BREAKING EDUCATIONAL BARRIERS WITH CONTEXTUALISED PERVASIVE AND GAMEFUL LEARNING

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Statement of originality

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LIST OF ABBREVIATIONS

GLP	Gamified Lesson Plans
GP	Game Plots
MG	Minigame
LP	Lesson Plans
STEM	Science, Technology, Engineering and Mathematics

EXECUTIVE SUMMARY

The BEACONING Project (Breaking Educational Barriers with Contextualised, Pervasive and Gameful Learning) will provide different learning scenarios supported by different technologies for teaching and learning in an inclusive society focusing on 21st century skills, competencies, strategies, learning outcomes and learning disabilities.

The GLP also referred to as the Gamified Lesson Plans (GLP) constitute the core of the BEACONING Project and experience. The GPL embed learning in the daily life of the students, while providing deep engagement through their Game Plots overlaid over the pedagogical content. The specific aim of this deliverable is to describe how GLP relate to and are supported by the other components of the platform, respectively the Authoring Tool, the User Interfaces, the Game Plots, the Minigames, the Location Based Activities, and the Learning Analytics. The deliverable presents how the GLP are structured and enmeshed into the narrative Game Plots, and how teachers access and modify them. Examples of the contents and structure are provided.

The deliverable presents a variety of GLP, designed and developed for a variety of contexts and through a variety of approaches, showcasing the flexibility of the platform. It provides therefore an initial set of pedagogical scenarios, fully integrated in the technological platform, to be iterated and refined during the upcoming piloting phases in Work Packages 5 and 6.

1 INTRODUCTION

The aim of D4.8 is to put into practice the design specifications of the BEACONING Project as described in D3.3, Learning Environment System Specification and D3.5, Game Design Document, and more specifically:

- To detail the design, role and the collocation of the Gamified Lesson Plans (GLP) within the overall BEACONING ecosystem architecture.
- To provide an overview and a demonstration of all the components that support the deployment and utilisation of Gamified Lesson Plans (Game Plots, Authoring Tool, Minigames, Location Based Activities).
- To describe how teachers and students will experience Lesson Plans both from a user experience point of view and in their pedagogical content.
- To provides examples of Lesson Plans currently being developed.
- To outline links with the feedback dynamics of Beaconing, as supported by Learning Analytics.

1.1 BACKGROUND

The BEACONING Project aims to "break the barriers" that constrain learning from a social, spatial and technological point of view, enabling teachers to co-design GLP immersed in the real world and supported by a broad community, and facilitating students to experience learning through these Lesson Plans in a game-like form, and through a variety of devices and contexts.

The GLP constitute the very core of the finalised Project and, as such, the main day-to-day interaction with the platform for students and teachers. Most of the other Tasks and Deliverables in the Project work toward either creating the conceptual, pedagogical and technological infrastructure for the Plans to be deployed, or supporting deployment, testing and iteration of the Plans toward their maximum appropriateness, effectiveness and impact.

1.2 ROLE OF THIS DELIVERABLE IN THE PROJECT

This deliverable presents the overall architecture for the definition, construction, deployment and experiencing of the GLP, aligned with the design specifications developed in Work Package 3 (D3.3 Learning Environment System Specification and D3.5 Game Design Document) by both game designers and pedagogical experts. It has been prepared following specific guidelines described in the DoA and has been structured as a key hub of contributions from all partners, in turn providing flexible examples of usage scenarios to be implemented, tested and refined within the pilots in Work Packages 5 and 6.

An updated version of the GLP, inclusive of a broader variety of examples, will be provided later in the project, based on the feedback collected from the pilots, following the guidelines established in D5.3 and D6.1.

1.3 APPROACH

The GLP described here have been developed in close collaboration between game designers, learning designers and technical partners, embedding both the learning and game component in an overarching architecture and ontology, hereby described and developed into specific scenarios.

The objective is to provide a modular, flexible repository of gamified learning activities and learning activity design, that will be easily embedded in a variety of pedagogical needs and contexts and narratives (both during the moderation and game design phases), to provide maximum engagement and relevance. The deliverable will focus on the pedagogical content, while including brief descriptions of all the components, interfaces and processes that enable and support its deployment and usage.

1.4 STRUCTURE OF THE DOCUMENT

Section 1 of this document provides the overview of the role of this deliverable in the project in general and in user experience, highlighting how it builds on the design brought forward from the three fronts i.e., Game, Interface and Learning.

Section 2 discusses the overall ontology of the lesson plans, and its links with all the components constituting opportunities for both authoring and usage (i.e., Authoring Tool; Meta-game and Narratives; Minigames; Location Based Activities). It also discusses how the interface allows for a seamless experience both on the teacher and student sides. This section concludes with the description of the general experience ("storyboard") of going through a Lesson Plan.

Section 3 provides some examples of possible Lesson Plans that are currently being developed and those to be included in the oncoming alpha version of the platform. Some of these lesson plans are presented in detail (Algebra; Digital identity; Robotics; Power tools) while others are briefly described.

Section 4 discusses opportunities for assessment to be embedded in the platform. This informs best practices and areas of focus identified in relation to co-designing assessment with pilot partners.

Section 5 provides a conclusive overview of the impact of this deliverable on the overall Beaconing Project. It further suggests, next steps as to refine and iterate the implementation of this deliverable in collaboration with stakeholders.

2 GAMIFIED LESSON PLAN ONTOLOGY

2.1 THE OVERALL ONTOLOGY AND ROLE OF THE GAMIFIED LESSON PLANS

Figure 1 shows the place of the Gamified Lesson Plans (GLPs) within the overall BEACONING Ontology. They occupy a central role in the ontology, where Game Plots (GP) drawn from the Game Vault (see D3.5 and D4.3), Minigames (MG) and Lesson Plans (LP), i.e., repurposable pedagogical content, converge to procedurally build game instances and provide the core experience of the BEACONING Platform. These game instances are linked with the Core Services component (see D3.6 and D4.1) retaining user information to both pull and push data, providing a persistent, data rich experience.

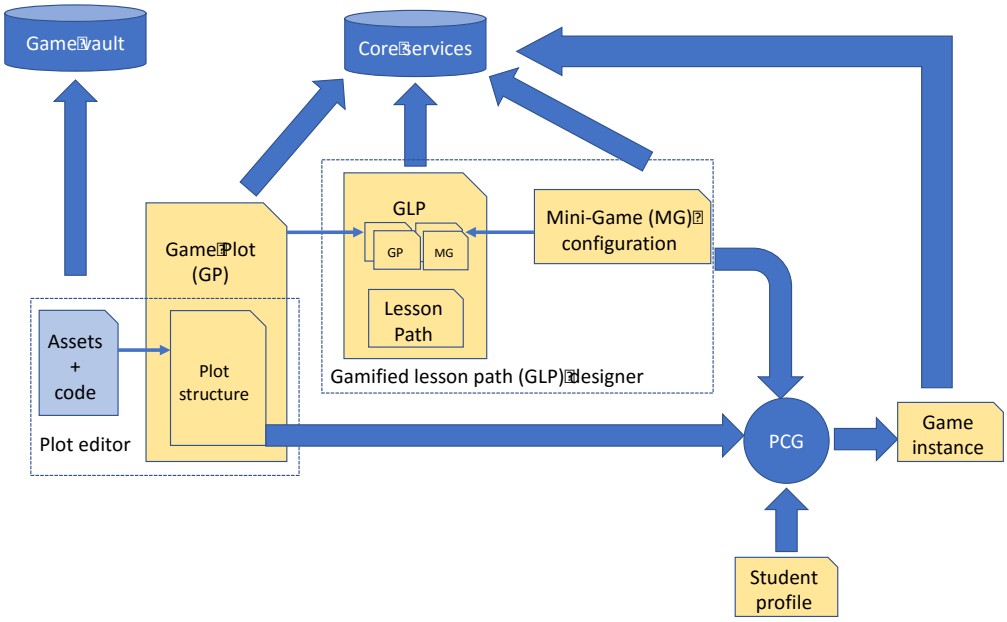


Figure 1. BEACONING Ontology, and role of Gamified Lesson Plans

2.1.1 Learning Taxonomy

The Learning Taxonomy is built to enable teachers to easily select, build and share appropriate GLP according to a system of Tags. To do this, the first step for a teacher is to select a STEM area (Science, Technology, Engineering and Mathematics) followed by a specific topic. In the next step, a specific and contextualised problem or challenge will be defined, targeting an age group or an educational activity. Finally, a brief description of the missions and quests that completes a Play-Lesson Plan, including some keywords that are associated with the Play-Lesson Plan are defined. Player characteristics (e.g. domain, age group) are considered when designing a GLP and they can used as filters.

The proposed Taxonomy includes categories (e.g. skills/competencies linked to activities or progress), aims/objectives, time frame, tools and so on. The Taxonomy will enable teachers to create scenarios and associated missions (tasks) and quests (subtasks). It is anticipated that the Taxonomy will be further developed through the pilots, and future versions will provide an easy and straightforward way for teachers to create and contextualise Gamified Lesson Plans.

2.1.2 Integration with Game Plots

To preserve the versatility, and scalability, and to foster engagement, immersion and retention, it is important that the GP (as discussed in D4.3) and the pedagogical content of the GLP properly interlace, through correct implementation and use of the Game Plot Editor (accessible at http://beaconing.eu/demo/gameploteditor). To enable this, both the game narrative and pedagogical content designers need to consider the following aspects:

- GP and LP do not necessarily need to progress at the same speed. However, they do need to fit in the same time scale.
- GP can be chained sequentially by meta-narratives that would be more meaningful to the students. These series of narratives belong to a major "campaign" (a series of linked Missions) and are parts of a larger plot.
- GP must not feel disjointed or drastically unrelated.
- GP should be designed generically, making it possible to adapt to different LP.

The concept of "slots" in the GP allows pedagogical content to be slotted (as shown if Figure 2). Some LP may require the player to go outside of the Game Plot to collect evidences, acquire knowledge or complete actions, in order to progress. Synchronisation must be maintained while moving in and out of the GP.

These "slots" will be conceptualised within the GP as "gates" and will enable a more flexible narrative design around pedagogical content. In order to make the GLP narrative to be fluent and consistent, we introduce the concept of teleport gates where the player has to move out of the GP. This will ensure that GP will not be endless tunnels that students will not be able leave without breaking immersion. Utilising this fishbone style structure allows traversing back and forth naturally in a game plot, as showcased in the example provided in Section 2.3.

In the current stage of design, "slots":

- Can be ignored or are not visible during the GLP authoring;
- Can be used to run Minigames;
- Can be used to run Location Based activities;
- Can be used to run Password gates (requiring a one-time answer).

Content upload is another function that will be implemented in the next phase. Users will be able to provide real world data and evidence into the ecosystem using this content uploading feature. As both pedagogical and game design will be iterated through the pilots, new possible functions for these slots will potentially emerge. Also, in the future, multiple and bespoke narratives will be developed matching various lesson plans.

Figure 2. Game Plot and Slots/Gates

2.1.3 Integration with Minigames

Minigames (described in D4.3, and accessible at http://beaconing.eu/demo/minigames) will be slotted and plugged by the teacher within the GP based on the above discussed structure, and will be triggered by students when traversing through the GLP. Minigames will be integrated with the Learning Analytics and Core Services, enabling both adapting to student requirements and providing real time feedback. While in their current form they are embedded in the LP, nevertheless once the pilot studies are initiated according to the guidelines discussed in D5.3 and D6.1, the possibility of (and level of teachers' interest towards) activating Minigames directly from the Teacher App will be explored, in order to provide more diverse and flexible opportunities for BEACONING supported learning design and activities.

Minigames are authorable through the Authoring Tool following a JSON schema based approach. As broadly described in D4.3 and D3.6, the Authoring Tool is able to automatically generate the authoring form and save the mini game configuration in the minigames backend.

Minigames are a web based component that will be experienced by the student inside the Game App, more specifically, the minigames will be triggered by the interactions of the player with the game characters encountered during the gamified learning plan. A callback mechanism ensures that the Student App triggers the opening of the specific minigame session through a query string parameter.

In the picture below one example of a minigame screen.

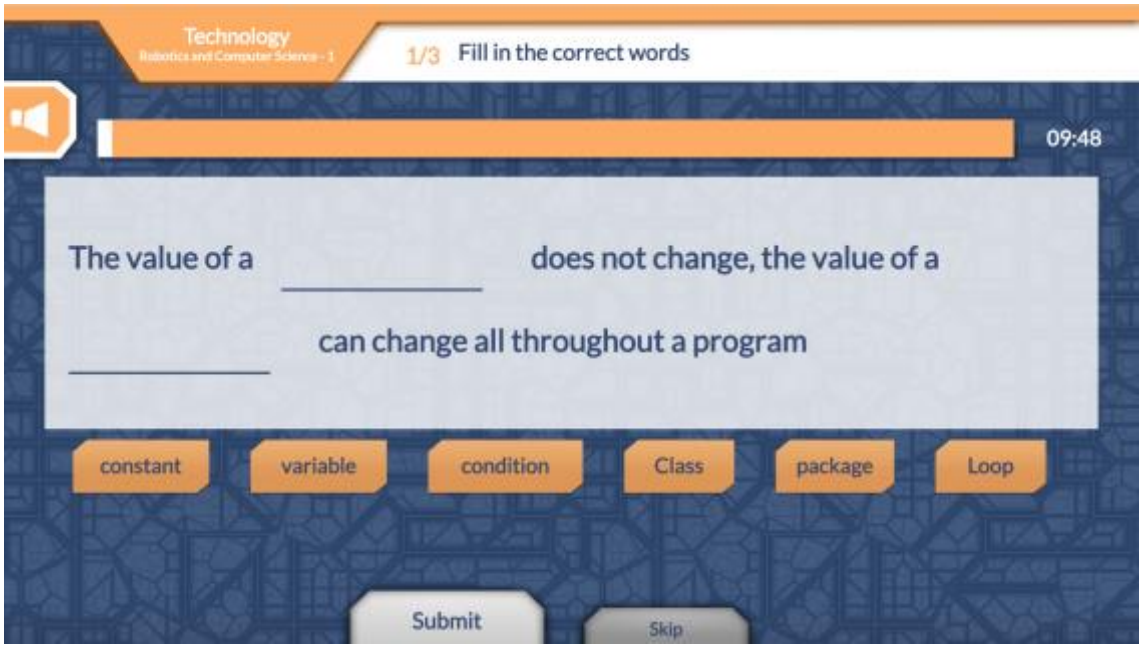


Figure 3. Minigame quiz screenshot

2.1.4 Integration with Location Based Activities

Teachers will be able to author and build customised activities through the Location Based Activities Authoring Tool (as described in D4.3, and accessible at http://beaconing.eu/demo/contextawareauthoring) as an integral part of the GLP. It can be done by selecting overall types of Location Based Challenges (described in depth in D4.3) and detailing the activities students are required to complete while being present at specific geographical points. This function will also be used along with the content upload, which will be key for the development of further location based activities.

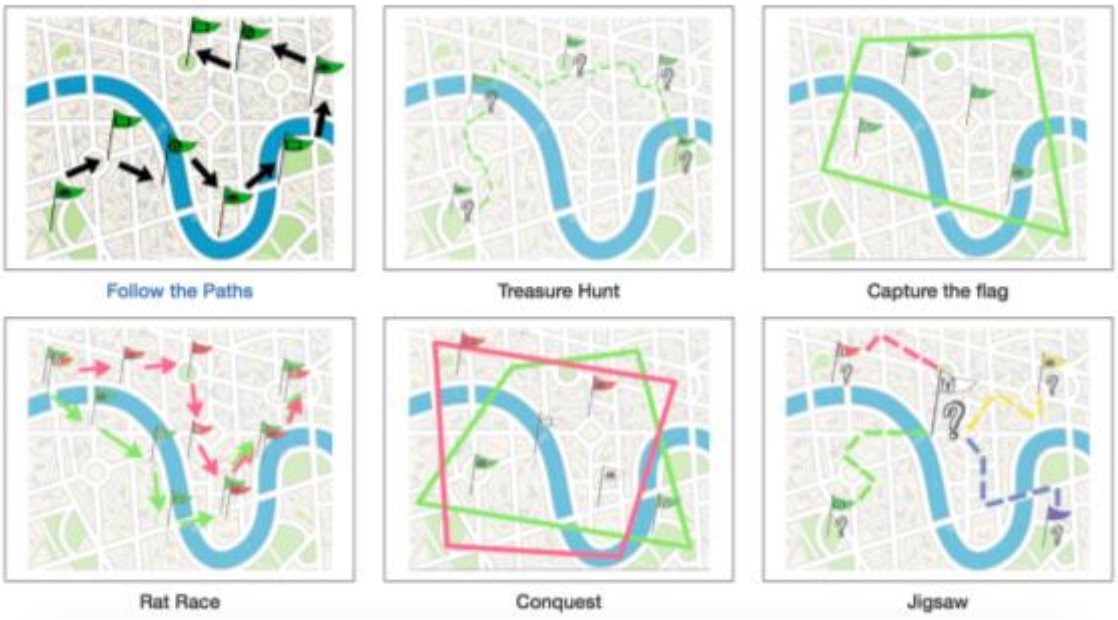


Figure 4. Location Based Authoring Tool, Types of Challenges

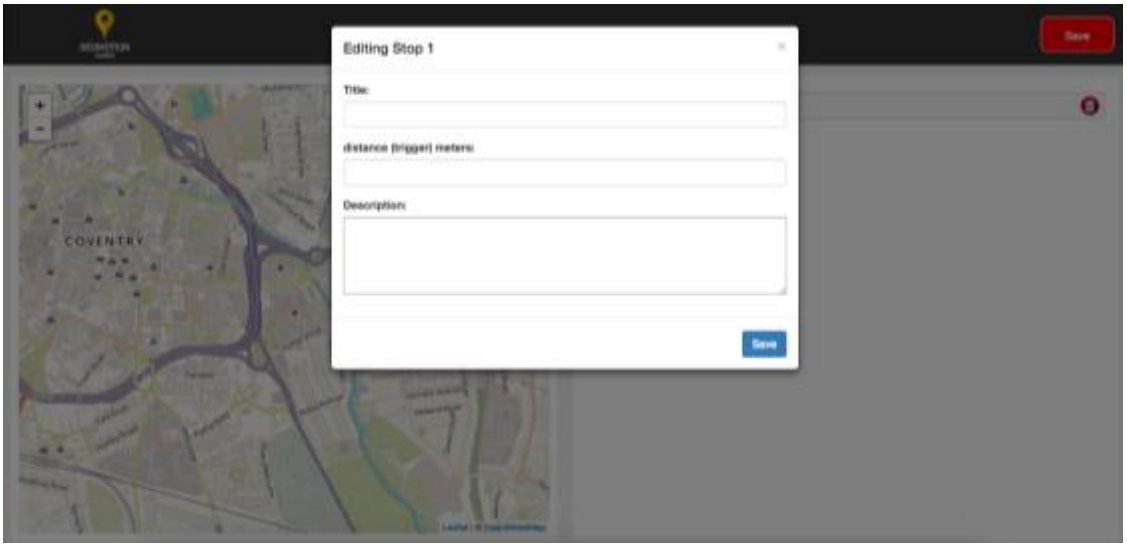


Figure 5. Location Based Authoring Tool, Point of Interest Editor

While the Location Based Activity Authoring Tool will be fully integrated with the general Authoring Tool, the modular design provides the opportunity to independently deploy location-based activities during the pilots, therefore they can be further tested and optimised to allow more diverse and flexible opportunities for BEACONING supported learning design and activities.

2.1.5 Integration with the Authoring Tool

The Authoring Tool (accessible at http://beaconing.eu/demo/authoringtool) is the primary component that enables learning designers (or sometimes teachers performing the same role) to author, edit and deploy Lesson Plans according to their specific needs. The Authoring Tool enables teachers to create Missions, and Quests. Single or multiple quests are integrated within a Mission, and sequential chains of Missions form a full LP. Examples of the activities that can be authored through this tool are shown in Annexes 1 and 2.

Figure 6. Mission Editor

Figure 7. Mission Overview in the Authoring Tool

2.2 INTERFACES

In this section, student and teacher interfaces will be briefly illustrated, as they constitute the means through which users, both on the student and teacher side, will be able to access and interact with the GLP. Working prototypes of the interfaces are available at http://beaconing.eu/demo/teacherui

2.2.1 The Student Dashboard & App

The Student Dashboard is the main web page where students can get an overview of their progression within the different GLPs, and link with the Community. From this same web page students, will be able to access and launch LP (or specific activities and Quests) which have been activated and assigned to them by their teachers.

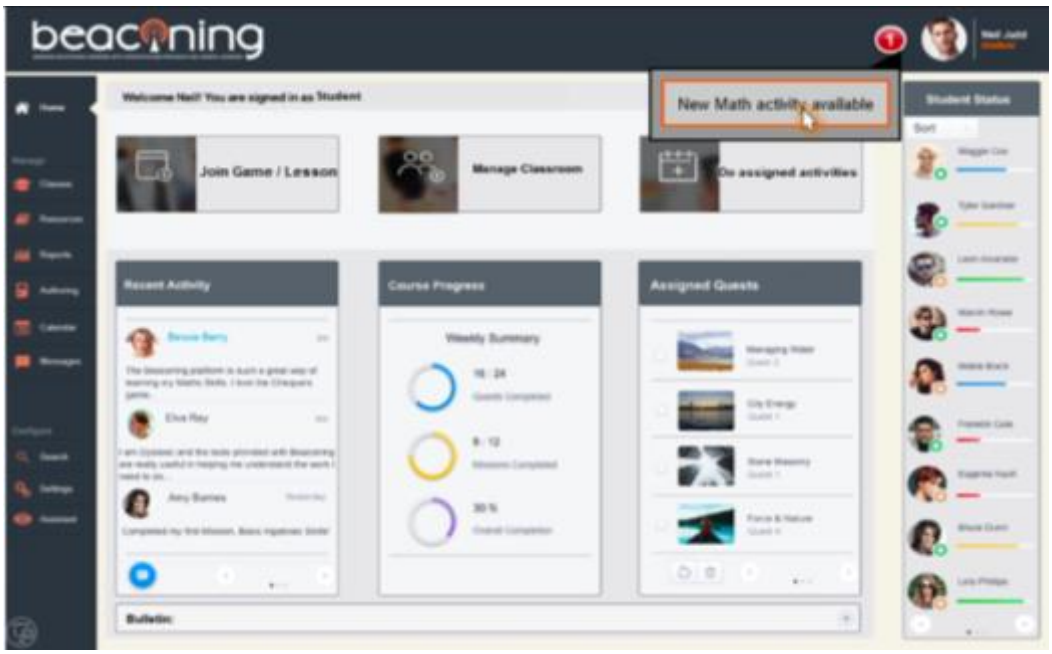


Figure 8. Student Dashboard

Students will be able to monitor their own progress through the student dashboard and compare it with their classmates, as shown below in Figure 9.

Figure 9. Student Progress Dashboard

When the student launches a GLP, the Game App will open (see D3.5 and D4.3 for in depth description). The Game App will frame the GLP in a Game Plot, as Missions and Quests undertaken by special agents (see Figure 9 below).

Figure 10. The Game App

2.2.2 The Teacher Dashboard and App

The Teacher App will provide teachers with an easy access to the Authoring Tool, where GLP can be built, edited and deployed, as shown in the figure below.

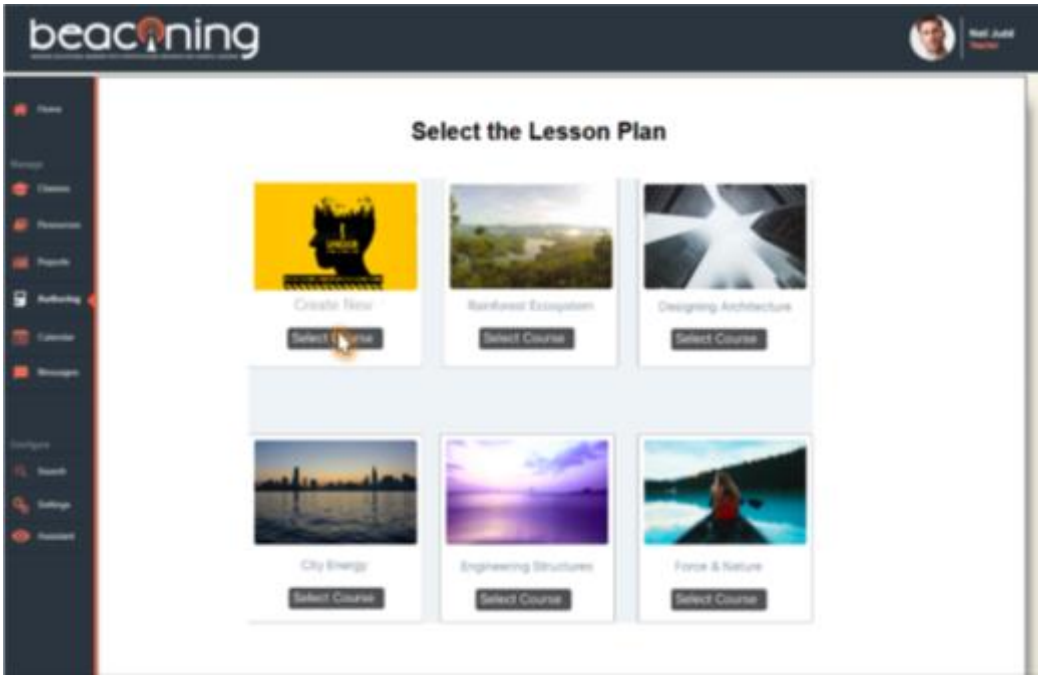


Figure 11. Lesson Plan Selection

The Teacher Interface will also provide a Dashboard where students' data concerning their interaction with the GLP will be collated and made accessible to enable teachers to provide evidence based feedback (see Section 5).

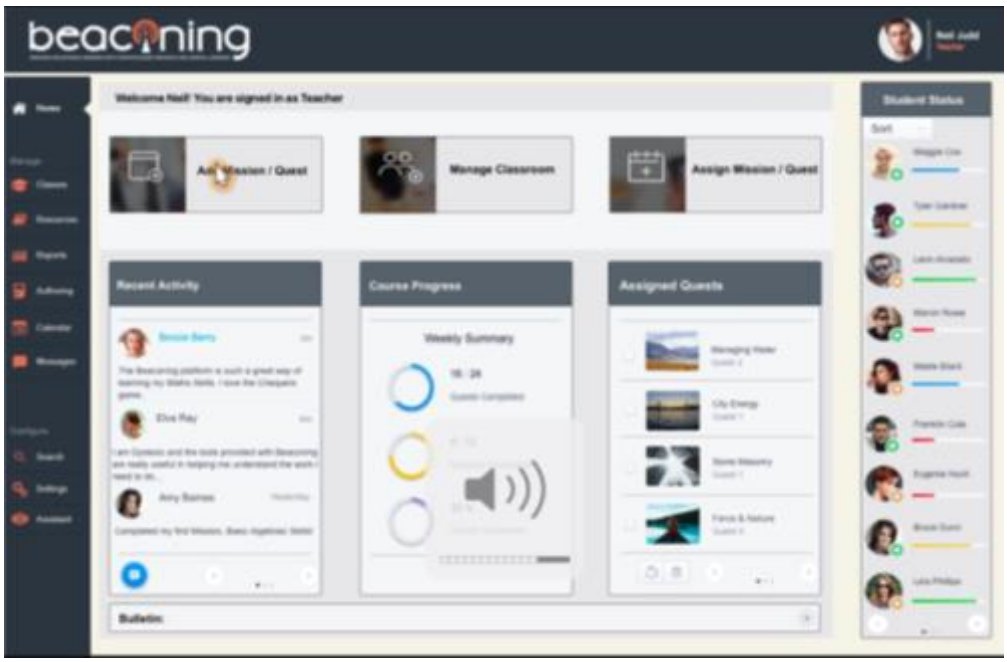


Figure 12. Teacher Dashboard

2.3 STORYBOARD AND GENERIC USE CASE

In this session, we will provide an example of how a GP and a LP can be organically merged and kept reusable and repurposable. A LP has its own rhythm as well as any good story has, so the main challenge, as discussed in section 2.1.3, is to synchronize both of them in a convincing way. This issue is addressed by introducing the above discussed slots at key points of the GP. The slots will allow the teacher to control the phase at which the students are progressing through the narrative. Events happening in a GP are grouped in "scenes" in a way that no scenes can have more than one slot inside, so as to maximise the modularity and versatility of the GP.

Slots can be of different types: for now, two types have been implemented:

- **Minigames**: the player must go through one Minigame to be able to continue in the next step of the GP.
- **Location Based Activities**: the player will go through a “Gate” and explore real world issues, providing context-based evidence.
- **Questions**: the player must enter the answer to a simple question (or a password) to be able to continue.
- **Content Upload**: is a third type planned but not yet implemented. With the content upload the student can upload evidences that are required by the teacher. The teacher will verify these evidences and greenlight whether the student can continue progress or not.

The scheme below provides the general organization of a GP (aimed at being played within the BEACONING Game App) mixed with an LP (aimed at being applied in the real life outside of the BEACONING Game App). It has been applied to a selected LP (Algebra) and a selected narrative (Save the boss) to demonstrate how well they integrate in the narrative and the LP.

Teachers can actually determine the content of the Gates, as well as whether they can enable or disable Gates/slots in a narrative. However, adding new, deleting or moving gateways can only be done by the plot editor, this is generally expected to be done by the game developers and not the teachers.

In the example below the slots (15 in total) featured in the Game Plot can be used to fit with both the Algebra and the Coding and Robotics lesson plans (see Annexes 1 and 2). Game Plots can have variable number of slots based on their complexity.

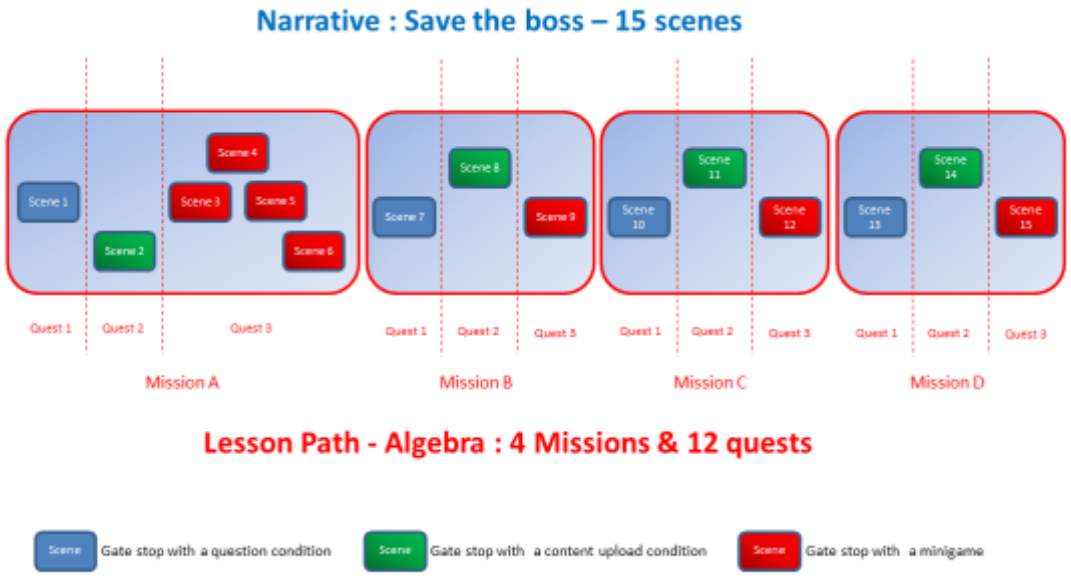


Figure 13. Game Plot Diagram

The table below provides a description of this Game Plot focused on the narrative experience. To match with the pedagogical content that can inserted in the Gates/Slots provided by this Game Plot, see Annexes 1 and 2.

Table 1. Lesson Plan descriptions matched with narrative scenes

Mission	Quest	Lesson Plan description	Lesson plan Gate	Matching narrative Scene
A	1	During the first tour of the school organized for the students, they are getting a quiz with activities containing questions to solve at each time they reach a certain place. There are 4 questions in each activity, one per each operation	Evidence: The results of quiz	Scene1
A	2	An introductory course is given and also some support material (paper, Internet).	Evidence: log of the access to the resources by the students	Scene2
A	3	Exercises are given to practice and reinforce as an automatism the refreshed knowledge. They can be done inside or outside the classroom, through minigames. The minigames in	Evidence: Minigame result	Scene3 Scene4 Scene5

		question must be of the fill-the-gap type.		Scene6
B	1	In the classroom, a test is given with some proportionality exercises This quest along with quest 2 gives a reverse-classroom theme to this mission, with lesson to be learnt/relearnt at home and practice being done in the classroom.	Evidence: The results of the in-class test	Scene7
B	2	An introductory course is given and also some support material (paper, Internet).	Evidence: log of the access to the resources by the students	Scene8
B	3	Exercises are given to practice and reinforce as an automatism the refreshed knowledge. They are triggered when the student enters into a supermarket or a shop (list of GPS locations have to be provided by the lesson plan designer, and the graphics of the minigame might be tailored to for the environment of the user). The minigames in question must be of multiple-choice-question type.	Evidence: minigame result	Scene9
C	1	In the classroom, a test is given with some exercises about divisibility rules This quest along with quest 2 gives a reverse-classroom theme to this mission, with lesson to be learnt/relearnt at home and practice being done in the classroom.	Evidence: The results of the in-class test	scene10
C	2	An introductory course is given and also some support material (paper, Internet).	Evidence: log of the access to the resources by the students	Scene11
C	3	Exercises are given to practice and reinforce as an automatism the refreshed knowledge. They can be done inside or outside the classroom, through minigames. The minigames in question must be of select-elements-in-a-list type.	Evidence: minigame result	Scene12
D	1	In the classroom, some activities about decomposition and factorization are	Evidence: The results of the	Scene13

		carried out. This quest along with quest 2 gives a reverse-classroom theme to this mission, with lesson to be learnt/relearnt at home and practice being done in the classroom.	in-class test	
D	2	An introductory course is given and also some support material (paper, Internet).	Evidence: log of the access to the resources by the students	Scene14
D	3	Exercises are given to practice and reinforce as an automatism the refreshed knowledge. They can be done inside or outside the classroom, through minigames. The minigames in question must be of fill-the-gap type.	Evidence: Minigame result	Scene 15

3 EXAMPLE LESSON PLANS

3.1 RATIONALE AND CONTEXT OF THE EXAMPLES

The examples presented below showcase the pedagogical content of two scenarios developed by ORT for a High School Environment and another one developed by Herriot-Watt University for a Further Education Environment. These scenarios are developed in very dissimilar contexts and using different approaches and formats. As long as they are in compliance with the general Learning Taxonomy they integrate well in the overall platform and ecosystem. This demonstrates the ability to integrate and interoperate a variety of technologies and standards, also supporting both Problem Based Learning and approaches that are more traditional.

3.2 FULL EXAMPLE: ALGEBRA

This LP represents a basic use of the BEACONING Platform, following a linear plan of quiz-like activities delivered through Minigames. The potentiality of the BEACONING Platform to be context sensitive here leans on its on-demand nature, and on the networking of data across its whole community, more than on the activities themselves. A demo version of this Lesson Plan was showcased at the eLSE conference, and is available at the following link:

http://beaconing.eu/demo/protobeaconing.apk

The example content is detailed in Annex 1.

3.3 FULL EXAMPLE: CODING AND ROBOTICS

This specific LP presents a more complex example of the potentialities of the BEACONING Platform, utilising both quiz-like activities delivered through Minigames and Location Based Activities. Here the current architecture and components of BEACONING are used to their full extent. A bespoke, demo version of this Lesson Plan was showcased and played at the eLSE conference (Bucharest, Romania, 28 April 2017) and is still available for any mobile device at the following link: http://beaconing.eu/demo/therobot
However, due to the nature of the Gamified Lesson Plan, Location Based Activities make it contextually playable only at the conference site.

The example content is detailed in Annex 2.

3.4 FULL EXAMPLE: VET (POWER TOOLS)

This specific LP, aimed at a Further Education environment and, as with all VET structured programmes, any BEACONING GLP deployed in this context has to comply with the National Occupational Standards and the respective Qualification Authority body for it to be beneficial to the stakeholder. The need of compliance is to ensure recognised qualifications and services; therefore, a lesson plan is designed from the outset of learning outcomes. The example herein follows the COSVR195 (http://www.ukstandards.co.uk/PublishedNos/COSVR195.pdf), relevant to occupations in bricklaying and stone masonry.

A. Domain / Area / Subject

VET / Construction industry / Health and Safety controls for 9 " Angle Grinder in stone cutting use

B. Topic

Stone masonry

C. Age Group / Key Stage / Year / Background

16yrs onwards / SQA / 4 / Pre Apprenticeships to Advanced Stonemasonry

D. What is it about?

To develop a comprehensive understanding and competency in interpreting information, adopting safe, healthy and environmentally responsible work practices of the occupational standards in stone masonry. Cognitive and technical learning outcomes include selecting and using materials, components, tools and equipment, and preparing and producing architectural stone enrichments in natural stone. The lesson plan is designed to meet NOS/SQA standards for people working in the occupational area of stonemasonry and can be used by operatives, supervisors and managers as a training/assessment application. The pedagogical approach is situational problem solving through experiential learning (construct-cognate-connect), the directive being errorless learning.

E. Overarching Narrative

The players work as individuals but are able to participate in a collaborative manner.

Environment: Inside or outside the VET college, at home, at workplace

Tasks: Health and safety topics are given throughout missions, in correspondence to the work tool, processes and procedures for stone masonry across missions.

Interaction: Activities and tasks through minigames/challenges, across different platforms (e.g. PC, mobile, blended) via with mixed interaction modalities (e.g. gestures, cyber-physical, props).

The lesson plan comprises 5 Missions, each with a corresponding Quest.

Mission A. Establishing pre-requisites

Quest 1. Establishing current knowledge in stone masonry occupational requirements, angle grinding methods, tools and techniques.

Mission B. Standards Interpreting Information

Quest 2. Learning tools/machine forms, engineering control and on site protocols.

Mission C. Adopting industry relevant, safe, and healthy working practices

Quest 3. Learning Stone masonry terminology, knowledge of basic waste removal techniques, knowledge of application of removal techniques into industry relevant safe and healthy working practices.

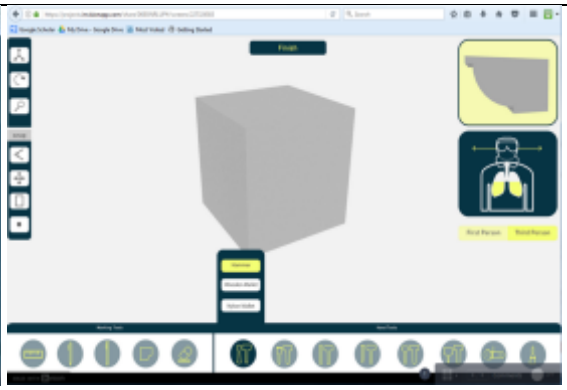
Mission D. Quantification of resources, trade skills, VE-STEM

Quest 4. Knowledge of selecting and understanding of Stone, Tool Process, Operational procedures (e.g. Waste removal, Work to template lines).

Mission E. Applying tools, moving, handling, using, storing, occupational safety

Quest 5. Demonstrate problem-solving through appropriate methods work practices processes control (HSE, protocols).

- *Quiz: students will be provided with 10 -15 questions, with each category of Mission questions with increasing difficulty, regarding all aspects of using an Angle Grinder for stonework on-site, process planning a job and occupational requirements.*
- *Simulation game: An interactive frontend where students can conduct stone masonry operations including health and safety implementation checks. A dashboard provides feedback.*



General trend of lesson plan: Classroom instruction (protocol and video explanation) → Immersive Virtual Site Visit (using 360 videos) → Hands-on VR tool (practice) → Use of the angle grinder on-site (Simulation in FE workshop: Plastic blade/substitute + mock stone- rigid thermoset modified resin insulant)

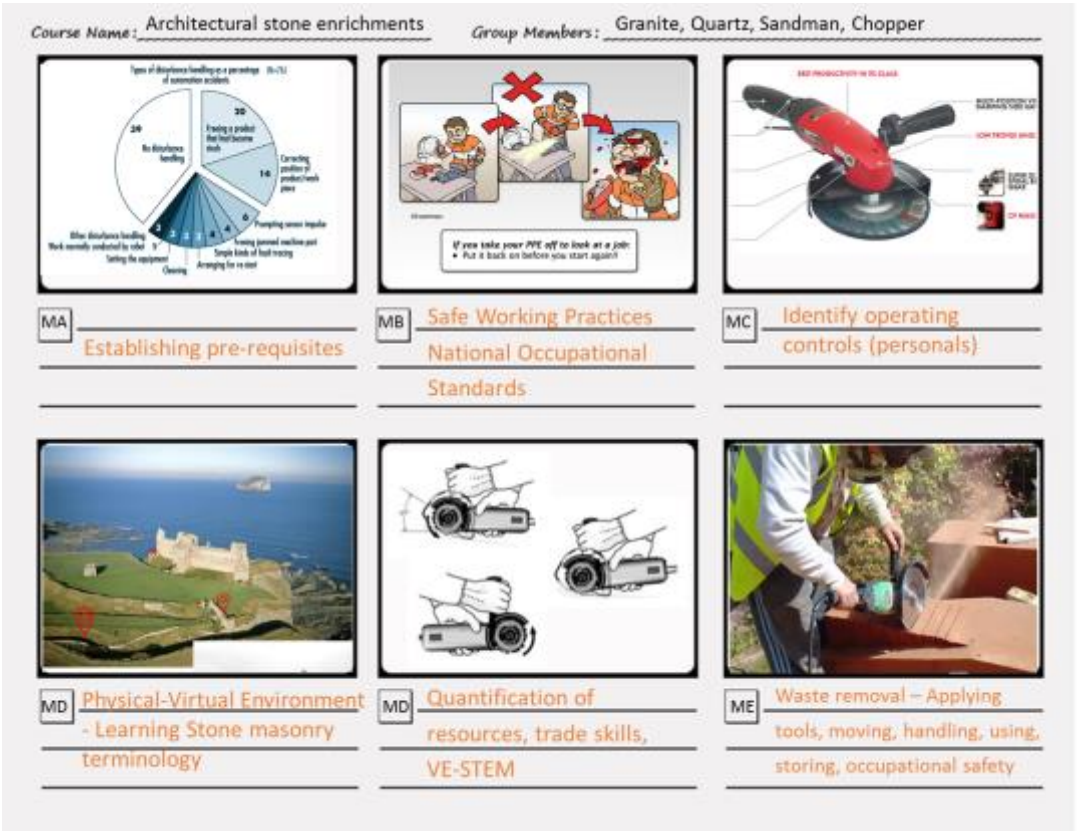


Figure 14. VET storyboard for performance criteria on waste removal

Further details on this example are provided in Annex 3.

3.5 FURTHER EXAMPLES (SHORT DESCRIPTIONS)

These are examples of GLP that are currently in development, many of them relying strongly on the soon-to-be-implemented Content Upload feature to provide a strongly context-based experience. Together, these examples will constitute the initial bundle of LP used in the pilot studies, their validity and design to be further iterated and refined according to the guidelines established in D5.3 and D6.1.

3.5.1 Example 1: Digital Identity

This LP is about learning the concept of digital identity, how to protect it, but also how to improve it, exploring how the ramifications of the concept of digital identities, both legal and social, are a complex and challenging topic. The Missions that compose this LP are:

1. Understanding the Concept of Digital Identities
2. A Close Experience on the Management of Digital Identities
3. Presentation of a Digital Identity
4. How to Protect a Digital Identity

3.5.2 Example 2: Design Thinking

Through this LP students will explore opportunities for collaborative design thinking to confront science and technology issues in the local area, and they will get a foundation in framing problems and rapidly prototyping and testing solutions. The Missions that compose this LP are:

1. What do we care about?
2. What can we do?
3. How can we do it?
4. How can we make it work?
5. Where do we go from here?

3.5.3 Example 3: Energy Management

This LP is about how energy usage can impact the environment, identifying different types of energy sources and planning sound, sustainable management from both a technical and environmental standpoint. The Missions that compose this LP are:

1. What is Energy
2. Energy Conservation
3. Energy in Your House

3.5.4 Example 4: Data Management

This LP is about enabling students to get acquainted with the fundamentals of data management, especially as pertaining statistical analysis. The Missions that compose this LP are:

1. Tendency of Data
2. Central Tendencies and Discrepancies
3. Data Integration
4. Base Rate Fallacy

3.5.5 Example 5: Graph Theory and Tessellation

This LP is about progressively recognising the relevance of geometry in the structure of everyday life, going from everyday objects to an in-depth exploration of the topology of their environments. The Missions that compose this LP are:

1. Geometry Treasure Hunt
2. Shapes of the City
3. Landscape Tessellation
4. Crowd Mapping

3.5.6 Example 6: Waterways

This LP explores the water cycle, water usage practices and consumption, both at school and at home and contextualise the local water ecology concerning nearby water bodies, and the impact of human activities.

1. Water Cycle in Theory
2. Water Cycle at Home
3. Water Cycle in my Town

3.5.7 Example 7: Chemistry and the Environment

This LP is about progressively recognising the relevance of chemistry in everyday life, and how every single day-to-day choice can impact environmental health. The Missions that compose this LP are:

1. The Environment Big Killers
2. Big Killers in Your Town
3. Environmental Reportage

4 ASSESSMENT, METRICS AND ANALYTICS

4.1 GENERAL EVIDENCE BASED ASSESSMENT APPROACH

Every BEACONING LP will come with rubrics and thresholds aimed at assessing the Competences explored through it, which are discussed more in depth in D6.1.

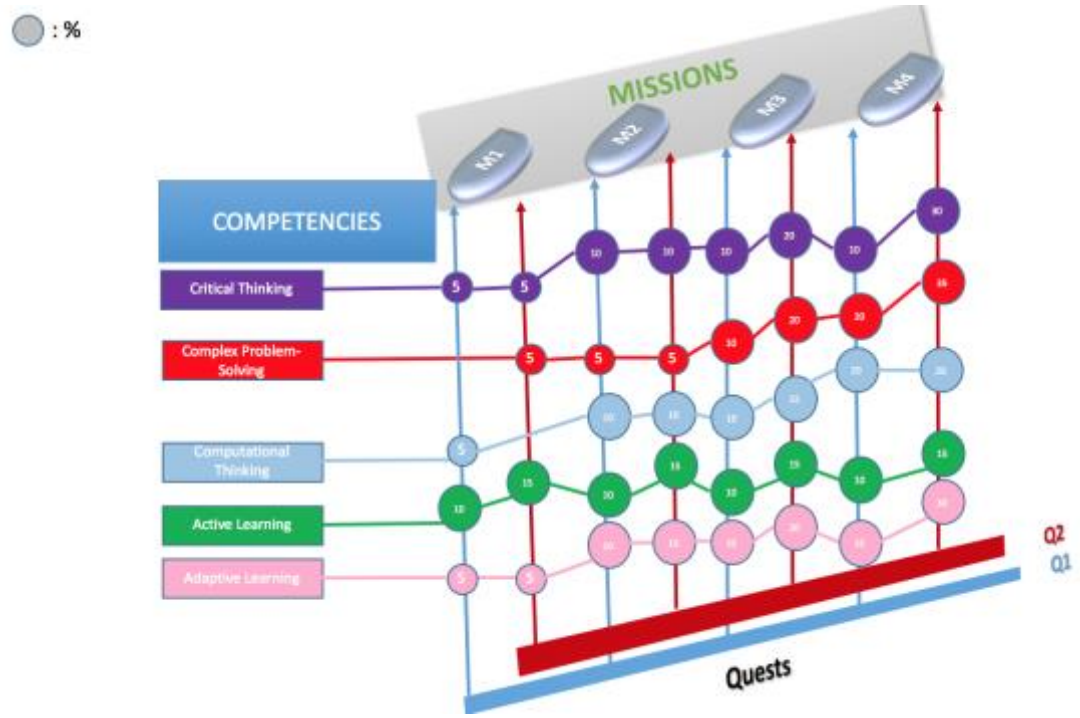


Figure 15. Competence Assessment Model

However, the above-mentioned built-in rubrics and metrics are not expected to be a one-size-fits all tool, and constitute mainly a guideline and a tool for teachers to more easily navigate the breadth of data that the BEACONING Ecosystem can provide. As assessment, has not been yet fully integrated, and Pilots will move beyond the technical phase to explore the complexities of using BEACONING as a learning design-and-assessment too.

4.2 LINKS TO LEARNING ANALYTICS

Work concerning integration of analytics with the GLP is still underway, with partial integration completed with the Minigames, location based games and the backend client side of the platform. On-going work will include integration with the game engine, Game Plots and the Authoring Tool for the GLP, therefore allow data generated by participating in the GLP to feed the Analytics – as part of the ongoing iterative work toward refining the Plans and making them both relevant and flexible.

5 CONCLUSION

This document exemplified and provided a rationale for the structure of the GLP, and discusses their core role within the complex network of functionalities and components that constitute the BEACONING Platform and Ecosystem. The proposed outline for the plans is grounded in the principles of modularity, flexibility, contextualisation and engagement, allowing them to be seamlessly and effectively embedded in a variety of pedagogical contexts, while generating a large volume of data for both teachers and students.

5.1 RESULTS

The deliverable describes the detailed structure of the BEACONING GLP, their relationships with the overall BEACONING Platform and Ecosystem, and illustrates ten scenarios that will be implemented within the platform.

The work provided herein represents therefore a key reference point for the design of GLP, particularly activities including context-informed and location-based components, providing the foregrounding for soon to be deployed pilots.

5.2 IMPACT

A revised version of the GLP (and an expanded repository of them) will be produced when the pilots will have produced actionable feedback, and will address specific technical, pedagogical and engagement issues and improvements that arise during pilot testing.

ANNEX 1 ALGEBRA

In this annex the pedagogical contents and challenges of the Algebra Lesson Plan are fully described. This is a basic example of the contents that can be "slotted" into Game Plots, and relies mostly on minigames and quizzes to provide evidence and progress.

Basic algebraic skills refresher course

Subject: Math Sub-subject: Algebra	Total Time: 20h

General Description

Today's world requires knowledge based on solid basic skills such as mathematic literacy. An alarming picture of the current situation in math literacy at high school level is provided by the PISA and TIMSS international surveys.
Some basic mathematical notions learned in primary and secondary schools are still not fully mastered by some students by the time they arrive in high school. This situation will lead those students to be unable to follow properly the math curricula, especially in algebra, are they are not able to build on this pre-existing knowledge.
This activity will address the problem by providing activities designed to work on essential algebraic notions needed throughout the high school curricula.

Basic algebraic skills refresher course

Mission A: The 4 basic operations

Subject: Math Sub-subject: Algebra	Quests: 3 Time: 5h

Description

With the prevalence of many automatic ways of computing simple operations such as pocket calculators, smartphones, computers and so forth, students very often forget how to realize simple operations by themselves and without help. They tend to commit simple mistakes that can often snowball and make all further computations wrong. Those mistakes could be easily avoidable by practicing the 4 basic operations in a step by step fashion.
The operations can be practiced by hand or by using an electronic device, either directly or in a fill-the-gap fashion.

Skills and Competencies

Analyze, Reflect, Solve, Evaluate, Interpret

Resources

Any book or web-based refresher course material, such as: http://www.basic-mathematics.com/basic-math-word-problems.html

Basic algebraic skills refresher course

Mission A: The 4 basic operations

Quest 1

During the first tour of the school organized for the students, they are getting a quizz with activities containing questions to solve at each time they reach a certain place. There are 4 questions in each activity, one per each operation.

Subquest 1: What are the four operations of arithmetic, and what are their operation signs?

Subquest 2: Solve the following 4 operations:
12 + 39; 2597 + 5684; 45,5 + 87,6; -12 + 20

Subquest 3: Solve the following 4 operations:
45 - 21; 567 -498; - 34,4 – 23,4; -20 – (-12)

Subquest 4: Solve the following 4 operations:
11 x 23; 1546 x 4879; 24,2 x 32,4; -45 x 99

Subquest 5: Solve the following 4 operations:
45 / 9; 4587 / 245; 254 / 5897; 45,6 / 5,3

Evidence: The results of quizz

Quest 2

A refresher course is given and also some support material (paper, Internet).

Evidence: log of the access to the resources by the students

Basic algebraic skills refresher course

Mission A: The 4 basic operations

Quest 3

Exercises are given to practice and reinforce as an automatism the refreshed knowledge. They can be done inside or outside the classroom, through minigames. The minigames in question must be of the fill-the-gap type.
The questions are asked in groups of 2. If the users gives 2 good answers, the difficulty level goes up, f it's two mistakes it goes down. The game starts at the easy difficulty level.

Set of 10 default operations for the game :
Additions
EASY: 25 + 14; 49 + 20; 58 + 63; 36 + 89; 48 + 55; 98 + 87; 65 + 23; 78 + 98; 155 + 244; 158 + 163
MEDIUM: 156 + 587; 896 + 135; 563 + 784; 456 + 789; 871 + 796; 1253 + 896; 5,6 + 10,4; 35,5 + 48,3; 56,8 + 87,9; 99,9 + 78,8
HARD: 1459 + 685; 1569 + 2687; 5478 + 7863; 25967 + 59687; 589763 + 54879; 12,26 + 56,41; 256,64 + 547,36; 1,236 + 2,5987; 5697,253 + 8976,4214; 97841,45 + 235,569
Subtractions
EASY: 25 - 14; 49 - 20; 58 - 63; 36 - 89; 48 - 55; 98 - 87; 65 - 23; 78 - 98; 155 - 244; 158 - 163
MEDIUM: 156 - 587; 896 - 135; 563 - 784; 456 - 789; 871 - 796; 1253 - 896; 5,6 - 10,4; 35,5 - 48,3; 56,8 - 87,9; 99,9 - 78,8
HARD: 1459 - 685; 1569 - 2687; 5478 - 7863; 25967 - 59687; 589763 - 54879; 12,26 - 56,41; 256,64 - 547,36; 1,236 - 2,5987; 5697,253 - 8976,4214; 97841,45 - 235,569
Multiplications
EASY: 6 x 9; 5 x 12; 32 x 3; 58 x 7; 26 x 41; 12 x 23; 25 x 34; 45 x 87; 56 x 58; 36 x 98
MEDIUM: 45 x 25; 58 x 98; 77 x 86; 56 x -45; 87 x -89; 12,5 x 4; 32,2 x 45; 9,5 x 8,6; 12,5 x 36,6; 89,3 x 67,9
HARD: 45 x 897; 5364 x 42; 457 x 783; 4567 x 2347; -245 x 654; -789 x -452; 23,45 x 45,98; 7,832 x 5,987; 489,8 x 59,21; 957,8 x 0,6541
Divisions
EASY: 12 / 6; 56 / 2; 45 / 5; 88 / 4; 51 / 3; 125 / 5; 100 / 20; 88 / 22; 121 / 11; 490 / 35
MEDIUM: 120 / 6; 45 / 15; 41 / 4; 127 / 5; -55 / 11; 256 / -16; 5640 / 32; 3590 / 16; 11624 / 200; 205 / 250
HARD: 98 / 7; -65 / 3; -47 / -5; 3 / 5; 25 / 31; 49 / 91; 456 / 87; 123 / 987; 65,87 / 4,5; 12,36 / 5,79

Evidence: minigames result

Basic algebraic skills refresher course

Mission B: Proportionality and cross-multiplication

Subject: Math	Quests: 3
Sub-subject: Algebra	Time: 5h

Description

In contrast with some other subjects, proportionality is a field which can prove to be extremely useful in the students every day's life when tackling simple tasks like quickly figuring out the importance of a discount on a price tag. Despite this usefulness, it is often a subject in which some students are lacking. Many practical problems can be used to illustrate proportionality, and the beaconing platform gives the teachers the flexibility to author several scenarios tackling subjects adapting directly to the students most direct interests.
The exercise could be solved by hand or by using an electronic device, presented as a text or as a table to fill or as a figure to draw. ICT can help the students by showing the immediate result of the data entered by the students in the problem's framework.

Skills and Competencies

Analyze, Reflect, Solve, Evaluate, Interpret

Resources

Any book or web-based refresher course material, such as: http://www.basic-mathematics.com/basic-math-word-problems.html

Basic algebraic skills refresher course

Mission B: Proportionality and cross-multiplication

Quest 1

In the classroom a test is given with some proportionality exercises
This quest along with quest 2 gives a reverse-classroom theme to this mission, with lesson to be learnt/relearnt at home and practice being done in the classroom.

Subquest 1: What does proportionality mean?
(Oral activity with the whole class)
Subquest 2: What is the rule of 3 (cross-multiplication) useful for?
(Oral activity with the whole class)
Subquest 3: Write down and solve the following 4 problems:
If 2 kg of fruits cost 10 euro, how much would be 1.5 kg?
On a map, 2cm represents 15km. We measure a distance of 13.4 cm between two towns on the map. How far are they apart?
10 erasers cost 22 euros, how much 17 of them will cost?
A pair of shoes costs 56 euros. There's a 30% discount. How much will you actually pay for them?
(Each student writing down or sending one student to the blackboard)

Evidence: The results of the in-class test

Quest 2

A refresher course is given and also some support material (paper, Internet).

Evidence: log of the access to the resources by the students

Basic algebraic skills refresher course

Mission B: Proportionality and cross-multiplication

Quest 3

Exercises are given to practice and reinforce as an automatism the refreshed knowledge. They are triggered when the student enters into a supermarket or a shop (list of GPS locations have to be provided by the lesson path designer, and the graphics of the minigame might be taylored to fir the environment of the user). The minigames in question must be of multiple-choice-question type.
The questions are asked in groups of 2. If the users gives 2 good answers, the difficulty level goes up, f it's two mistakes it goes down. The game starts at the easy difficulty level.

EASY (Choosing between two products only (the discount tag is indicated in parenthesis)):
8 and 9(-10%)
80 and 90 (-10%)
800 and 900 (-10%)
21 and 25 (-20%)
120 and 150 (-30%)
250 and 280 (-20%)
439 and 550 (-20%)
21 and 110 (-80%)
23 and 30 (-25%)
15 and 18 (-25%)

MEDIUM (Choosing between three products):
10 and 12(-10%) and 14(-20%)
20 and 24(-20%) and 28(-30%)
30 and 45(-35%) and 38(-25%)
40 and 78(-40%) and 95(-55%)
21(-10%) and 22(-14%) and 25(-24%)
25(-15%) and 26(-19%) and 25(-15%)
35(-14%) and 39(-23%) and 38(-24%)
12(-23%) and 12.5(-25%) and 13(-27%)
15(-31%) and 12(-12%) and 13(-18%)
8(-13.5%) and 7.5(-12.5%) and 8.5(-19.5%)

HARD (Choosing between four products):
10 and 11.5(-10%) and 13.5(-20%) and 19.5(-45%)
10(-14%) and 9.8(-13%) and 9.7(-12%) and 9.6(-11%)
10(-26%) and 8(-10.5%) and 9.8(-22.6%) and 12(-37%)
10(-37%) and 7.4(-11%) and 8.95(-23%) and 11.49(-41%)
8.5(-48%) and 5(-10%) and 4.8(-2.4%) and 4.75(-4.5%)
8.5(-6%) and 8.1(-1.1%) and 8.8(-8.6%) and 8.3(-3.5%)
8.5(-9.6%) and 7.9(-3%) and 7.85(-2.5%) and 7.95(-4.3%)
6.5(-21%) and 5.65(-9%) and 5.03(+1.57%) and 5.4(-4%)
6.5(-3%) and 6(+1.9%) and 5.99(+2.4%) and 5.75(+5.5%)
6.5(-11%) and 5.8(-0.4%) and 5.9(-4.7%) and 5.85(-2.37%)

Evidence: minigames result

Basic algebraic skills refresher course

Mission C: Divisibility Rules

Subject: Math	Quests: 3
Sub-subject: Algebra	Time: 5h

Description

Sometimes performing a full division is not necessary to solve a certain problem. A divisibility rule is a shorthand way of determining whether a given number is divisible by a fixed divisor without performing the division, by examining its digits. Knowing those rules is a very handy tool in the math tool box of a high school student and can contribute to a faster and accurate resolution of many problems. The decomposition rules can be practiced by hand or by using an electronic device.

Skills and Competencies

Analyze, Reflect, Solve, Evaluate, Interpret

Resources

Any book or web-based refresher course material, such as: http://www.basic-mathematics.com/basic-math-word-problems.html

Basic algebraic skills refresher course

Mission C: Divisibility Rules

Quest 1

In the classroom a test is given with some exercises about divisibility rules
This quest along with quest 2 gives a reverse-classroom theme to this mission, with lesson to be learnt/relearnt at home and practice being done in the classroom.

Subquest 1: How can we spot easily if an integer can be divided by 2?
(Oral activity with the whole class)
Subquest 2: How can we spot easily if an integer can be divided by 5?
(Oral activity with the whole class)
Subquest 3: Do you know any other divisibility rules?
(Oral activity with the whole class)
Activity 5: Write down and solve the following 4 problems:
Is 723 divisible by 3?
Is 672 divisible by 7?
Is 109816 divisible by 8?
Is 2013 divisible by 9?
(Each student writes down or send one student to the blackboard. Blackboard is better as this becomes a participative effort)

Evidence: The results of the in-class test

Quest 2

A refresher course is given and also some support material (paper, Internet).

Evidence: log of the access to the resources by the students

Basic algebraic skills refresher course

Mission C: Divisibility Rules

Quest 3

Exercises are given to practice and reinforce as an automatism the refreshed knowledge. They can be done inside or outside the classroom, through minigames. The minigames in question must be of select-elements-in-a-list type.
The questions are asked in groups of 2. If the users gives 2 good answers, the difficulty level goes up, f it's two mistakes it goes down. The game starts at the easy difficulty level.

EASY (Choosing between two lines only (the divisor is indicated in parenthesis)):
12 and 13 (2)
24 and 22 (3)
16 and 20 (5)
20 and 21 (10)
28 and 27 (3)
35 and 36 (3)
45 and 47 (9)
32 and 30 (8)
28 and 27 (7)
42 and 41 (7)

MEDIUM (Choosing between three lines):
62 and 64 and 66 (8)
107 and 108 and 109 (9)
187 and 188 and 189 (9)
168 and 169 and 170 (7)
215 and 216 and 217 (7)
198 and 199 and 200 (11)
252 and 253 and 254 (11)
593 and 594 and 595 (11)
232 and 233 and 234 (13)
325 and 326 and 327 (13)

HARD (Choosing between four lines):
764 and 765 and 766 and 767 (9)
615 and 616 and 617 and 618 (11)
517 and 508 and 519 and 507 (11)
182 and 185 and 168 and 194 (13)
621 and 624 and 612 and 614 (13)
475 and 485 and 480 and 490 (15)
520 and 525 and 530 and 535 (15)
503 and 504 and 512 and 513 (21)
668 and 653 and 650 and 672 (21)
1561 and 1569 and 1573 and 1571 (143)

Evidence: minigames result

Basic algebraic skills refresher course

Mission D: Prime decomposition, integer factorization

Subject: Math	Quests: 3
Sub-subject: Algebra	Time: 5h

Description

Identifying numbers as prime or composite is a very basic and important algebra skill. Once a number has been identified as a composite, the students need to be able to decompose it at will into its prime factors.
There are many different way to represent decomposition into prime factors such as the prime factor tree, Venn diagram and so forth.

Skills and Competencies

Analyze, Reflect, Solve, Evaluate, Interpret

Resources

Any book or web-based refresher course material, such as: http://www.basic-mathematics.com/basic-math-word-problems.html

Basic algebraic skills refresher course

Mission D: Prime decomposition, integer factorization

Quest 1

In the classroom some activities about decomposition and factorization
This quest along with quest 2 gives a reverse-classroom theme to this mission, with lesson to be learnt/relearnt at home and practice being done in the classroom.

Subquest 1: What is a prime number?
(Oral activity with the whole class)
Subquest 2: What is a factorization?
(Oral activity with the whole class)
Subquest 3: Write down and solve the following 4 problems:
How can we decompose the number 18 in prime numbers?
How can we decompose the number 50 in prime numbers?
How can we decompose the number 120 in prime numbers?
How can we decompose the number 121 in prime numbers?
(Each student writing down or sending one student to the blackboard)

Evidence: The results of the in-class test

Quest 2

A refresher course is given and also some support material (paper, Internet).

Evidence: log of the access to the resources by the students

Basic algebraic skills refresher course

Mission D: Prime decomposition, integer factorization

Quest 3

Exercises are given to practice and reinforce as an automatism the refreshed knowledge. They can be done inside or outside the classroom, through minigames. The minigames in question must be of fill-the-gap type.
The questions are asked in groups of 2. If the users gives 2 good answers, the difficulty level goes up, f it's two mistakes it goes down. The game starts at the easy difficulty level.

EASY:
12 (2*2*3)
25 (5*5)
36 (2*2*3*3)
41 (41)
52 (2*2*13)
78 (2*3*13)
79 (79)
85 (5*17)
99 (3*3*11)
120 (2*2*2*3*5)

MEDIUM:
130 (2*5*13)
156 (2*2*3*13)
189 (3*3*3*7)
210 (2*3*5*7)
224 (2*2*2*2*2*7)
259 (7*37)
288 (2*2*2*2*2*3*3)
312 (2*2*2*3*13)
366 (2*3*61)
380 (2*2*5*19)

HARD:
993 (3*331)
1001 (7*11*13)
1002 (2*3*167)
1015 (5*7*29)
1350 (2*3*3*3*5*5)
1701 (3*3*3*3*3*7)
1800 (2*2*2*3*3*5*5)
2916 (2*2*3*3*3*3*3*3)
3213 (3*3*3*7*17)
2431 (11*13*17)

Evidence: minigames result

ANNEX 2 CODING & ROBOTICS

In this annex the pedagogical contents and challenges of the Coding and Robotics Lesson Plan are fully described. This is a more advanced basic example of the contents that can be "slotted" into Game Plots, and relies on minigames, quizzes, location based activities and real world evidence to progress.

An Introduction to Coding&Robotics

Subject: Technology Sub-subject: Robotics and Computer Science	Total Time: 18h

General Description

In today's world robots and automated system occupy an ever growing space, either as every-day life facilitators or replacements for human workers. Basic knowledge based about robotics and coding is slowly becoming a basic skill.
This activity will allow the users to discover and apply entry level notions of coding by using the LEGO Mindstorm solution.
The lesson path is divided in four missions presenting basic robotic knowledge. The lesson starts with a simple robot able to move all around under the direct orders of the user and continues with a more evolved version of the robot able to move by itself according to the programming it received. Then the robot becomes more sophisticated by being equipped with a whole range of different sensors (light/touch/colors/etc…) improving its capacities. Finally all robots created by the students will be pitted against each other in a competition.

An Introduction to Coding&Robotics

Mission A: Discovering the LEGO Mindstorms

Subject: Technology Sub-subject: Robotics and Computer Science	Quests: 3 Time: 8h

Description

In the first mission we will take a look at how to physically build simple things using LEGO bricks and discover the array of possibilities offered by the more complex Technic parts. We will then discover the basic terminology offered by the drag and drop interface of the LEGO programming software and write our first program. We will familiarize ourselves with what are the possibilities offered by the software. Finally we will make the link between the software and the hardware by learning how to upload a program into the Mindstorm programming brick and create a very simple robot obeying basic movement commands.

Skills and Competencies

Design Thinking, Participation, Creativity, Content Creation

Resources

Books and web-based educational resources

An Introduction to Coding&Robotics

Mission A: Discovering the LEGO Mindstorms

Quest 1

Discover the LEGO Mindstorm physical solution. The students will be asked to build a certain model, but some essential mechanical pieces will be missing. To find them, they will be directed in an educational treasure hunt among their school /neighborhood (GPS-based) to discover the relevant LEGO bricks they will need for the construction and learn more about the role of technical bricks they will need later for the construction of their own robot.

Evidence: The GPS treasure hunt via BEACONING, using the TREASURE HUNT/FOLLOW THE PATH type of exercise

QUESTION 1 (for supporting documents, see here : http://sariel.pl/2009/09/gears-tutorial/)Hello, and welcome to this interactive and very mobile quizz. You have discovered and played with all the LEGO pieces you will need to build your robot. You now know there are many different gears of different size that exist. One common way to differentiate all those gears is by their number of teeth. For example the smallest gear has 8 teeth and the bigger one has 40.

But how many different distinct number of teeth exist ?
Please add all the one you know and divide this number by 10 to discover the number of the classroom/street number in which you have to go to find your next challenge.
(Answer 8 + 12 + 14 + 16 + 20 + 24 + 36 + 40 = 170, 1701/10 = 17, so room 17)

An Introduction to Coding&Robotics

Mission A: Discovering the LEGO Mindstorms

QUESTION 2
Almost every mechanism has its driver and follower gear. In every pair of meshed gears there is a driver gear and a follower gear. It should be sufficient to remember that the driver gear is the one the drive is transferred from, and the follower gear is the one the drive is transferred to. The gear ratio is the relationship between the number of teeth on two gears that are meshed or two sprockets connected with a common roller chain. In LEGO terms, a gear ratio is simply: "number of follower's gear teeth : number of driver's gear teeth". What is the gear ratio of the second biggest gear used as the follower and the second smallest gear used as the driver ?
Divide the first number of the ratio by the second to get the classroom/street number in which you need to go now.
(Answer 36 / 12 = 3, so room 3)

QUESTION 3
Pick two sentences that are true :
1) the more the friction, the better
2) the less the efficiency, the better
3) the more gears, the better
4) the less gears, the better
5) the smaller gears, the better
6) the bigger gears, the better
Multiply the number of the two correct sentences to get the classroom in which you need to go now.
(Answer: 4 and 5 are correct, room number is 4*5=20)

An Introduction to Coding&Robotics

Mission A: Discovering the LEGO Mindstorms

QUESTION 4

Which sensor should I use if I want the robot to evaluate a distance ?

22)  **23)**  **24)**  **25)** 

(Answer: 22 is correct, room number is 22)

QUESTION 5

Which sensor should I use if I want the robot to evaluate the intensity of a certain light source ?

22)  **23)**  **24)**  **25)** 

(Answer: 23 is correct, room number is 23)

FINAL STEP

When the student enter into room 20/certain address with 20 in it, they find a package with LEGO bricks in it to start building their new robot.

An Introduction to Coding&Robotics

Mission A: Discovering the LEGO Mindstorms

Quest 2

Discover the LEGO Mindstorm software solution

Evidence: The scripts authored by the users

Quest 3

Building the first robot obeying to RC commands

Evidence: The robot

An Introduction to Coding&Robotics

Mission B: Building an autonomous robot

Subject: Technology	Quests: 3
Sub-subject: Robotics and Computer Science	Time: 8h

Description

The second mission delves deeper into the programming aspect of the course by first containing a more theoretical lesson about programming, Concepts such as branches and loops are explored and needs to be mastered by the students. The gained knowledge is applied into the LEGO software in order to enhance the existing program the user's robots are using to move around. A dose of autonomy is given to the robot when their software is now capable of making them move around without any intervention from the outside.

Skills and Competencies

Design Thinking, Participation, Creativity, Content Creation

Resources

Books and web-based educational resources

An Introduction to Coding&Robotics

Mission B: Building an autonomous robot

Quest 1

Discovering basic principles of programming (tests, loops). The students will then play a minigame to test their knowledge.
Presently : the minigame used is one offering multiple choice questions,
(In the future : the minigame is one of the existing minigames about coding).

Evidence: The result of the minigame

Quest 2

Apply those principles inside the Mindstorm software

Evidence: The scripts authored by the users

Quest 3

Building the first robot displaying a little bit of autonomy regarding movement

Evidence: The robot

9 questions in the quizz, either multiple choice or true/false statements

You need special software to write programs

- True
- False

What is the difference between a variable and a constant?

- Variables can be declared only in software languages
- The value of a constant doesn't change, the value of a variable can change all throughout a program
- No difference
- Constants can be declared only in Java

Ask user for a number, ask user for another number, multiply the two numbers, print result., etc. .What do you call this set of instructions?

- PHP
- An algorithm
- A compiler
- A class

What is the software called that translates code into something meaningful the computer can understand?

- Translator
- Converter
- Compiler
- Transliterator

Which of the following is NOT a web language?

- C++
- PHP
- HTML
- Javascript

Which of the following is NOT a programming language?

- C++
- Java
- HTML
- C#

If you needed to execute some code repeatedly based on a certain condition, which of the following would you use?

- Conditional
- Loop
- Compiler
- Variable

What is object-oriented programming?

- A type of programming using only numbers
- A type of programming not in use anymore
- A type of programming involving data types representing data structures
- A type of programming involving a structured method of creating programs

Before source code can be compiled, it has to be …

- capitalized
- saved in a separate file
- viewed in a command prompt
- parsed

An Introduction to Coding&Robotics

Mission C: Improving the robot

Subject: Technology	Quests: 2
Sub-subject: Robotics and Computer Science	Time: 3h

Description

This mission develops the current possibilities offered by the Mindstorm solution by introducing a whole new arrays of sensors available to the students such as IR, UV, colors, touch, etc. Once the students have learned about those sensors, their usage and how to program them, they can upgrade their robots by giving them improved capacities for movement.

Skills and Competencies

Design Thinking, Participation, Creativity, Content Creation

Resources

Books and web-based educational resources

An Introduction to Coding&Robotics

Mission C: Improving the robot

Quest 1

Presentation of new sensors and programming ideas in a reverse classroom style and learning by doing methodology. A quiz is given to the students to test their knowledge through a minigame of the multiple choice questions kind.

Evidence: The result of the minigame

Quest 2

Applying what was learned to improve the robot and make it capable of passing new tests.

Evidence: The robot

An Introduction to Coding&Robotics

Mission D: Robot competition

Subject: Technology	Quests: 2
Sub-subject: Robotics and Computer Science	Time: 4h

Description

With everything that the students have learned and applied so far, it is now time to test the results of their work by pitting their robot into a grand competition. The competition is divided into two bouts, one where the robots will have to navigate successfully a maze of specific sensors and another where the movement of the robot will be tracked.

Skills and Competencies

Design Thinking, Participation, Creativity, Content Creation

Resources

Books and web-based educational resources

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Mission D: Robot competition

Quest 1

The first competition between the students' robots will involve a maze of sensors. The competition can be done virtually or with everyone in the same place (best solution for fairness). A leaderboard and records of time to break will be established.
Several bouts can be organized to test the reaction of the robots to different type of mazes (colors, touch, combination, etc.)

Evidence: The results of the competition, to be uploaded

Quest 2

The second competition between students' robots is set to test their versatility. Several different activities/challenges for the robots are set up on tables in different parts of the room, each one indicated by a QR code or beacon. The players have to complete the activity at their table and then move to the following one, according to the instructions received up until all the activities are done. Each activity is timed and a leaderboard and records of time to break will be established.

Evidence: The results of the competition , to be uploaded

ANNEX 3 VET (POWER TOOLS)

This annex showcases the full taxonomy, pedagogical content and mission structure for the VET Lesson Plan discussed in the main document. It also provides an example of a specific assessment rubric for this lesson plan, to be linked with Learning Analytics.

What skills participants will develop? ***Skills/Competencies***	**How much time?** *Time*	**Who is taking part?** *Players/Participants*	**Where is the mission going to take place?** *Places of Interest*	**What is available for this mission?** *Tools/Resources*	**What evidence should participants provide?** *Evidence*
STEM • Reasoning • Inquiry • Tool Use • Logical/Spatial Thinking **Autonomy/Initiative** • Planning • Organisation • Management	• 9 hours	• Apprentices • Trainees • Employees	**School** • Workshop • Studio **Home**	**BEACONING** **Devices** • Mobile phones/ Computer • Sensors / Cyber physical System • Large Display **Teachers** • Face-to-face • Lab tools • Pen & paper	• Final stone geometry •

Mission A ***Background*** Research types of power tools + the terminology used in stonemasonry, Research H+S engineering controls for power tool use. Research H+S protocol. ***Skills*** I Research/Standards interpreting Information	Quests: Learning tools/machine forms, engineering control and on site protocols						
	Time Frame 6 hours	**Participants** Students Lecturers CITB	**Location(s)** Anywhere	**Resources** Tablet/ Mobile Web interface	**Evidence** Correctness of identification and selections	**Rewards**	**Beacons** Geolocation (optional)
Mission B ***Background*** Students will learn to comply with the given, relevant legislation and official guidance to carry out at work and maintain safe work practices. Through the selection / mix and match user interfaces. ***Skills*** Adopting industry relevant, safe, and healthy working practices	Quests: Learning Stone masonry terminology, knowledge of basic waste removal techniques, knowledge of application of removal techniques into industry relevant safe and healthy working practices						
	Time Frame 6 hours	**Participants** Students Lecturers CITB	**Location(s)** Anywhere	**Resources** Tablet/ Mobile Web interface	**Evidence** Correctness of identification and selections	**Rewards** Wildcard to hidden level; Obtain partial course credit	**Beacons**
Mission C ***Background*** Students will learn and enhance their visualization a planning skills. They will plan the cutting process, require resources and sequences without performing	Quests: knowledge of selecting and understanding of Stone, Tool Process, procedures						
	Time Frame 9 hours	**Participants** Students Lecturers	**Location(s)** Anywhere Classroo	**Resources** Tablet/ mobile Worksta	**Evidence** Results of calculations/ identifyin	**Rewards** Options to upgrade game	**Beacons**

any actual or virtual cut. ***Skills*** Select/quantify resources		CITB	m Worksh op	tion Calculati on tools Visualiza tion tools	g and selecting (Errorless learning)	assets; Obtain partial course credit	
Mission D ***Background*** Students will use cyber-physical game for expecting the waste removal procedure. They will perform the virtual stone cutting using the augmented grinder and the display. ***Skills*** Applying tools, moving, handling, using, storing, occupational safety	Quests: Demonstrate appropriate methods work practices processes control (HSE, protocols)						
	Time Frame 19 hours	**Participa nts** Students Lecturer s CITB	**Locatio n(s)** Worksh op	**Resourc es** Augmen ted waste removal tools and grinders Sensors Processi ng algorith ms	**Evidence** Complian ce with Standards (Errorless earning)	**Rewards** Tangible skills certificat e; Obtain partial CREW credit	**Beacons** RFID

The following table show the parallel scoring approach used in the game for evaluating performance levels in each element of the process.

The overall score is a factored-product of scores from individual elements as shown by the equation below.

$$S_{overall} = S_1 \times S_2 \times S_3 \times \ldots \times S_n$$

$$S_{overall} = \left(\sum element\ scores_1 + C_1\right) \times \left(\sum element\ scores_2 + C_2\right) \times \left(\sum element\ scores_3 + C_3\right) \times \ldots \times \left(\sum element\ scores_n + C_n\right)$$

	Selection	score	(max)	Waste Removal	score	(max)	Health & Safety	score	(max)	Health & Safety	score	(max)
element scores	Blade	15	20	Positional accuracy	15	20	Dust Mask	20	20	Cleaning Dust	30	30
	Cutting tool	10	20	Depth of cut accuracy	25	30	Safety glasses	20	20	Platform Height	20	30
	Hand tool	10	20	Angle of cut	30	30	Helmet	20	20	Stone orientation	30	30
	Chisel	10	20	Use of splays	0	10	PPE	20	20			
				Use of checks	0	10	Gloves	20	20			
excess (Cn)		20	20		0	0		0	0		10	10
total (Sn)		65	100		70	100		100	100		90	100
%		0.6500	1.0000		0.7000	1.0000		1.0000	1.0000		0.9000	1.0000