizing that they allow an improvement in the quality of life.
	  ○ Suggesting, from examples of daily life, some of the main uses that people make of natural resources, pointing out advantages and disadvantages and making proposals for their conservation.
	
	• Mathematical, scientific and technological competence (EU). Technological competence Technology.
	  ○ Accessing services for the exchange and publication of digital information under criteria of security, privacy and responsible use.
	  ○ Preparing and publishing contents on the web that integrate textual, numerical, sound and graphic information adequately.
	
	• Social and civic competences (EU). Social and civic competence
	  ○ Obtaining relevant and concrete information about facts or phenomena previously delimited, using different sources, both direct and indirect.
	  ○ Developing responsibility, effort, perseverance and reflection on the learning process itself.
	  ○ Value group work, showing attitudes of cooperation and responsible participation, accepting differences and tolerating the ideas and contributions of others in the dialogues and debates.
	  ○ Developing creativity and entrepreneurial spirit, increasing the capacities and competences to using multiple information to obtain innovative conclusions in different situations.
	  ○ Making a responsible use of nature's assets, contributing to preserving the environment by understanding and interpreting events, analysing causes and predicting consequences.

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	• Cultural awareness and expression (EU). Consciousness and cultural expression ○ Applying in visual and musical productions, techniques and resources appropriately to their own needs for expression and communication, arguing the reason for the choice.
EVALUATION METHODOLOGY	RULES FOR SELF-EVALUATION, INDIVIDUAL AND / OR GROUP EVALUATION.
LEARNING EXPERIENCES	**EXPERIENCE 1** **PAYT** **Experience:** Using the 0Waste mobile game or other tracking system, collect information individually or in teams to monitor the waste generation. Analise the data and decide who must pay more and why. Try to reduce the generation and as a consequence, the amount of taxes. **Teacher:** Organize the experience regarding the 3 weeks' time: Previously, research about the waste collection scheme in the municipality to configure the app. Afterwards: 1. Week: Start collecting data of waste generation individually or in teams. Analyse in teams and present different types of waste payment, taking into account the municipalities one. Decide which one would apply to the classroom teams and

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	calculate each team waste generation cost. Make a ranking of the teams according the waste generation and the economic issues. Information: • http://web.bizkaia.eus/es/web/educacion-tributaria/impuestos • http://www.zamudio.eus/es-ES/Ayuntamiento/Ordenanzas-Reglamentos/Paginas/Ordenanzasfiscales2017.aspx • https://www.interregeurope.eu/policylearning/news/550/pay-as-you-throw-schemes-increase-recycling-rates/ 2. Week: continue monitoring the waste generated and its cost, regarding the payment system defined. Define actions to reduce the generation and analyse its impact in the payment. 3. Week: continue monitoring the waste generated after applying zero waste activities decided to use and compare with previous weeks. Make a new ranking of the teams according the waste generation and the economic issues. Each week update the ranking and exchange recommendations and tricks in order to reduce the amount of taxes payed. **Evaluation:** Auto evaluation survey.
MOBILE GAME	# MOBILE GAME 1 ## 0WASTE Use the mobile game from de Waste4Think project called 0Waste to reinforce the classification concepts and compare the type of recycling and amount of it among the students. • Android: https://play.google.com/store/apps/details?id=com.virtualware.w4tzerowaste • iOS: https://itunes.apple.com/es/app/zero-waste/id1448990110?mt=8

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PC: https://virtualwaregroup-my.sharepoint.com/:f:/p/mmadarieta/Euq7nBZY9P1BntszLLNrz70BZSwNd8JTBaOyWXWGSNBnXw?e=gxjOk8

MOBILE GAME 3

TREASURE MACHINE

Use the mobile game from de Waste4Think project called Treasure Machine to work with concepts related with waste valorisation.

- Android: https://play.google.com/store/apps/details?id=com.virtualware.w4tTreasureMachine
- iOS: https://itunes.apple.com/es/app/treasure-machine/id1447500492?mt=8
- PC: https://virtualwaregroup-my.sharepoint.com/:f:/p/mmadarieta/EjoAMtGadClFqiNl2lrVTkkB-jk_-kEr7HmJuTu3__XQDA?e=XEB7ji

MOBILE GAME 4

WASTEQUEST

Use the mobile game from de Waste4Think project called WasteQuest to work with dilemmas related with your municipality and try to solve them in teams.

- Android: https://play.google.com/store/apps/details?id=com.virtualware.w4tgymkhana
- iOS: https://itunes.apple.com/es/app/wastequest/id1455327407
- PC: not available

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SERIOUS GAME	**SERIOUS GAME 2** **Eco-design Game** Use the serious game from de Waste4Think project called Waste2Sort to reinforce the concepts. **Recommended for last level of secondary school** **SERIOUS GAME 3** **VIRTUAL CITY** Use the serious game from de Waste4Think project called Virtual City to reinforce the concepts. **Recommended for high school.**
APPS	**APP 1-2** **CITIZEN AND LOCAL TRADE APP** Use the app from de Waste4Think project called Citizen and Local Trade to reinforce the concepts. **APP 3** **LOCAL TRADE** Use the app from de Waste4Think project called Citizen and Local Trade to reinforce the concepts.

Table 6. Digital Project 5

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2.7 Digital project 6

DIGITAL PROJECT 6

NAME	**ZERO WASTE**
AGE GROUP	**Basic Education (primary and secondary)**
MAIN SUBJECT	**ZERO WASTE**
PROJECT DESCRIPTION	Set of **experiences** to know the concept of zero waste
DURATION	**6 HOURS** Distributed in 3 weeks' time
RESOURCES	• Work scenario 1: Internet connection available: Internet connection, paper or PDF materials. • Work scenario 2: There is no internet connection: Materials on paper, photocopies, cardboards, scissors, markers and glue.
WORKING METHODOLOGY	Work by projects. Inductive thinking. Propose a hypothesis, analysis and presentation of results. Team work.

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	 **3 TEAM MEMBERS**
SPECIFIC OBJECTIVES	• Know Zero waste concept • Prevention, reuse • Identify zero-waste ecosystems
GENERAL COMPETENCES	• Competence for verbal, non-verbal and digital communication • Mathematics, Science and Technology • Digital competence • Initiative and entrepreneurial spirit • Learn to learn
CONTENTS	• Zero waste • Zero waste ecosystem • Prevention • Reuse • People as agents of change

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EVALUATION CRITERIA TRANSVERSAL BASIC COMPETENCES	

	• Communicating in a mother tongue and foreign language (EU). Competence for verbal, non-verbal communication.
	  ○ Know how to communicate
	  ○ Communicate, orally and in writing, with fluency, autonomy, creativity and effectiveness.
	  ○ Use, in an integrated and harmonious way, the basic codes of body language, arts and maths.
	  ○ Interpret, in a critical way, the socio-communicative reality of the society and the world and participate responsibly and with an ethical sense in the communicative processes of its context.
	
	• Digital competence (EU). Competence for digital communication.
	  ○ Interpret and evaluate, in a critical way, the messages of the social media.
	  ○ Use ICT resources appropriately, effectively and responsibly, for designing and planning a task, managing information, creating digital productions, cooperating and communicating results.
	
	• Learning to learn (EU). Competence to learn to learn and to think.
	  ○ Search select and record information from various sources (printed, oral, audio-visual, digital ...).
	  ○ Understand and memorize information (comprehensive thinking).
	  ○ Interpret and evaluate information (critical thinking).
	  ○ Create and select ideas (creative thinking)
	  ○ Use cognitive resources strategically, mobilizing and transferring learning to other situations.
	
	• Social and civic competences (EU). Competences to live together.
	  ○ combining the satisfaction of their own and others' desires, assertively expressing their own feelings, thoughts and desires, while actively listening and considering the feelings, thoughts and desires of others.
	  ○ Learn and work in groups, assuming their responsibilities and acting cooperatively in the tasks of common objective, recognizing the richness of the diversity of people and opinions.
	  ○ Behaving in accordance with the ethical principles that derive from human rights and in accordance with social norms that derive from the basic social conventions for coexistence.

WASTE 4think

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	○ Find a solution to conflicts, through dialogue and negotiation. • Sense of initiative and entrepreneurship (EU). Competence for initiative and entrepreneurship. ○ Generation of new ideas and solutions and suggesting alternatives to improve reality with a critical spirit, solidarity and from social responsibility. ○ Execute the planned actions and adjust when necessary. ○ Evaluate the actions carried out and make suggestions for improvement.
EVALUATION CRITERIA. BASIC DISCIPLINARY COMPETENCES	• Communicating in a mother tongue and foreign language (EU). Competence in linguistic and literary communication. ○ including oral and written texts, in different supports, of different genre from the fields of use of interpersonal relationships, media, learning. Recognizing the global meaning and selects the information relevant to the proposed objective. ○ Producing, in a guided way, oral or written texts, in different supports. Belonging to areas of use such as interpersonal relationships, media, learning. ○ Participating in the interactive situations of the classroom and in the centre, respecting the rules of communicative exchange. ○ Using ICT in a guided manner in the recovery, selection, processing and communication of information to answer to the needs of the activity. • Mathematical, scientific and technological competence (EU). Mathematical competence ○ Developing and cultivating appropriate personal attitudes inherent to the mathematical task in the search for solutions to research and problems. Identifying and posing simple problems of daily life that can be solved using different mathematical contents. ○ Solving and formulating simple problems related to objects, facts and situations of daily life, selecting the operations and using the corresponding basic algorithms or other resolution procedures, including calculator, and orally expressing the process carried out. ○ Solving open problematic situations and simple mathematical investigations and small work projects on numbers, calculations, measurements and geometry, using different strategies, collaborating

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	• Mathematical, scientific and technological competence (EU). Scientific competence Natural Sciences.
	  ○ Performing with the help of a script, research and field or laboratory practices applying the scientific methodology, assessing its execution and interpreting its results.
	  ○ Applying strategies of scientific work in the realization of tasks and projects.
	  ○ Using digital tools and Internet to manage information and create new content.
	  ○ Linking scientific ideas with technological advances and in other fields, recognizing that they allow an improvement in the quality of life.
	  ○ Suggesting, from examples of daily life, some of the main uses that people make of natural resources, pointing out advantages and disadvantages and making proposals for their conservation.
	
	• Mathematical, scientific and technological competence (EU). Technological competence Technology.
	  ○ Accessing services for the exchange and publication of digital information under criteria of security, privacy and responsible use.
	  ○ Preparing and publishing contents on the web that integrate textual, numerical, sound and graphic information adequately.
	
	• Social and civic competences (EU). Social and civic competence
	  ○ Obtaining relevant and concrete information about facts or phenomena previously delimited, using different sources, both direct and indirect.
	  ○ Developing responsibility, effort, perseverance and reflection on the learning process itself.
	  ○ Value group work, showing attitudes of cooperation and responsible participation, accepting differences and tolerating the ideas and contributions of others in the dialogues and debates.
	  ○ Developing creativity and entrepreneurial spirit, increasing the capacities and competences to using multiple information to obtain innovative conclusions in different situations.
	  ○ Making a responsible use of nature's assets, contributing to preserving the environment by understanding and interpreting events, analysing causes and predicting consequences.

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	• Cultural awareness and expression (EU). Consciousness and cultural expression ○ Applying in visual and musical productions, techniques and resources appropriately to their own needs for expression and communication, arguing the reason for the choice.
EVALUATION METHODOLOGY	RULES FOR SELF-EVALUATION, INDIVIDUAL AND / OR GROUP EVALUATION.

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LEARNING EXPERIENCES

EXPERIENCE 1

Zero waste ecosystem

Experience:

Using the 0Waste mobile game or other tracking system, collect information individually or in teams to monitor the waste generation. Analise the data and decide how to try to reduce the generation.

Teacher:

Organize the experience regarding the 3 weeks' time:

1. Week: Start collecting data of waste generation individually or in teams. Make a ranking of the teams according the waste generation.
2. Week: continue monitoring the waste generated. Analise zero waste activities or recommendations and decide which ones use to reduce the generated waste.
3. Week: continue monitoring the waste generated after applying zero waste activities decided to use and compare with previous weeks. Make a new ranking of the teams according the waste generation and the economic issues.

Each week update the ranking and exchange recommendations and tricks in order to reach a zero-waste ecosystem

Evaluation:

Auto evaluation survey.

EXPERIENCE 2

Visit a zero-waste ecosystem

Experience:

Visit in your country, municipality or region a cero waste ecosystem.

Teacher:

Determine the ecosystem to visit and organize the trip.

Some examples to inspire teachers:

- https://www.youtube.com/user/ZeroWasteHome
- https://www.youtube.com/watch?v=Em_wyEe9pHY

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EXPERIENCE 3

Mobile Game 0Waste

Experience:

Know the waste generated according to the data collected through the Mobile Game, called 0Waste. Using household and community data capture, compare the different waste generated and the difference of the different captures (at home, in the municipality, in the community), drawing conclusions.

Teacher:

Use the MG 0Waste in different platforms (smartphone, Tablet, PC) to know how it works and decide which one to use and how to apply it in the classroom. Use the user manual to understand its functionality.

https://virtualwaregroup-my.sharepoint.com/:f:/p/mmadarieta/Euq7nBZY9P1BntszLLNrz70BZSwNd8JTBaOyWXWGSNBnXw?e=ciQCHz

Evaluation:

Evaluation survey.

https://docs.google.com/forms/d/e/1FAIpQLSePvnr9KBhfrk4MimbhKnrQEHK2ATMX_v3SiJkgfslDjK0row/viewform?usp=sf_link

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MOBILE GAME

MOBILE GAME 1

0WASTE

Use the mobile game from de Waste4Think project called 0Waste to reinforce the classification concepts and compare the type of recycling and amount of it among the students.

- Android: https://play.google.com/store/apps/details?id=com.virtualware.w4tzerowaste
- iOS: https://itunes.apple.com/es/app/zero-waste/id1448990110?mt=8

PC: https://virtualwaregroup-my.sharepoint.com/:f:/p/mmadarieta/Euq7nBZY9P1BntszLLNrz70BZSwNd8JTBaOyWXWGSNBnXw?e=gxjOk8

MOBILE GAME 3

TREASURE MACHINE

Use the mobile game from de Waste4Think project called Treasure Machine to work with concepts related with waste valorisation.

- Android: https://play.google.com/store/apps/details?id=com.virtualware.w4tTreasureMachine
- iOS: https://itunes.apple.com/es/app/treasure-machine/id1447500492?mt=8
- PC: https://virtualwaregroup-my.sharepoint.com/:f:/p/mmadarieta/EjoAMtGadClFqiNl2lrVTkkB-jk_-kEr7HmJuTu3__XQDA?e=XEB7ji

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	# MOBILE GAME 4 ### WASTEQUEST Use the mobile game from de Waste4Think project called WasteQuest to work with dilemmas related with your municipality and try to solve them in teams. • Android: https://play.google.com/store/apps/details?id=com.virtualware.w4tgymkhana • iOS: https://itunes.apple.com/es/app/wastequest/id1455327407 • PC: not available
SERIOUS GAME	# SERIOUS GAME 2 ### Eco-design Game Use the serious game from de Waste4Think project called Waste2Sort to reinforce the concepts. **Recommended for last level of secondary school** # SERIOUS GAME 3 ### VIRTUAL CITY Use the serious game from de Waste4Think project called Virtual City to reinforce the concepts. **Recommended for high school.**

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APPS	
	APP 1-2 **CITIZEN AND LOCAL TRADE APP** Use the app from de Waste4Think project called Citizen and Local Trade to reinforce the concepts. **APP 3** **LOCAL TRADE** Use the app from de Waste4Think project called Citizen and Local Trade to reinforce the concepts.

Table 7. Digital Project 6

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2.8 Connection with the FIWARE Back-End

The learning materials have as input data information from Fiware.

Each pilot school can use the data collected and get from the architecture to compare the main indicators (Generation, Collection, Treatment, etc.) in the schools with the ones of the municipality and obtain conclusion with the students. The specific data to use in the Digital Project activities depends of the location, schools could use the ones reported by the system.

Regarding the implementation of the Digital project, as well for the rest of the digital materials, is especially relevant the link to the Social Actions developed (or under developing) in Zamudio and Halandri Pilot. There is a double link in this case; on one hand, the messages and activities students can receive in the municipality to promote a change in habits regarding food waste, light packaging prevention, PAYT, etc. usually received with their families and in an out-of-school context; on the other hand, the messages and changes "lived" in their schools, improving school waste generation and separate collection. Digital projects are consistent with both.

2.9 Waste4think key project indicators (KPI)

General Key Project Indicators (KPIs) are valuable information for the learning material. They provide main parameters about waste management to be transmitted to children in educational activities to be performed via learning materials.

As mentioned in D2.9, for ensuring that the CEPM is effective, it is necessary to update Key Project Indicators (KPIs). These indicators act as a measurement tool for the responsible of municipal waste management or the business manager/entrepreneur/researcher to assess how well the CEPM service is doing in the context of a CE, allowing their companies/ municipalities to estimate how advanced they are on their journey from linear to circular.

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In the D1.3 Sustainable Assessment Models, the KPIs that the CEPM will use have been defined, as follows:

Generation (for each Waste Collection Circuit (WCC))	T.1.2 Annual generation rate (kg/inhab /year)
Collection (for each Waste Collection Circuit (WCC))	T.2.3 Total gross separate collection (%)
	T.2.4 Total net separate collection (%)
Treatment for each Waste Collection Circuit (WCC)	T.3.1 Primary waste destination (kg)
	T.3.2 Dry recyclables to primary destination (%)
	T.3.3 Organic recyclables to primary destination (%)
	T.3.4 Residual waste to primary destination (%)
	T.3.5 Destination recycling (DREC) (%)
GHG emissions (total)	E.1.1 net GHG emissions (kg CO2/ kg of waste) collection & treatment
Management costs (total)	C.1.2 Treatment gate fee (€/ton)
	C.1.3.1 Collection and Transport cost (€)
	C.1.3.2 Total waste management cost (€)
Social impact	S.2.1 Number of workers (n)

Table 8. Circular Economy Module KPIs (D1.3 – Table 5)

These values obtained via the FIWARE Back-End are used as input data in the Learning materials. However, Digital project lessons are a paper-based material and therefore, will not be linked with Fiware platform automatically. The input data to work with in the Digital project lessons will be obtained from the public observatory web page.

At the same time, when these values are calculated, the incidence of the Learning materials will also be considered (as described in the next point – Digital project monitoring). For example, to measure if doing these activities influences school members and their family's behaviour or feed the system with the data obtained from the Learning materials use.

2.10 Digital Project monitoring

The learning materials have as output a set of defined KPI to measure their educational effectiveness. The educational Contents/ Learning material will also be input information for Fiware platform to indicate the results of the educational effectiveness of the material generated in each pilot site (Zamudio/Halandri).

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A set of 9 output KPIs have been selected to measure the impact according to usability aspects of the Digital Materials (DIGITAL KPIs) and enhancing learning process (Educational KPIs) by using these materials.

KPI	MEASURED FEATURE
DIGITAL KPI	1. Easy to use - USE 2. Easy to install programs and add-ons - INSTALL 3. Didactic Versatility: modifiable, levels, adjustments and reports - VERSATIL 4. Running execution - EXECUTION
EDUCATIONAL KPI	**5. Didactic Effectiveness, easy to achieve of objectives - EFFECTIVENESS** **6. Ability to Motivate - MOTIVATE** **7. Adaptation of the contents to the target groups - TARGET** **8. Promote self-learning - SELFLEARNING** 9. **Facilitate cooperative work – COOPERATIVE**

Table 9. Digital and Educational KPI

In the context of Digital Projects only educational KPIs can be applied, because DPs are non-ICT educational materials.

2.10.1 Educational KPI definition

2.10.1.1 Didactic Effectiveness, easy to achieve of objectives

1.- DIDACTIC EFFECTIVENESS, EASY TO ACHIEVE OF OBJECTIVES	
1 GENERAL DESCRIPTION	
VARIABLE	EDUCATIONAL
STAGE	OVERALL
TYPE	INDIRECT
2 CALCULATION METHODOLOGY	
DEFINITION	"Didactic Effectiveness, easy to achieve of objectives" refers to measure the efficacity of the Educational contents generated in Task 4.2 Learning materials with properly didactic sessions.
FORMULA	Rate from 1 to 5. 1: low – 5 excellent
STANDARDIZED METHODOLOGY	Questionnaire to teachers
UNIT OF MEASURE	Subjective opinion
PROCEDURE	The moment to measure is when the application is finished

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PERIODICITY	2 testing periods: - After first release - When the final version is ready		
3 OBSERVATIONS			
PRELIMINARY INDICATORS	IA	**PRELIMINARY INDICATORS**	IA
It is compulsory to measure at least at the end of the period of app development			

Table 10. Educational KPI 5 - EFFECTIVENESS

2.10.1.2 Ability to Motivate

2.- ABILITY TO MOTIVATE	
1 GENERAL DESCRIPTION	
VARIABLE	EDUCATIONAL
STAGE	OVERALL
TYPE	INDIRECT
2 CALCULATION METHODOLOGY	
DEFINITION	"Ability to Motivate" refers to the "engaiment" generated by the Educational content in Task 4.2 Learning materials.
FORMULA	Rate from 1 to 5. 1: low – 5 excellent
STANDARDIZED METHODOLOGY	Questionnaire to teachers
UNIT OF MEASURE	Subjective opinión
PROCEDURE	The moment to measure is when the application is finished
PERIODICITY	2 testing periods: - After first release - When the final version is ready
3 OBSERVATIONS	

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PRELIMINARY INDICATORS	IA	**PRELIMINARY INDICATORS**	IA
It is compulsory to measure at least at the end of the period of app development			

Table 11. Educational KPI 6 - MOTIVATE

2.10.1.3 Adaptation of the contents to the target groups

3.- ADAPTATION OF THE CONTENTS TO THE TARGET GROUPS			
1 GENERAL DESCRIPTION			
VARIABLE	EDUCATIONAL		
STAGE	OVERALL		
TYPE	INDIRECT		
2 CALCULATION METHODOLOGY			
DEFINITION	"Adaptation of the contents to the target groups of the contents" refers to have Educational content in Task 4.2 Learning materials with ability to adapt to the students age and level.		
FORMULA	Rate from 1 to 5. 1: low – 5 excellent		
STANDARDIZED METHODOLOGY	Questionnaire to teachers		
UNIT OF MEASURE	Subjective opinión		
PROCEDURE	The moment to measure is when the application is finished		
PERIODICITY	2 testing periods: - After first release - When the final version is ready		
3 OBSERVATIONS			
PRELIMINARY INDICATORS	IA	**PRELIMINARY INDICATORS**	IA
It is compulsory to measure at least at the end of the period of app development			

Table 12. Educational KPI 7 - TARGET

2.10.1.4 Promote self-learning

4.- PROMOTE SELF-LEARNING

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1 GENERAL DESCRIPTION			
VARIABLE	EDUCATIONAL		
STAGE	OVERALL		
TYPE	INDIRECT		
2 CALCULATION METHODOLOGY			
DEFINITION	"Promote self-learning" refers to have Educational content in Task 4.2 Learning materials and the option to perform the educational process on your own.		
FORMULA	Rate from 1 to 5. 1: low – 5 excellent		
STANDARDIZED METHODOLOGY	Questionnaire to teachers		
UNIT OF MEASURE	Subjective opinión		
PROCEDURE	The moment to measure is when the application is finished		
PERIODICITY	2 testing periods: - After first release - When the final version is ready		
3 OBSERVATIONS			
PRELIMINARY INDICATORS	IA	**PRELIMINARY INDICATORS**	IA
It is compulsory to measure at least at the end of the period of app development			

Table 13. Educational KPI 8 - SELFLEARNING

2.10.1.5 Facilitate cooperative work

5.- Facilitate cooperative work	
1 GENERAL DESCRIPTION	
VARIABLE	EDUCATIONAL
STAGE	OVERALL
TYPE	INDIRECT
2 CALCULATION METHODOLOGY	

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DEFINITION	"Facilitate cooperative work" refers to have Educational content Task 4.2 Learning materials that would require collaborative working with other students inside/outside the class.		
FORMULA	Rate from 1 to 5. 1: low – 5 excellent		
STANDARDIZED METHODOLOGY	Questionnaire to teachers		
UNIT OF MEASURE	Subjective opinión		
PROCEDURE	The moment to measure is when the application is finished		
PERIODICITY	2 testing periods: - After first release - When the final version is ready		
3 OBSERVATIONS			
PRELIMINARY INDICATORS	IA	**PRELIMINARY INDICATORS**	IA
It is compulsory to measure at least at the end of the period of app development			

Table 14. Educational KPI 9 - COOPERATIVE

2.10.2 Educational KPI measurement survey

The educational KPI are acquired using a survey oriented to the teachers that are using the created resources. In the questionnaire, as starting points, there are included some standard questions for categorization of participating profiles such us age or number of students. Regarding KPIs, Digital Projects, as a non-ICT material, the set of Educational KPIs are only considered and included in the survey.

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In order to better clarify the relationship between KPIs and survey questions we match both in the next table:

General information	KPI	Question of the survey
1	Age	In what age range is used?
2	User acceptance	Have you learned anything using the Digital Project?
		Do you like the Digital Project?
		Would you recommend the Digital Project to other users?
Educational KPI		
1	Didactic Effectiveness, easy to achieve of objectives	How do you assess the didactic effectiveness of the Digital Project? -
2	Ability to Motivate	Does the Digital Project motivate or generate engagement?
3	Adaptation of the contents to the target groups	Is the content suitable for the target group?
4	Promote self-learning	Does the Digital Project promote self-learning?
5	Facilitate cooperative work	Does it facilitate cooperative work?

Table 15. Educational KPI and survey questions match

Each Digital Project has its form to collect the previous mentioned information:

- Digital Project 1 https://goo.gl/forms/JLAEvSjr3WDzCwBc2
- Digital Project 2 https://goo.gl/forms/5Jf1DtE8CNhm9pdr2
- Digital Project 3 htt ps://goo.gl/forms/c06efB7onrXWHAxy1
- Digital Project 4 https://goo.gl/forms/3WDVYftb85WvjKp23
- Digital Project 5 https://goo.gl/forms/rZXuathvNyHYLMnq1
- Digital Project 6 https://goo.gl/forms/wOH2FNgwHkMjhLxt2

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The complete survey has the next questions:

Through this form we want you to give us your opinion about:

Select the age of the users *

6-7 years old

7-8 years old

8-9 years old

9 -10 years old

10- 11 years old

11-12 years old

12 years old

13 years old

14-15 years old

How do you assess the didactic effectiveness of the Digital Project?

Low 1 2 3 4 5 Excellent

Tell us comments or improvements about the didactic effectiveness

……..

Does the Digital Project motivate or generate engagement?

Nothing 1 2 3 4 5 Very much

Tell us comments or improvements about how to generate motivation

……..

Is the content suitable for the target group?

Nothing 1 2 3 4 5 Very much

Tell us comments or improvements about the content

……..

Does the Digital Project promote self-learning?

Nothing 1 2 3 4 5 Very much

Tell us comments or improvements about the use of the materials on your own

……..

Does it facilitate cooperative work?

Nothing 1 2 3 4 5 Very much

Tell us comments or improvements about to improve the cooperative work

……..

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Have you learned anything using the Digital Project? Nothing 1 2 3 4 5 Very much Tell us comments or improvements about learning outcomes ……
Do you like the Digital Project? Nothing 1 2 3 4 5 Very much
Would you recommend the Digital Project to other users? I wouldn´t recommend it1 2 3 4 5 Of course I would recommend it Tell us other aspects to be considered ……

Table 16. Educational KPI capture survey

In the next figure we can see an example of the data acquisition form:

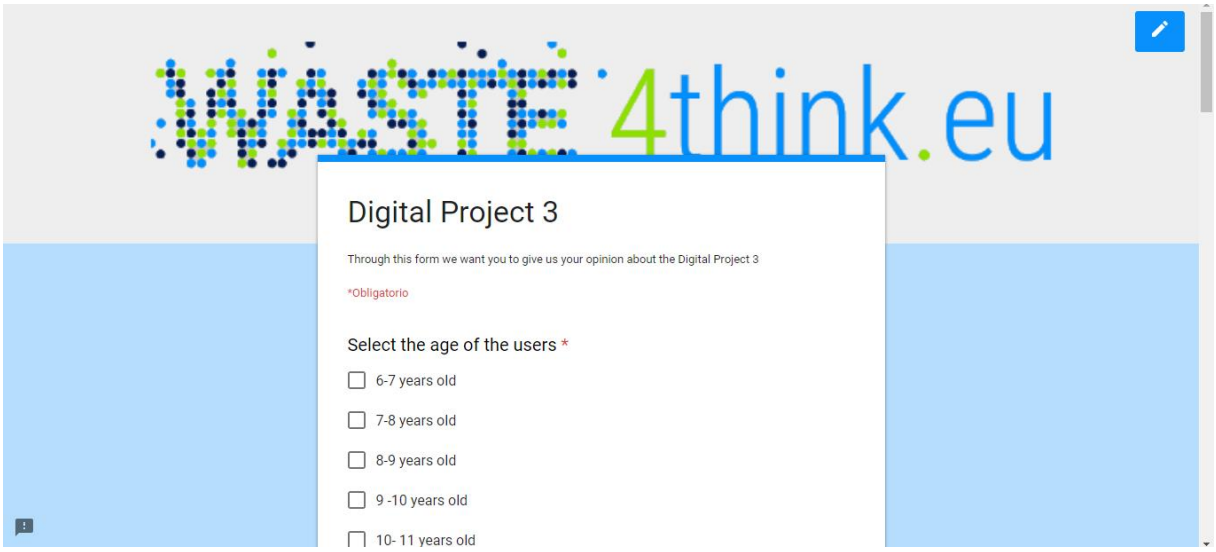

Figure 1. Digital Project questionnaire form example

The effectiveness of Digital Projects in selected pilots (Zamudio and Halandri) will be measured through the indicated surveys and the responses will be an input for the Waste4Think platform, reported in D1.6.

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3 Mobile games

3.1 User requirements

Based on customer profile analysis and motivations, we present the following high-level architecture design of general engagement.

3.1.1 Benefit

The benefit describes the economic or social return of the solution with the introduction of gamification. According to the results of the analysis, the following income or benefits were identified (classified by relevance):

- Collect data of its usage and the different range of players
- Spread the knowledge around compost
    1. Giving users a fun space where they can learn about compost
    2. Giving users a fun space to discover microorganism and organism involve in each phase of the composting

3.1.2 Players

In this section we identify the customers of the game. Who are the players, how are the players, what do they like, what do they want?

According to the information collected from the questionnaire that we analysed, the characteristics of the following actors were identified:

- Students from different EU countries from 6 to 17 years old
- Players that like games and videogames

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3.1.3 Aesthetics

What makes the game experience attractive? Aesthetics connects with the emotional motivators of the users and, as such, defining the elements most pleasing to them is a key process for creating the desired attractive behaviours.

These three elements will be the key to involving players in the project:

- Challenge (short-term commitment)
    1. A challenge related to the discovery or achievement of an objective: have a good sunflower
- Discovery (short-medium term commitment)
    1. Discover how to do a new process and acquire new knowledge: make compost
    2. Discover and collect elements: soil organisms

3.1.4 Behaviour

The benefits of the game are directly linked with the behaviours of the players.

- Survey
    1. Answer some questions, for example the country, zip code and age
- Recommend something
    1. Recommend the compost process and its benefits to friends or people payers know

3.1.5 Dynamics

What dynamics will we use to create the aesthetics of our game? What dynamics works best for our customers? How will these dynamics work in our game?

This layer describes the actions created by mechanics with the aim of fostering specific aesthetic experiences. The execution of these mechanisms by the client will be the factor that will trigger the desired aesthetic experience and, therefore, the commitment to play.

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The dynamic corresponds to the layer of actions and the behaviours correspond to the real actions we want the client to perform in the game. The dynamics create behaviours in a transparent and fun way.

The selected dynamics are the following:

- Reward
    1. Reward for carrying out actions with a positive effect, for example the state of the sunflower
- Progress
    1. Progress will be shown through some element that tells them that they have advanced in the game objectives, for example, the compost inside de compost bin.
- Call to Action
    1. Time will be used as a motivating element.

3.1.6 Mechanics

Mechanics are the rules of the game. It is the functioning of the experience in order to generate game dynamics within the aesthetic framework of the project.

The first time the players enter the application, they would fill in the survey data shown (country, municipality, zip code, age, genre and language). This screen is necessary to obtain the application usage and data of the different range of players. It's also necessary to configure the module that obtains the temperature and humidity of the place where we are playing.

After the initial configuration screen, there will be different screens explaining the game objective and the elements with which we can interact.

- Objective: maintain the sunflower in a good state
- How: check the weather conditions and decide if it is necessary to water the sunflower or not

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- Compost: check the compost bin to know its advance and interact with it to get a good quality

Once in the main screen, the first-time player access they will see the seed of the sunflower falling to the soil and how the sunflower grows with an animation. After that the different action buttons will glow to touch them. The first-time player touch or click the button, a message explaining its function is going to appear. The different buttons are:

- AR
    1. With this button we activate the Augmented Reality option and it would be possible to see the sunflower (only with smartphones and tablets)
- Watering can
    1. With this button we activate the function to water the sunflower
- Compost bin
    1. This is the way to access to the compost bin and check its status
- Soil organism's collection
    1. This is the option to access the collection of soil organism

Feedback will be given after activating each action, giving information about the action itself and it the player has made it properly or not.

3.1.7 Components

Together with rules, the components are the most important elements to produce the desired Mechanics. These are the proposed components:

- Inventory
    1. Each soil organism we collect from the compost bin will be a reward and it will be available in the soil organism's collection
- Progress bar

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1. The progress bar on the bottom of the sunflower will show the state of the sunflower, giving feedback and encouraging to do actions to take care of it

- Counter

1. The usage of the compost generated it is not immediate, the process of recollect the compost must be after certain time

3.1.8 Platforms

Describe the platforms on which to implement game mechanics. What platforms we have available and will the game run on?

According to the project requirements the game will run on in the next platforms:

- Smartphone app: Android and iOS
- Tablet app: Android and iOS
- Computers and laptops: Windows

The application will be displayed in landscape resolution (landscape) on computer and vertically on mobiles and tablets (portrait). The windows and interface elements shown in the application will be similar, but the arrangement of some elements may be fluid.

3.2 Ethical issues

The learning contents data capture procedures follow the ethical rules defined in WP9, the Informed Consent clause in case children are involved – as defined in D9.3 and data privacy rules for schools.

In this second case, privacy requirements for schools, the project is oriented to schools not to individual participants which requires a much lighter fact to fit to data protection regulation (i.e. if a Database would be generated with all the participants and their emails other warranties should have been incorporated – such us, rights to rectification and forgotten, information of what would happen with the data obtained at the end of the survey and contact email to exercise these rights)

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The complete questionnaire is available at Annex II – Questionnaire, however below the informed Consents Clause as it is provided in the survey is shown.

The data protection information disclosure in the Information Sheets is generated based on general example and specific ones for pilots available at D9.5 – PODP – Requirement no. 6.

Informed Consent Clause.

Thank you for Reading this information

We would like you to participate in a survey about waste management habits within the Waste4Think project by filling this questionnaire. It is voluntary, but your answers will be of great value for the development of the educational materials that will be generated within the project.

We only need the e-mail of the school contact person to have a partner along the project. We do not need any further information; The questionnaire can be completed in an anonymous way. Although we will not be processing any identifying information, stored data will be treated in a way that ensures confidentiality.

The survey will be saved to know the evolution of the habits about waste management in educational centres along project life-time (4 years). The questionnaires will be stored in a Virtualware server in Basauri.

Personal data (such as e-mail of the responsible) will only be accessible for the research team.

The research results are part of a survey with the aim of improving waste management at council level, reducing waste generation and promoting good habits for separating, preventing and reusing waste. If you have any questions, you can contact Leire Armentia (larmentia@virtualwaregroup.com)

Do you agree in taking part in this survey? YES, NO, OTHER

I do confirm that I have read the consent clause and I accept the terms of use of data collected in the survey YES, NO

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Link to privacy policy of third-party service providers used by the app

Google Play Services

Log Data

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Cookies are files with a small amount of data that are commonly used as anonymous unique identifiers. These are sent to your browser from the websites that you visit and are stored on your device's internal memory.

This Service does not use these “cookies“ explicitly. However, the app may use third party code and libraries that use “cookies“ to collect information and improve their services. You have the option to either accept or refuse these cookies and know when a cookie is being sent to your device. If you choose to refuse our cookies, you may not be able to use some portions of this Service.

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• To provide the Service on our behalf;

• To perform Service-related services; or

• To assist us in analysing how our Service is used.

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We value your trust in providing us your Personal Information, thus we are striving to use commercially acceptable means of protecting it. But remember that no method of transmission over the internet, or method of electronic storage is 100% secure and reliable, and we cannot guarantee its absolute security.

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This Service may contain links to other sites. If you click on a third-party link, you will be directed to that site. Note that these external sites are not operated by us. Therefore, we strongly advise you to review the Privacy Policy of these websites. We have no control over and assume no responsibility for the content, privacy policies, or practices of any third-party sites or services.

Children’s Privacy

These Services do not address anyone under the age of 13. We do not knowingly collect personally identifiable information from children under 13. In the case we discover that a child under 13 has provided us with personal information, we immediately delete this from our servers. If you are a parent or guardian and you are aware that your child has provided us with personal information, please contact us so that we will be able to do necessary actions.

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3.3 Mobile game 1: 0Waste

3.3.1 Repository

The mobile game is available for Android and iOS devices, and also for PC. In the next links users can download it:

- Android: https://play.google.com/store/apps/details?id=com.virtualware.w4tzerowaste
- iOS: https://itunes.apple.com/es/app/zero-waste/id1448990110?mt=8
- PC: https://virtualwaregroup-my.sharepoint.com/:f:/p/mmadarieta/Euq7nBZY9P1BntszLLNrz70BZSwNd8JTBaOyWXWGSNBnXw?e=gxjOk8

In the next figure we can see the main screen of the game

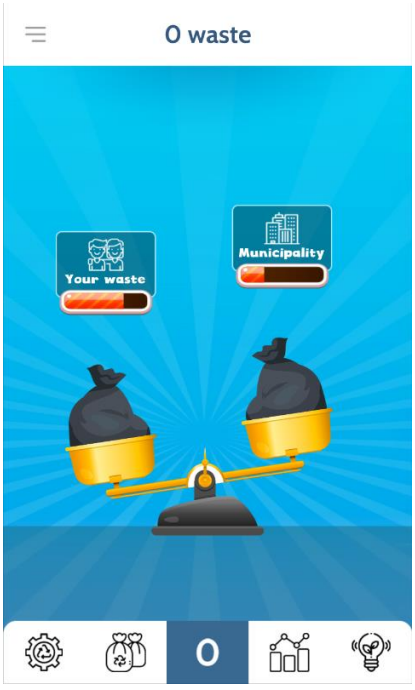

Figure 2. MG 1 - 0 Waste – Main screen

3.3.2 User manual

The aim of this mobile game is to develop a tool for monitoring the waste/resource generation and the time evolution in a funny an easy way. Actually, most of the monitoring tools that we have found in markets are oriented to adults, because of that the usability, aesthetic and functionalities are not adapted to the user we want to focus on.

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This mobile game will allow to:

1. Recording the waste generation in an easy way
2. Visualizing an historical timeline evolution
3. Identify changes related to specific improvement actions
4. Give recommendations based in a prevention and low waste generation model
5. Compare the own generation with the data from municipality recorded into fiware
6. Engage the user by using some gamification strategies

3.3.2.1 Configuration screen

This section is necessary to collect basic information about the users and detect the pilot where it is using to adapt it to its characteristics.

1. Country: There are only available EU countries.
2. Municipality: Depending on the country chosen the dropdown municipality will change. For now, only Greece and Spain contain municipality data.
3. Zip code: Whether or not a municipality is chosen, this field is mandatory.
4. Age: This app has been developed for children, from 6 years old. So, with this field we check the age of the user.
5. Gender: The user can choose Boy, Girl or Other. This will be useful for statistics.
6. Privacy Policy: Before entering the app, the user must read and accept the Privacy Policy.

3.3.2.2 Code Screen

Each school has to assign a unique code for its students to use in all the games of the project. With this code the student's behaviour can be tracked. However, this field is not mandatory and can be left empty to use the application.

3.3.2.3 Onboarding

Before beginning to play, these screens explain each one of the sections of the game.

3.3.2.4 Side menu

This menu contains information regarding About us and Legal bases and also the Settings sections.

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3.3.2.4.1 About us

This option explains that 0Waste is an application developed for Waste4Think Project and who the partners of this project are. If the Waste4Think logo is clicked the browser will open the web.

3.3.2.4.2 Settings

As students from different countries can use this app, they can choose the language in which they will play.

Moreover, it is possible to turn on and turn off the sound effects and music of the app individually.

3.3.2.4.3 Legal Bases

The privacy policy of the application is explained here.

3.3.2.5 Waste configuration

In this section users are able to configure their regular recycling system creating new waste containers or editing existing ones.

In each fraction, users decide its representative colour, the amount collected in litres and the fraction itself. In the next figure we can see the screen where a fraction is defined.

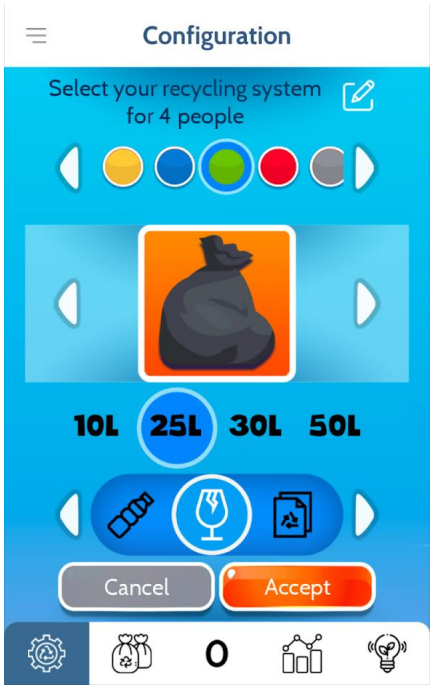

Figure 3. MG 1 - 0 Waste – Configuration screen

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3.3.2.6 Waste container creation

Create a new container by adjusting the different given options: container colour and volume used to collect waste for that container. After users click on the Accept button, they will be redirected to the Waste configuration screen.

3.3.2.7 Waste container edition

Once a recycling container is set, it is possible to change its configuration clicking on the pencil icon. Waste container creation section will be opened to set the new requirements.

3.3.2.8 Waste registration

Players will register every week the amount of waste they have generated. They can adjust the different volumes with the plus and minus buttons. Once registered Save button will led to the main screen to see the comparison with the municipality data.

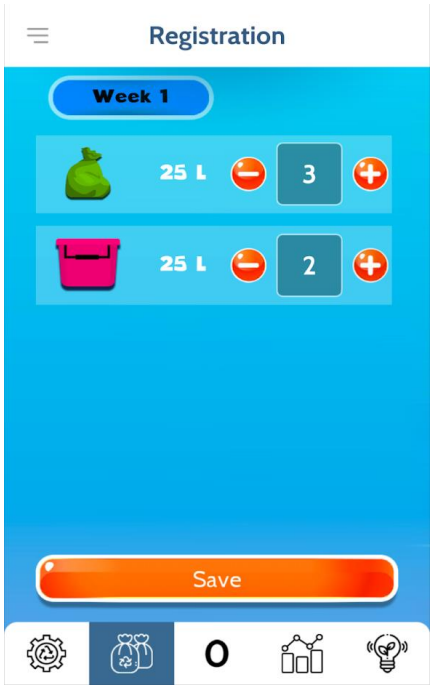

Figure 4. MG1 – 0Waste – Registration screen

3.3.2.9 Main Screen

The scale in the main screen shows how much waste the player has registered compared to their municipality one.

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The slider image above each waste container holds a value between 0% and 100%, comparing one value to the other. For example, if the user generates the same waste as the average, it will show a 50% filled image above each waste container. So, representation is in percentage.

The data used to compare is the one mentioned in Table 8 , regarding the annual generation but converted to weeks an in litres.

The average annual generation rate values are taken from the table below, taken from D1.3:

Municipality	Plastic (kg/inhab/year)	Organic (kg/inhab/year)	Glass (kg/inhab/year)	Paper (kg/inhab/year)
Zamudio	22,24	203,6	28,91	12,36
Halandri	14,03% of 98	71,1% of 348	1,53% of 98	10,75% of 348

Table 17. MG1 – 0 Waste – Reference data for the scale

3.3.2.10 Waste Evolution

In this graph users can analyse how much waste they have produced for each waste type. They can see each fraction by clicking on the different icons.

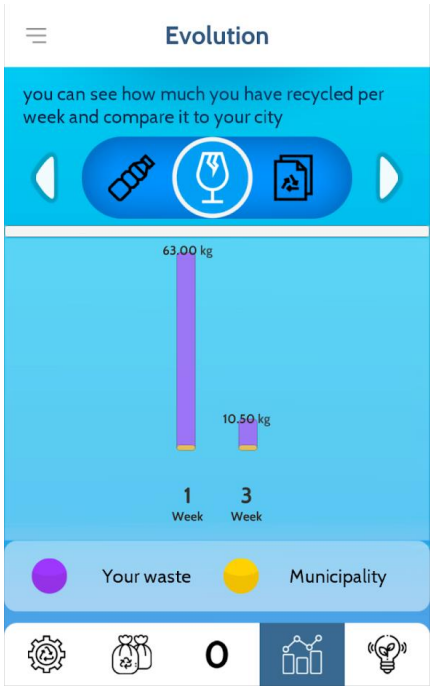

Figure 5. MG1 – 0 Waste – Evolution graph

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3.4 Mobile game 2: Sunflower

3.4.1 Repository

The mobile game is available for Android and iOS devices, and also for PC. In the next links users can download it:

- Android: https://play.google.com/store/apps/details?id=com.virtualware.w4tsunflower
- iOS: https://itunes.apple.com/es/app/sunflower/id1448876219?mt=8
- PC: https://virtualwaregroup-my.sharepoint.com/:f:/p/mmadarieta/EkjwSThYSdlPip90lLGFTuAByfeYDyYx6iEt1wDccZQi8Q?e=Pap8wU

3.4.2 User manual

3.4.2.1 Splash screen

The game will start with the next screen.

Figure 6. MG2 – Sunflower – Splash screen

3.4.2.2 Configuration screen

The first time we access the application, we must introduce information to configure it. The application shows weather, temperature and humidity data, so it is necessary to introduce de country and the zip code. Also, and only for statistical use, the application asks for the age and gender.

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1. Country: There are only available EU countries.
2. Municipality: Depending on the country chosen the dropdown municipality will change. For now, only Greece and Spain contain municipality data.
3. Zip code: Whether or not a municipality is chosen, this field is mandatory.
4. Age: This app has been developed for children, from 6 years old. So, with this field we check the age of the user.
5. Gender: The user can choose Boy, Girl or Other. This will be useful for statistics.
6. Privacy Policy: Before entering the app, the user must read and accept the Privacy Policy.

3.4.2.3 Code Screen

Each school has to assign a unique code for its students to use in all the games of the project. With this code the student's behaviour can be tracked. However, this field is not mandatory and can be left empty to use the application.

3.4.2.4 Onboarding

Before beginning to play, these screens explain each one of the sections of the game.

3.4.2.5 First access animation

The first time we access the application, we will see an animation in 2D of the seed of the sunflower falling to the soil and the sunflower being watered and growing.

3.4.2.6 Main screen

The main screen shows the status of the sunflower, together with the actual weather, temperature, humidity, considering if it is at daytime or at night.

3.4.2.7 Weather

The weather and the atmospheric data depend directly of the country and zip code introduced in the configuration screen. The possible weather conditions shown are:

- Clear sky
- Few clouds
- Scattered clouds
- Broken clouds
- Shower rain
- Rain
- Thunderstorm
- Snow
- Mist

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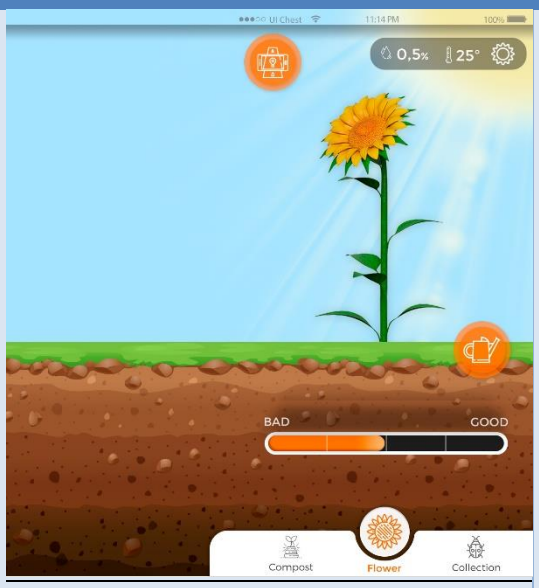
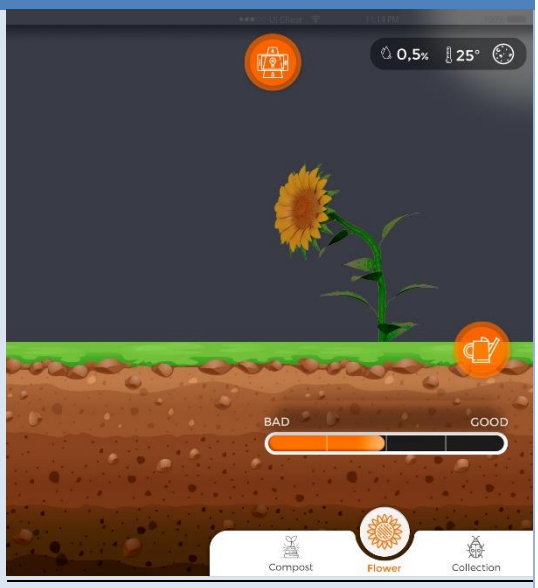
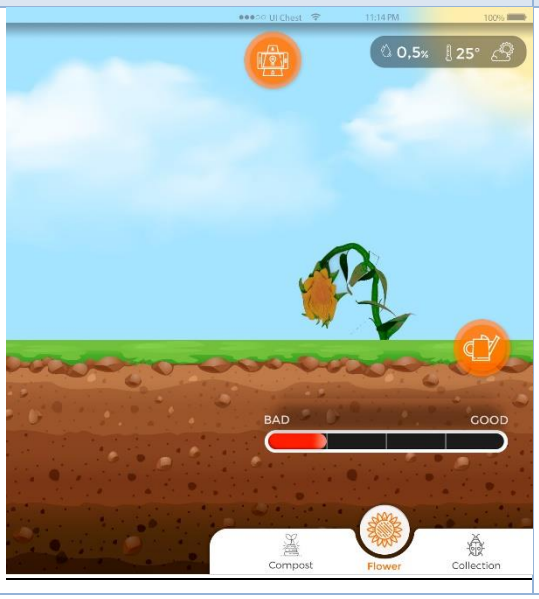
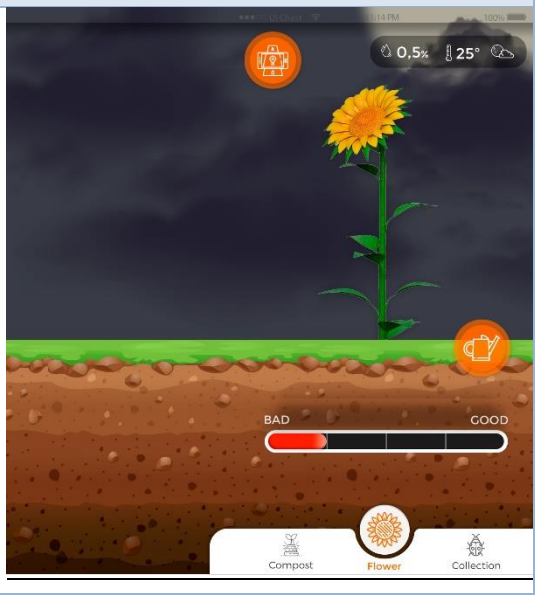
Weather conditions	Day	Night
Clear sky		
Few clouds		

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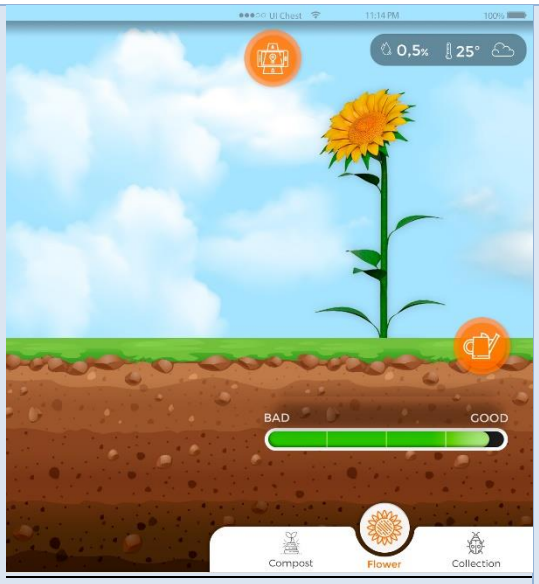
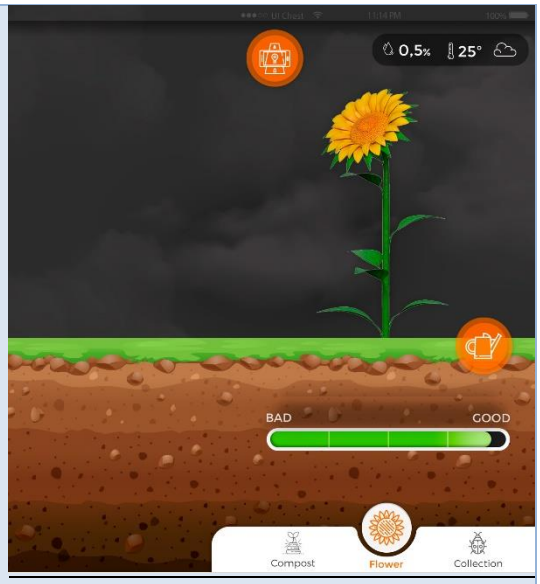
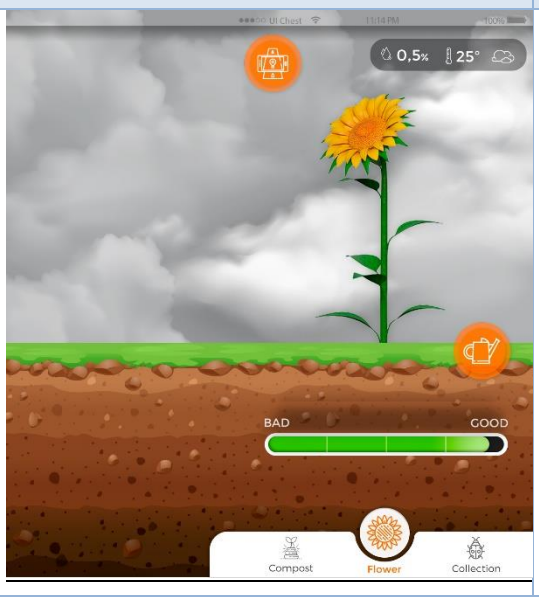
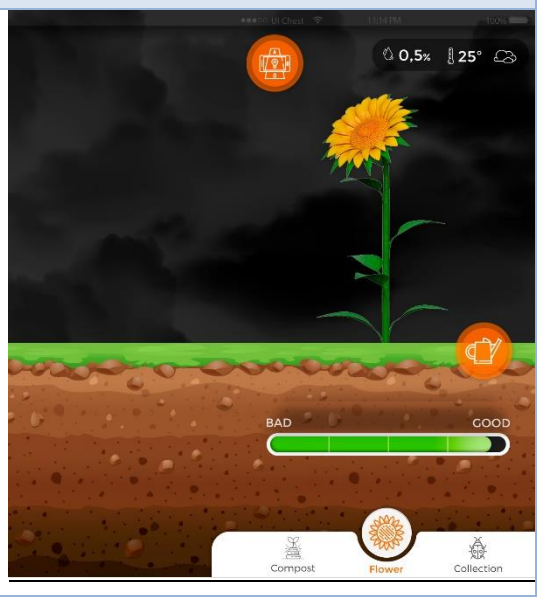
Scattered clouds		
Broken clouds		

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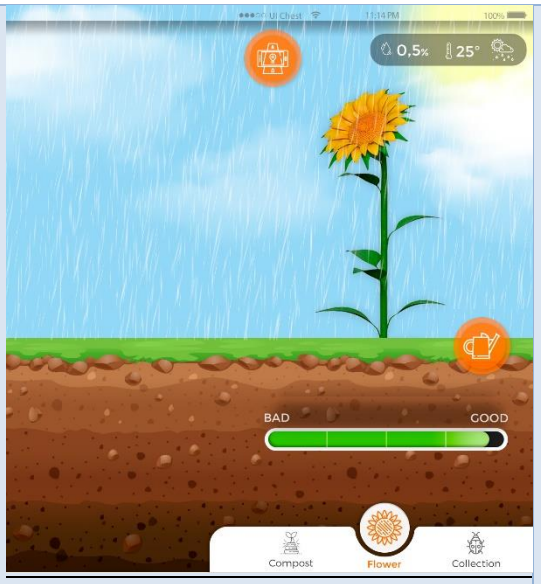
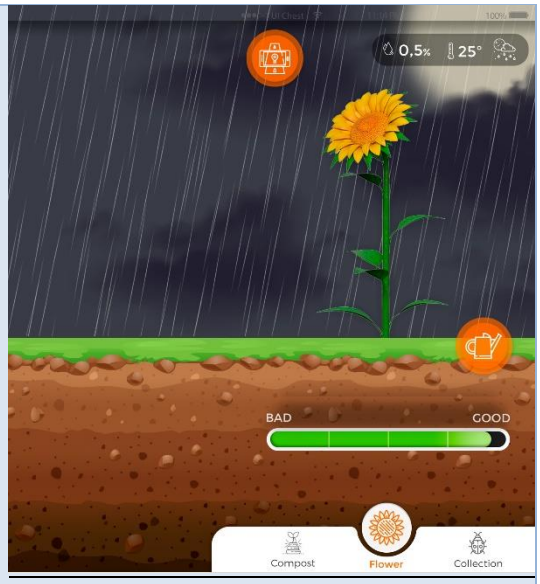
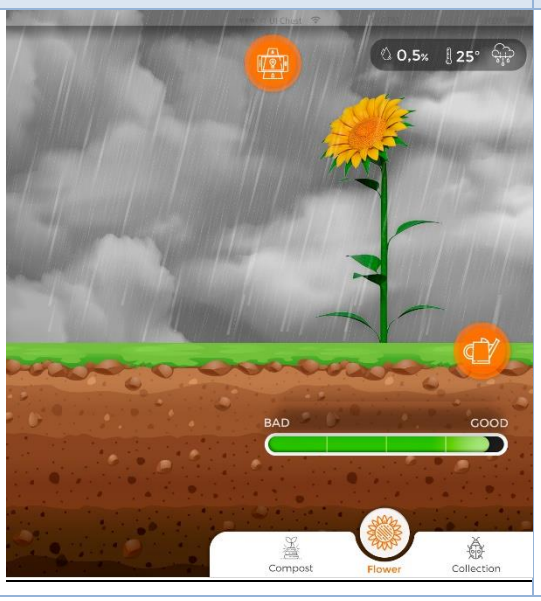
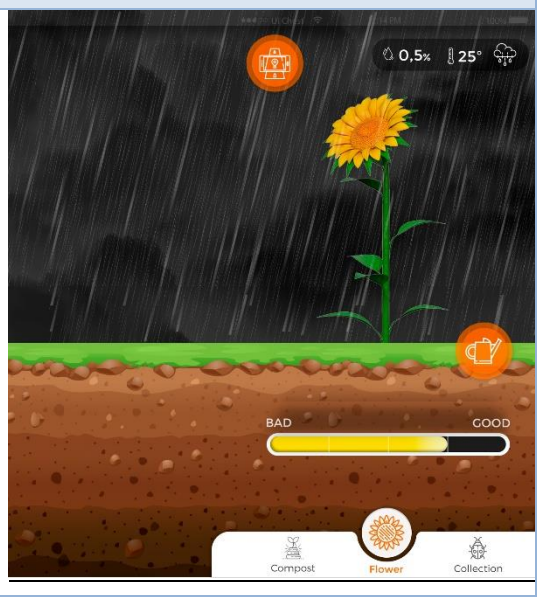
Shower rain		
Rain		

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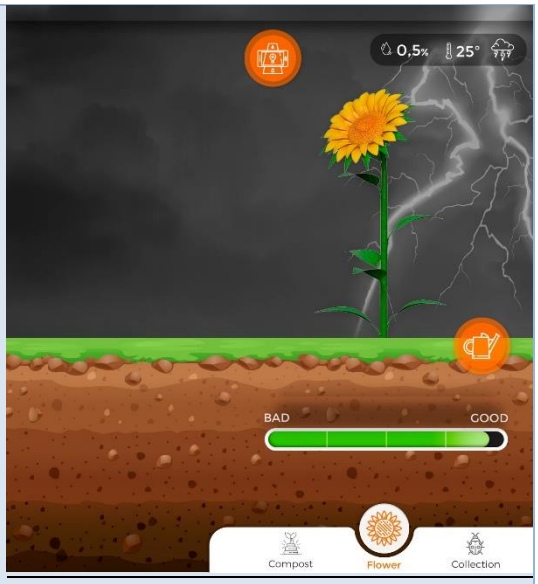
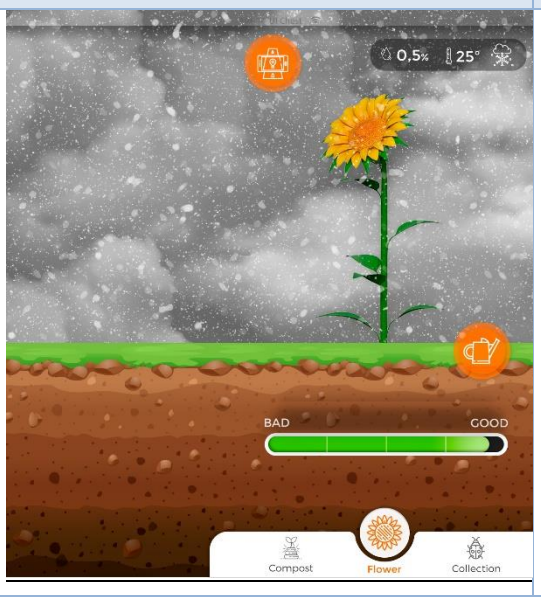
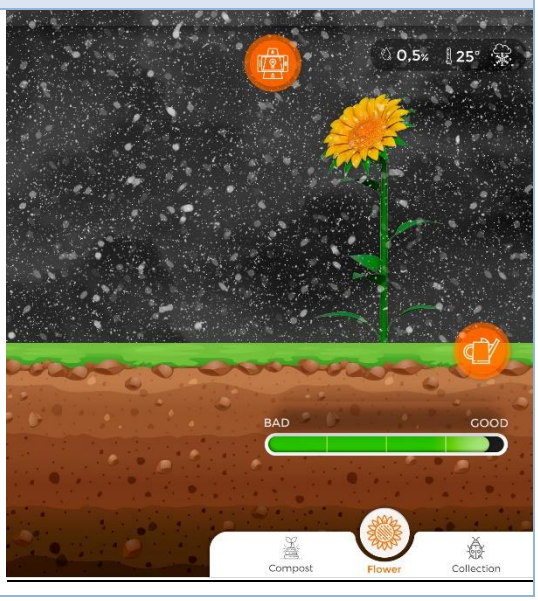
Thunderstorm		
Snow		

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Mist	

Figure 7. MG2- Sunflower – Main screen status'

The status of the sunflower could be shown in 2D or with augmented reality in 3D, using a specific marker (see the next image) and only in the smartphone and tablet version.

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Figure 8. Marker for sunflower application

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3.4.2.8 Watering

Depending on the weather conditions it would be necessary to water the sunflower. The application is going to show a feedback message telling that it was necessary to do so or not, also if you don't water and it's necessary to do so.

3.4.2.9 Sunflower status

The progress bar will show the state of the sunflower with 4 different levels:

- If the game has started today (it is considered to have started after reading the instructions) and the flower has not received water or compost, we are in the **BAD 1** state. It is the default state when entering the application for the first time. The progress bar is filled 50%.
- If the flower has received water in less than 2 days and compost 2 in less than 5 days, we are in the state **GOOD 1**. The progress bar is filled 100%.
- If the flower has received water in less than 2 days or compost 2 in less than 5 days, we are in the state **GOOD 2**. The progress bar is filled 75%.
- If the flower has received water in less than 4 days or compost 2 in less than 10 days, we are in the state **BAD 1**. The progress bar is filled 50%.
- If the flower has not received water or compost for a long time, we are in state **BAD 2**. The progress bar is filled 25%.

3.4.2.10 Access to other screens

Being the main screen, there would be buttons to access the other screens: the compost bin and the soil organism's collection.

3.4.2.11 Compost bin screen

The compost bin screen shows the compost status.

At the beginning, it will be empty, and a message will encourage to fill it with remains of garden pruning's. The message could be something like this:

- *Empty bin: New bin! You can start using your bin for making compost. Add some garden pruning. And feed it completely.*

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3.4.2.12 Compostable elements

Pushing the button to feed the compost, a new screen appears with the elements we could put in the bin.

Green and brown elements to put in the compost bin

There will be different elements to put in the compost bin:

- Remains of food (green):
    1. Coffee drums
    2. Egg shells
    3. Fruit peels
    4. Vegetables
    5. Legumes
    6. Bread
    7. Meat/Fish
    8. Grass

- Remains of garden pruning (brown):
    1. Straw
    2. Wood chips
    3. Shredded branches

After selecting the element or elements to feed the compost, we will see them in the compost bin.

Some elements are not allowed. If the user chooses them, the application warns them.

An important aspect to bear in mind is the 30/70 ratio. i.e., the amount of food or garden pruning that is poured into the composting should not be more than 70%.

At most the percentage between food and garden pruning can be 30/70 or 70/30.

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3.4.2.13 Compost aerator

It is necessary to have an adequate airflow in the compost pile and to do so it is essential to stir up the compost, using a compost aerator.

Each time we push the compost aerator button, an animation will show that air enters the compost.

3.4.2.14 Water the compost

The composting process requires the addition of water.

3.4.2.15 Composting process

The first time on the composting screen, it is shown empty and the instructions are indicated: “Click on the Compost button and select the elements you will use in your first compost”.

When Remains of food or Remains of garden is chosen, the list of valid and invalid elements indicated in the project definition is displayed, depending on the municipality.

The instructions syndicate the elements required for composting, although it is possible to select more or less.

- If 2 elements are added, it is shown without compost.
- If 3 or 4 elements are added, the elements are displayed, and compost is shown at a low level.
- If more than 5 elements are added, the last 5 are shown and the rest is compost.

When composting is completed (with 10 elements) the last ones are shown, and the rest is compost at the highest level and changes colour. This is how phase 1 begins.

3.4.2.15.1 Phase 1

- Start: Outdoor temperature. The phase does not start until you click on Air and Water. Each action rises 2º.
- Half: A level 1 bug is unlocked, and the text indicates the weeks that elapse.
- End: Temperature 60º, the putty is reduced by half and changes colour. The elements are hidden. The text indicates that 1 month has elapsed.

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3.4.2.15.2 Phase 2

- Start: Temperature 60º. The phase does not start until you click on Air and Water. Each action rises 2º.
- Half: A level 1 bug is unlocked, and the text indicates 1 month.
- End: Temperature 65º, the putty is reduced by half and changes colour. The text indicates that 2 months have elapsed.

3.4.2.15.3 Phase 3

- Start: Temperature 65º. The phase does not begin until you click on Air and on Water. Each action rises 1º.
- Half: A level 2 bug is unlocked, and the text indicates 2 months.
- End: Temperature 50º, the putty is reduced by half and changes colour. The text indicates that 3 months have elapsed.

3.4.2.15.4 Phase 4

- Start: Temperature 50º. The phase does not start until you click on Air and Water. Each action rises 1º.
- Half: A level 3 bug is unlocked, and the text indicates 3 months.
- End: Temperature 32º, the putty is reduced by half and changes colour. The text indicates that 4 months have elapsed. Message displayed: “You've got a compost ready to use with the sunflower”.

If the user enters the application and has not used it for a long time, the composts in progress will start with the outside temperature and will finish until they reach the final temperature corresponding to them depending on the phase in which they are.

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3.4.2.15.5 Maturation phase

In the flower screen the compost button is loaded and at the end of the phase the button is scaled indicating that it can be used.

If you press it, the used compost disappears from the compost bin.

If you repeat the actions within each phase, a warning message is displayed, the animation is displayed but the temperature does not rise.

At no time do we stop the process.

Even if 2 composting processes evolve at the same time, only one bug will be unlocked.

3.4.2.16 Soil organisms

Inside the bin there would appear different soil organisms, necessary to the process of decomposition. Clicking on them, players will collect and show them in the collection screen.

3.4.2.17 Soil organism's collection

Initial decomposition is carried out by **mesophilic microorganisms**, which rapidly break down the soluble, readily degradable compounds. The heat they produce causes the compost temperature to rapidly rise.

During the thermophilic phase, high temperatures accelerate the breakdown of proteins, fats, and complex carbohydrates like cellulose and hemicellulose, the major structural molecules in plants. As the supply of these high-energy compounds becomes exhausted, the compost temperature gradually decreases, and mesophilic microorganisms once again take over for the final phase of "curing" or maturation of the remaining organic matter.

- First level consumers
  1. bacteria, fungi, beetle, snail, worm, millipedes
- Second level consumers
  1. protozoa, flatworm, feather winged beetle, beetle mite, mild mite
- Third level consumers
  1. ground beetle, centipedes, pseudo scorpion, predatory mite, rove beetle, ant

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3.5 Mobile game 3: Treasure Machine

3.5.1 Repository

The mobile game is available for Android and iOS devices, and also for PC. In the next links users can download it:

- Android: https://play.google.com/store/apps/details?id=com.virtualware.w4tTreasureMachine
- iOS: https://itunes.apple.com/es/app/treasure-machine/id1447500492?mt=8
- PC: https://virtualwaregroup-my.sharepoint.com/:f:/p/mmadarieta/EjoAMtGadClFqiNl2lrVTkkB-jk_-kEr7HmJuTu3__XQDA?e=XEB7ji

3.5.2 User manual

Identifying the value of waste is the key for moving its definition from waste to resource. Playing with this game will allow to understand the importance of a good sorting at the origin and will improve the way the society look to the resource management system.

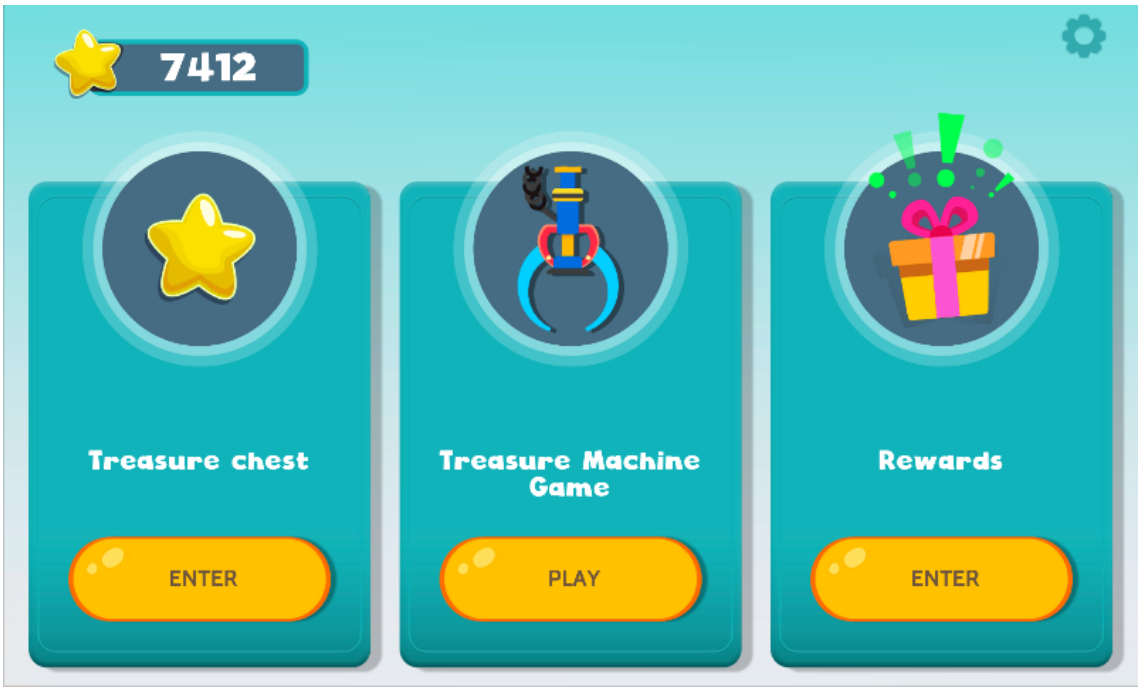

Figure 9. MG3 – TreasureMachine – Main screen

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The resources machine is going to born with this objective: show the real value of the "waste".

In this game the user must identify the value of the resources that have arrived at the "waste" sorting machine. For each element that they identify they will win some elements to improve the sorting in origin. As a result, the machine will work better, it will be easier to identify value objects and at last they will develop a machine full of treasures that will return to the society with a new live.

This game will allow to:

- Identify the value of resources
- Identify good practices for improve the sorting in origin
- Have fun learning about product life cycle and circular economy

The application is available in the next link and its possible to use in computers or mobile devices.

3.5.2.1 Splash screen

The game will start with the next screen.

Figure 10. MG3 – TreasureMachine – Splash Screen

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3.5.2.2 Configuration screen

This section is necessary to collect basic information about the users and detect the pilot where it is using to adapt it to its characteristics.

1. Country: There are only available EU countries.
2. Municipality: Depending on the country chosen the dropdown municipality will change. For now, only Greece and Spain contain municipality data.
3. Zip code: Whether or not a municipality is chosen, this field is mandatory.
4. Age: This app has been developed for children, from 6 years old. So, with this field we check the age of the user.
5. Gender: The user can choose Boy, Girl or Other. This will be useful for statistics.
6. Privacy Policy: Before entering the app, the user must read and accept the Privacy Policy.

3.5.2.3 Code Screen

Each school has to assign a unique code for its students to use in all the games of the project. With this code the student's behaviour can be tracked. However, this field is not mandatory and can be left empty to use the application.

3.5.2.4 Onboarding

Before beginning to play, these screens explain each one of the sections of the game.

3.5.2.5 Side menu

This menu contains information regarding About us and Legal bases and also the Settings sections.

3.5.2.6 About us

This option explains that TreasureMachine is an application developed for Waste4Think Project and who the partners of this project are.

If the Waste4Think logo is clicked the browser will open the web.

3.5.2.7 Legal bases

The privacy policy of the application is explained here.

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3.5.2.8 Treasure machine game

The player has to click on the elements that appear on the conveyor belt. When clicking on an element the hook takes it to the Treasure chest.

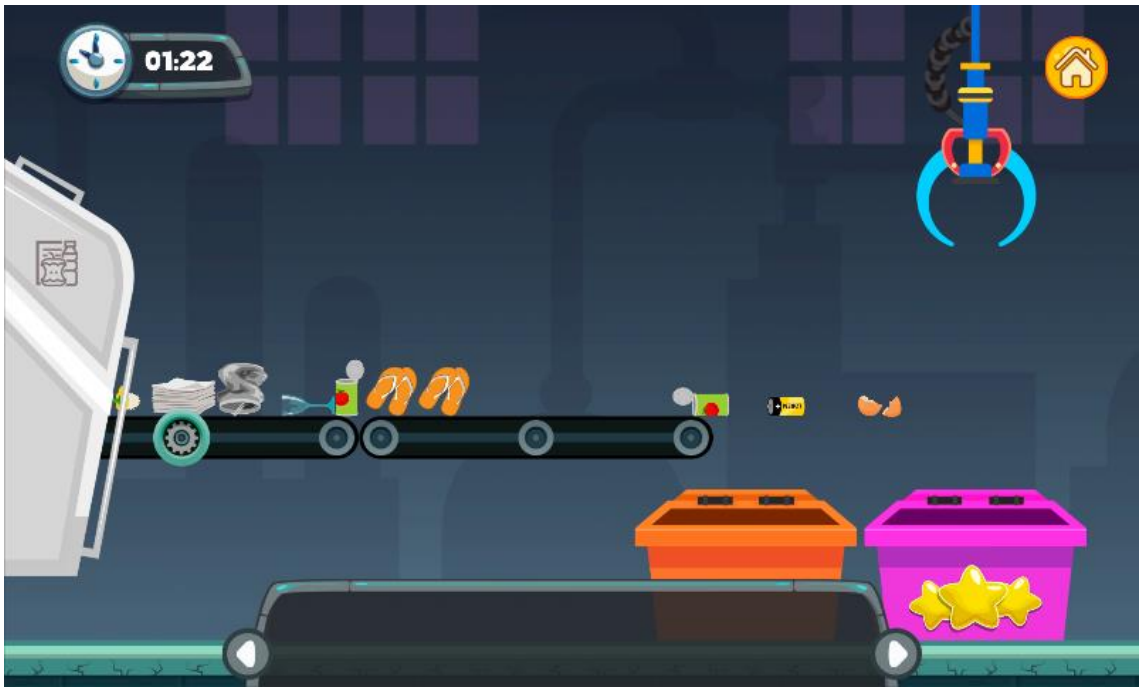

Figure 11. MG3 – TreasureMachine – Game screen

3.5.2.8.1 Back to main menu

The user can exit the game by pressing the back button.

3.5.2.8.2 Congratulations message

When time runs out, a message of congratulations comes out. The user can return to the game or continue to the Treasure chest.

3.5.2.9 Treasure chest

In this window, the player can see the trapped elements. If the player has no elements in the Treasure chest, an information message appears.

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3.5.2.9.1 Treasure chest with elements

Caught elements have a value that indicated in stars and also a multiplier that shows how many times the user has caught each element. To win the stars the user must click on each element.

Figure 12. MG3 – TreasureMachine – Treasure chest

3.5.2.9.2 Stars

Clicking on an element, it transforms, and the player gets the corresponding stars.

3.5.2.9.3 Rewards

In this section, the players can exchange stars with rewards of mechanics, selection elements or daily habits.

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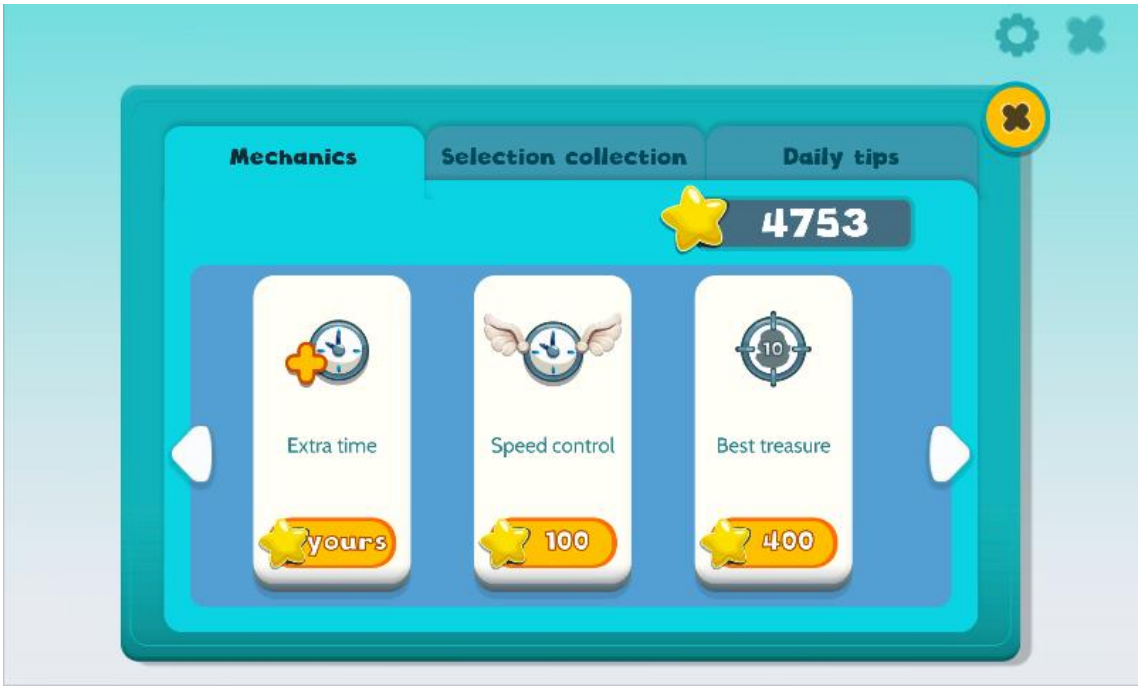

Figure 13. MG3 – TreasureMachine - Rewards

3.5.2.9.4 Mechanics

In this window, the player can exchange stars to obtain more mechanics for the game.

3.5.2.9.4.1 Reward description

By clicking on a reward, the application displays a description of the selected reward.

3.5.2.9.4.2 Reward exchange

When the player exchanges a reward, the application displays a text indicating that the reward already belongs to the user.

3.5.2.9.4.3 Extra time reward

This reward adds 30 seconds to the game.

3.5.2.9.4.4 Speed reward

This reward allows the player to change the speed of the conveyor belt.

3.5.2.9.4.5 Best Treasure reward

This reward highlights the most valuable element of the conveyor belt.

3.5.2.9.4.6 Selection collection

In this section, players can exchange stars for container types to use in the game.

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3.5.2.9.4.7 Container reward

This reward changes the colour of the game container. Then, elements from the selected container appear on the conveyor belt.

3.5.2.9.4.8 Daily habits

In this section, the player can buy information about circular economy. The information rewards are related with daily habits.

3.6 Mobile game 4: WasteQuest

3.6.1 Repository

The mobile game is available for Android and iOS devices, and also for PC. In the next links users can download it:

- Android: https://play.google.com/store/apps/details?id=com.virtualware.w4tgymkhana
- iOS: https://itunes.apple.com/es/app/wastequest/id1455327407
- PC: not available

3.6.2 User manual

3.6.2.1 Splash screen

The game will start with the next screen.

Figure 14. MG4 – WasteQuest – Splash Screen

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3.6.2.2 Configuration screen

This section is necessary to collect basic information about the users and detect the pilot where it is using to adapt it to its characteristics.

1. Country: There are only available EU countries.
2. Municipality: Depending on the country chosen the dropdown municipality will change. For now, only Greece and Spain contain municipality data.
3. Zip code: Whether or not a municipality is chosen, this field is mandatory.
4. Age: This app has been developed for children, from 6 years old. So, with this field we check the age of the user.
5. Gender: The user can choose Boy, Girl or Other. This will be useful for statistics.
6. Privacy Policy: Before entering the app, the user must read and accept the Privacy Policy.

3.6.2.3 Code Screen

Each school has to assign a unique code for its students to use in all the games of the project. With this code the student's behaviour can be tracked. However, this field is not mandatory and can be left empty to use the application.

3.6.2.4 Onboarding

Before beginning to play, these screens explain each one of the sections of the game.

3.6.2.5 Side menu

This menu contains information regarding About us and Legal bases and also the Settings sections.

3.6.2.6 About us

This option explains that WasteQuest is an application developed for Waste4Think Project and who the partners of this project are.

If the Waste4Think logo is clicked the browser will open the web.

3.6.2.7 Legal bases

The privacy policy of the application is explained here.

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3.6.2.8 Locations

The game will have from 5 to 10 general missions that everybody can develop at his own house, town, city, school place.

Figure 15. MG4 – WasteQuest – Location screen

The purpose is to search and record all the waste management tools that you can find in your location and identify what kind of resource is sorted there.

3.6.2.9 Challenges

In each place users could create challenges, following the instruction of the teachers or educational facilitators. A challenge will be identified by a Title and a Description.

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Figure 16. MG4 – WasteQuest – New challenge

3.6.2.10 Evidences

Each of the challenges need evidences to show that they are accomplish. In this case, the evidences are pictures taken by the device camera.

Figure 17. MG4 – WasteQuest – Evidences screen

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3.7 Connection with fiware

All learning materials generated during the project will be obviously related to the contents and deployment of the Environmental Education Program and its Social Actions. The integration of all ICT tools in the Social Strategies were kept in mind since the beginning of the definition of the Environmental Education Program. During the first part of the project, Social Actions have been innovative activities but without the use of ICT tools. While the eco-solutions are being thought and developed, and until they are ready to use, pilots are detecting and describing the use of the ICT solutions in the Environmental Education Program. The idea is to use them (and the new functionalities they allow) during the implementation of the foreseen actions as they are described in D4.1 (current version) and detect new opportunities to develop new social actions around them. This integration will be summarized in D4.2 and will be integrated in a new version of D4.1 Environmental Education Program.

Regarding the implementation of the Mobile Games lessons, as well for the rest of the digital materials, is especially relevant the link to the Social Actions developed (or under developing) in Zamudio and Halandri Pilot. There is a double link in this case; on one hand, the messages and activities students can receive in the municipality to promote a change in habits regarding food waste, light packaging prevention, PAYT, etc. usually received with their families and in an out-of-school context; on the other hand, the messages and changes “lived” in their schools, improving school waste generation and separate collection. Mobile Games (and associated digital projects) are consistent with both.

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In the following table the dependencies (as input/output information) to be shared between Fiware platform mainly (or other Waste4Think resources) and Mobile Games is characterized:

Mobile Game	Input	Output
MB1. 0 Waste	Identify for each pilot best practices to monitor the results KPIs already defined in D1.3 – section 4.4 as well as annexes C and D. This section contains KPIs - (Intermediate and Low Level).	learning analytics educational KPIs
MB2. SUNFLOWER	No direct input from Fiware but input data considered are: Home composting (Vocational school can send also their experience and monitoring, type of information proposed: best mixture of C:N (foodwaste+prunning), what happens with different TºC range (microorganisms & macroinvertebrats changes, higienyzation), visual evolution of the foodwaste during the process, humidity levels, pH levels and problems related, ..	learning analytics educational KPIs
MB3. TREASURE MACHINE	No direct input from Fiware but input data considered are: Waste flows of the Municipality, circular economy module, etc.. Best practices from the circular economy module and D1.2	learning analytics educational KPIs
MB4. WASTE QUEST	No direct input from Fiware but input data considered are waste systems at home, in schools, in the municipality, and movement to collect evidences.	learning analytics educational KPIs

Table 18. Mobile Game input and output data to Fiware

3.8 Waste4think key project indicators (KPI)

This General Key Project Indicators (KPIs) are an important information input for the learning material.

As mentioned in D2.9, for ensuring that the CEPM is effective, it is necessary to update Key Project Indicators (KPIs). These indicators act as a measurement tool for the responsible of municipal waste management or the business manager/entrepreneur/researcher to assess how well the CEPM service is doing in the context of a CE, allowing their companies/ municipalities to estimate how advanced they are on their journey from linear to circular.

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In the D1.3 Sustainable Assessment Models, the KPIs that the CEPM will use have been defined, as follows:

Generation (for each Waste Collection Circuit (WCC))	T.1.2 Annual generation rate (kg/inhab /year)
Collection (for each Waste Collection Circuit (WCC))	T.2.3 Total gross separate collection (%)
	T.2.4 Total net separate collection (%)
Treatment for each Waste Collection Circuit (WCC)	T.3.1 Primary waste destination (kg)
	T.3.2 Dry recyclables to primary destination (%)
	T.3.3 Organic recyclables to primary destination (%)
	T.3.4 Residual waste to primary destination (%)
	T.3.5 Destination recycling (DREC) (%)
GHG emissions (total)	E.1.1 net GHG emissions (kg CO2/ kg of waste) collection & treatment
Management costs (total)	C.1.2 Treatment gate fee (€/ton)
	C.1.3.1 Collection and Transport cost (€)
	C.1.3.2 Total waste management cost (€)
Social impact	S.2.1 Number of workers (n)

Table 19. Economy Module KPIs (D1.3 – Table 5 Circular)

These values obtained via Fiware are used as input data in the mobile games. However, even though Mobile Games are ICT materials, are not be linked with Fiware platform automatically. The information obtained from Mobile Games will be collected via google Analytics and send later on to Fiware platform.

At the same time, when these values are calculated, the incidence of the mobile games will also be considered, as described in the next point, Mobile Game Monitoring. For example, to measure if doing these activities influences school members and their family's behaviour or feed the system with the data obtained from the Learning materials use.

3.9 Mobile Game Monitoring

The mobile games have as output a set of defined KPI to measure their educational effectiveness. The educational Contents/ Learning material will also be input information for Fiware platform to indicate the results of the educational effectiveness of the material generated in each pilot site (Zamudio/Halandri).

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A set of 9 output KPIs have been selected to measure the impact according to usability aspects of the Digital Materials (DIGITAL KPIs) and enhancing learning process (Educational KPIs) by using these materials.

KPI	MEASURED FEATURE
DIGITAL KPI	**1. Easy to use - USE** **2. Easy to install programs and add-ons - INSTALL** **3. Didactic Versatility: modifiable, levels, adjustments and reports - VERSATIL** **4. Running execution - EXECUTION**
EDUCATIONAL KPI	5. Didactic Effectiveness, easy to achieve of objectives - EFFECTIVENESS 6. Ability to Motivate - MOTIVATE 7. Adaptation of the contents to the target groups - TARGET 8. Promote self-learning - SELFLEARNING 9. Facilitate cooperative work – COOPERATIVE

Table 20. Digital and Educational KPI

In the context of the mobile games the main focus stands on the digital KPI, because they are ICT educational materials.

3.9.1 Digital KPI definition

3.9.1.1 Easy to use

1.- EASY TO USE	
1 GENERAL DESCRIPTION	
VARIABLE	DIGITAL
STAGE	OVERALL
TYPE	INDIRECT
2 CALCULATION METHODOLOGY	
DEFINITION	Easy to use refers to the facility to use Educational contents in Task 4.2 Learning materials by teachers and students
FORMULA	Rate from 1 to 5. 1: low – 5 excellent
STANDARDIZED METHODOLOGY	Questionnaire to teachers
UNIT OF MEASURE	Subjective opinion
PROCEDURE	The moment to measure is when the application is finished

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PERIODICITY	2 testing periods: - After first release - When the final version is ready.		
3 OBSERVATIONS			
PRELIMINARY INDICATORS	IA	**PRELIMINARY INDICATORS**	IA
It is compulsory to measure at least at the end of the period of app development			

Table 21. Digital KPI 1 - USE

3.9.1.2 Easy to install programs and add-ons

1. EASY TO INSTALL PROGRAMS AND ADD-ONS	
1 GENERAL DESCRIPTION	
VARIABLE	DIGITAL
STAGE	OVERALL
TYPE	INDIRECT
2 CALCULATION METHODOLOGY	
DEFINITION	Easy to install programs and add-ons refers to the facility to install educational contents in Task 4.2 Learning materials
FORMULA	Rate from 1 to 5. 1: low – 5 excellent
STANDARDIZED METHODOLOGY	Questionnaire to teachers
UNIT OF MEASURE	Subjective opinion
PROCEDURE	The moment to measure is when the application is finished
PERIODICITY	2 testing periods: - After first release - When the final version is ready.

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3 OBSERVATIONS			
PRELIMINARY INDICATORS	IA	**PRELIMINARY INDICATORS**	IA
It is compulsory to measure at least at the end of the period of app development			

Table 22. Digital KPI 2 - INSTALL

3.9.1.3 Didactic Versatility: modifiable, levels, adjustments and reports

3.- DIDACTIC VERSATILITY: MODIFIABLE, LEVELS, ADJUSTMENTS AND REPORTS			
1 GENERAL DESCRIPTION			
VARIABLE	DIGITAL		
STAGE	OVERALL		
TYPE	INDIRECT		
2 CALCULATION METHODOLOGY			
DEFINITION	"Didactic Versatility: modifiable, levels, adjustments and reports" refers to have Mobile location-based games in Task 4.2 Learning materials with options to adjust, report or modify didactic con		
FORMULA	Rate from 1 to 5. 1: low – 5 excellent		
STANDARDIZED METHODOLOGY	Questionnaire to teachers		
UNIT OF MEASURE	Subjective opinion		
PROCEDURE	The moment to measure is when the application is finished		
PERIODICITY	2 testing periods: - After first release - When the final version is ready		
3 OBSERVATIONS			
PRELIMINARY INDICATORS	IA	**PRELIMINARY INDICATORS**	IA
It is compulsory to measure at least at the end of the period of app development			

Table 23. Digital KPI 3 - VERSATIL

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3.9.1.4 Running execution

4.- RUNNING EXECUTION			
1 GENERAL DESCRIPTION			
VARIABLE	DIGITAL		
STAGE	OVERALL		
TYPE	INDIRECT		
2 CALCULATION METHODOLOGY			
DEFINITION	"Running execution" refers to have educational contents in Task 4.2 Learning materials without running exceptions.		
FORMULA	Rate from 1 to 5. 1: low – 5 excellent		
STANDARDIZED METHODOLOGY	Questionnaire to teachers		
UNIT OF MEASURE	Subjective opinion		
PROCEDURE	The moment to measure is when the application is finished		
PERIODICITY	2 testing periods: - After first release - When the final version is ready		
3 OBSERVATIONS			
PRELIMINARY INDICATORS	IA	**PRELIMINARY INDICATORS**	IA
It is compulsory to measure at least at the end of the period of app development			

Table 24. Digital KPI 4 - EXECUTION

3.9.2 Digital KPI measurement survey

The digital KPI are acquired using a survey oriented to the teachers that are using the created resources. In the questionnaire, as starting point, there are included some standard questions for categorization of participating profiles such us age or number of students. Regarding KPIs, Mobile games, as ICT material, the set of Digital KPIs are only considered and included in the survey.

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In order to better clarify the relationship between KPIs and survey questions we match both in the next table:

General information	KPI	Question of the survey
1	Age	In what age range is used?
2	User acceptance	Do you like the application?
		Would you recommend the application to other users?
Educational KPI		
1	Easy to use	Is the application easy to use?
2	Easy to install programs and add-ons	Is it easy to install?
3	Didactic Versatility: modifiable, levels, adjustments and reports	MG1 specific • Have you understood what to do to configure the collection system? • Have you understood how to register the generated waste? • Have you learned anything using the application?
		MG2 specific • Have you understood what to do to make the Sunflower look good? • Have you understood what to do to make compost? • Have you learned anything using the application?
		MG3 specific • Have you understood how to play? • Have you understood how to obtain rewards? • Have you learned anything using the application?
		MG4 specific • Have you understood how to generate a new challenge? • Have you understood how to make evidences? • Have you learned anything using the application?
4	Running execution	Does it run properly?

Table 25. Digital KPI and survey questions match

The surveys are in the next links:

- Mobile Game 1 https://goo.gl/forms/7TJXEAfqfY9Rzwlk1
- Mobile Game 2 https://goo.gl/forms/QpAEBn5MU1s9l46E3
- Mobile Game 3 https://goo.gl/forms/9augK4hwEJtKgjy83
- Mobile Game 4 https://goo.gl/forms/zM7EDFPrxEX2NLc43

The complete survey has the next questions (the MG2 – Sunflower survey example):

Select the age of the users *
6-7 years old
7-8 years old
8-9 years old
9 -10 years old
10- 11 years old
11-12 years old

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12 years old 13 years old 14-15 years old
Is the application easy to use? Difficult 1 2 3 4 5 Very easy Tell us comments or improvements about the game usability ……
Is it easy to install? Difficult 1 2 3 4 5 Very easy Tell us comments or improvements about the game installation ……
Does it run properly? It has a lot of problems 1 2 3 4 5 It runs very well Tell us comments or improvements about the game performance ……
Have you understood what to do to make the Sunflower look good? Nothing 1 2 3 4 5 Very much Tell us comments or improvements about the sunflower functionality ……
Have you understood what to do to make compost? Nothing 1 2 3 4 5 Very much Tell us comments or improvements about the compost functionality ……
Have you learned anything using the application? Nothing 1 2 3 4 5 Very much Tell us comments or improvements about learning outcomes of the game ……
Do you like the application? Nothing 1 2 3 4 5 Very much
Would you recommend the application to other users? I wouldn´t recommend it1 2 3 4 5 Of course I would recommend it

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Tell us other aspects to be considered ……

Table 26. Digital KPI capture survey

Example of evaluation questionnaire for Mobile Game 2 - Sunflower

Figure 18. Digital KPI survey example

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3.9.3 Learning analytics

The Mobile Games are ICT materials, and this led as the opportunity to capture the final user's behaviour using analytics. In this case, we have the behaviour of the students and we extract the game statistics, that will be injected into the Fiware system to obtain the learning analytics.

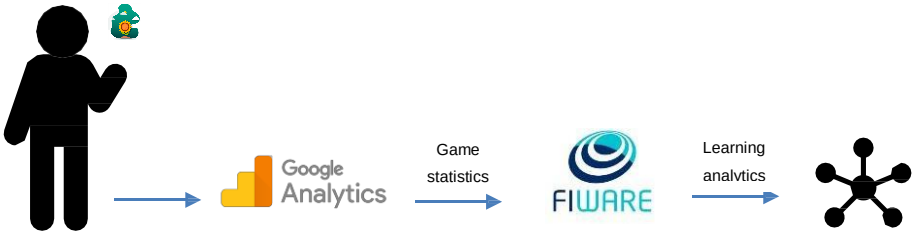

Figure 19. Game Statistics to Learning analytics workflow

For this purpose, there is extra behaviour data collected by the application and defined and adapted as follows. To better analyse the data, each student has a user identification code with a specific format. The proposed format is: CV1A01, CV1B02…

- First of all, the school name: in the example there are 2 letters for it (CV Colegio Vizcaya). You can use the number of letters you need.
- Second part, the level or course: numerical value regarding the age of the students (in the example first course is for first level of secondary)
- Class: the next letter indicates if the student is from the A, B or C group of that level
- Finally, the student number, in the example with two digits is enough as there are les dan 30 students in each class.

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3.9.3.1 Mobile Game 1 – 0 Waste

The variables captured as game statistics are the ones shown in the next table.

Category	Action	Label (es el user code)
app_start		CV1A01
app_platform	android	CV1A01
login_country	spain	CV1A01
login_zipcode	48170	CV1A01
login_gender	girl	CV1A01
login_age	6	CV1A01
show_tutorial		CV1A01
home_inhabitants	3	CV1A01
week_year	1_2019*	CV1A01
new_configuration	bag_red_glass_25**	CV1A01
new_configuration	bin_blue_cardboard_40	CV1A01
edit_configuration	bag_green_glass_25	CV1A01
delete_configuration	bin_blue_cardboard_40	CV1A01
new_registration	bag_green_glass_25_2_400***	CV1A01

Table 27. MG1 – 0 Waste - Game Statistics

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3.9.3.2 Mobile Game 2 – Sunflower

The variables captured as game statistics are the ones shown in the next table.

Category	Action (example)	Label (user code, example)
app_start		CV1A01
app_platform	android	CV1A01
login_country	spain	CV1A01
login_zipcode	48170	CV1A01
login_gender	girl	CV1A01
login_age	6	CV1A01
show_tutorial		CV1A01
home_inhabitants	3	CV1A01
week_year	1_2019*	CV1A01
new_configuration	bag_red_glass_25**	CV1A01
new_configuration	bin_blue_cardboard_40	CV1A01
edit_configuration	bag_green_glass_25	CV1A01
delete_configuration	bin_blue_cardboard_40	CV1A01
new_registration	bag_green_glass_25_2_400***	CV1A01
Category	Action (with examples)	Label (user code example)
app_start		CV1A01
app_platform	android	CV1A01
login_country	spain	CV1A01
login_zipcode	48170	CV1A01
login_gender	girl	CV1A01
login_age	7	CV1A01
show_tutorial		CV1A01
ar_start		CV1A01
ar_complete_time	10000 (milisegundos)	CV1A01
flower_action	water	CV1A01
flower_action	compost	CV1A01
flower_state_change	BAD 1	CV1A01
compost_action	water	CV1A01

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compost_action	aerate	CV1A01
feed_compost	4 coffee, 2 fruits,…	CV1A01
organism_collected	fungi	CV1A01

Table 28. MG2 – Sunflower - Game Statistics

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3.9.3.3 Mobile Game 3 – Treasure Machine

The variables captured as game statistics are the ones shown in the next table.

Category	Action	Label (es el user code)
app_start		CV1A01
app_platform	android	CV1A01
login_country	spain	CV1A01
login_zipcode	48170	CV1A01
login_gender	girl	CV1A01
login_age	6	CV1A01
show_tutorial		CV1A01
machine_selected_items	banana: 2, bulb: 3,…	CV1A01
chest_stars_by_item	shirt: 90	CV1A01
chest_stars_by_item	ball: 120	CV1A01
buy_reward	glass	CV1A01
buy_reward	velocity_buff	CV1A01
use_reward	points_buff	CV1A01

Table 29. MG3 – Treasure Machine - Game Statistics

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3.9.3.4 Mobile Game 4 – Waste Quest

The variables captured as game statistics are the ones shown in the next table.

Category	Action	Label (es el user code)
app_start		CV1A01
app_platform	android	CV1A01
login_country	spain	CV1A01
login_zipcode	48170	CV1A01
login_gender	girl	CV1A01
login_age	6	CV1A01
show_tutorial		CV1A01
new_challenge	Home_0	CV1A01
new_challenge	School_0	CV1A01
delete_challenge	Municipality_2	CV1A01
new_evidence	Home_0_1	CV1A01
new_evidence	School_1_3	CV1A01
delete_evidence	Home_0_2	CV1A01

Table 30. MG4 – Waste Quest - Game Statistics

The effectiveness of Mobile games in selected pilots (Zamudio&Halandri) will be implemented and measured through the indicated Learning Analytics in Waste4Think outcome platform and reported in Dx.x.

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4 Conclusion

This deliverable is the final released of innovative educational materials envisaged in Task 4.2 Learning materials within WP4 CREATION OF INNOVATIVE SOCIAL ACTIONS.

The outcome results of T4.2 are:

- 6 digital project scenarios
- 4 digital STEAM lessons
- 4 mobile location-based games

Along this document is described the final version of the 6 Digital projects and 4 Mobiles Games.

In previous deliverable - D4.3 Implementation of R8: STEAM Lessons – 4 STEAM Lessons were released with associated Digital Projects 1 and Digital Project 2, about “waste prevention and reuse” and “Source Separation and recycling” respectively.

All the designed educational contents have been created through an extensive interactive process involving all Waste4Think partners with a special focus on coping with requirements and needs of two involved pilots’ sites; Zamudio in Spain and Halandri in Greece. These materials have be tested and validated in participating schools as described in DX.X - XXXX.

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5 Comments from external reviewers

AGENCIA DE ECOLOGIA URBANA DE BARCELONA CONSORCIO

09-05-2019

Issue	Yes	No	Score (1=low to 5=high)	Comments
Is the format of the document correct?	X		4	It's correct.
Has the document a Executive Summary?	X		4	The summary refers to what it should be described.
Does the format of the document meet the objectives of the work done?	X		3	As it is written in the introduction this deliverable should contain final educational materials. In these terms we find the format should contain less tables and more instructions, theoretician information adapted for students, printable information for teachers etc
Does the index of the document collect precisely the tasks and issues that need to be reported?	X		3	Yes, but we consider that some contents are still needed for a clear idea on how to apply the materials at class
Is the content of the document clear and well described?	x		3	The scholar contents and the games still need to be improved and completed. The audience (teachers) won't find here enough help about the key points we want to transfer through the developed tools.
Does the content of each section describe the advance done during the task development?	x	X	4	
Does the content have sufficient technical description to make clear the research and development performed?	X		3	A lot of work has been done in the DP and mobile games, but the products might include wider descriptions about concepts to be learned and application at class. Also some corrections regarding technical issues regarding waste management must be reviewed
Are all the figures and tables numerated and described?	X		5	
Are the indexes correct?	X		5	
Is the written English correct?	X		5	
Main technical terms are correctly referenced?	X		3	Some suggestions have been included
Glossary present in the document?	X		3	Needs to include some acronyms used and waste management concepts adapted to different levels of students at school

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Partner: BCN

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SERIOUS GAME INTERACTIVE (SGI)

02-05-2019

Issue	Yes	No	Score (1=low to 5=high)	Comments
Is the format of the document correct?	Yes		4	
Has the document a Executive Summary?	Yes		3	
Does the format of the document meet the objectives of the work done?	Yes		4	
Does the index of the document collect precisely the tasks and issues that need to be reported?	Yes		5	
Is the content of the document clear and well described?	Yes		3	
Does the content of each section describe the advance done during the task development?	Yes		4	
Does the content have sufficient technical description to make clear the research and development performed?	Yes		4	
Are all the figures and tables numerated and described?	Yes		5	
Are the indexes correct?				
Is the written English correct?	Yes		3	Yes, there's a few comments in relation to the English that should be addressed
Main technical terms are correctly referenced?	Yes		3	A few internal references
Glossary present in the document?	Yes		4	

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Partner: Serious Games Interactive

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Engineering Ingegneria Informatica S.p.A. ENG

8/5/2019

Issue	Yes	No	Score (1=low to 5=high)	Comments
Is the format of the document correct?	x		3	In the text of the deliverable lacks the cross-refences to the tables, figures , annexes, external docs and internal sections. All acronyms used in the document should be described in the Glossary section.
Has the document a Executive Summary?	x		4	
Does the format of the document meet the objectives of the work done?	x		4	
Does the index of the document collect precisely the tasks and issues that need to be reported?	X		4	
Is the content of the document clear and well described?	x		3	
Does the content of each section describe the advance done during the task development?	x		4	
Does the content have sufficient technical description to make clear the research and development performed?	x		3	lack of technical aspects related to the integration with the FIWARE back-end
Are all the figures and tables numerated and described?	x		5	
Are the indexes correct?	x		3	In the text of the deliverable lacks the cross-refences to the tables, figures , annexes, external docs and internal sections.
Is the written English correct?	X		4	
Main technical terms are correctly referenced?	x		3	
Glossary present in the document?	x		3	All acronyms used in the document should be described in the glossary section.

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ENG

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