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GRINSCO
GREEN INSULATION SKILLS FOR CONSTRUCTION WORKERS

GRINSCO

Green Insulation Skills for Construction Workers

R3-T1 **Simulation-based assessment methodology for GRINSCO learners**

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Table of Contents

1. Introduction

1.1 Background & objectives

Game based learning or gamification represents an innovative training delivery method that takes advantage of the educational potential offered by games to boost work-based training procedures.

Broadly speaking, games have a relatively low presence in Work-Based Learning (WBL), even though they offer a unique structure and diverse strategies to complement traditional educational strategies, by infusing learning with excitement, energy and foster apprentices' personal development and self-esteem. This becomes even more prominent when learners learn via simulations game as they offer a unique virtual environment that assists immersion, contains elements of informed decision making and interaction with other players in a risk and consequence free, realistic environment. In short, simulation-based games represent an innovative training delivery method that makes the learning experience more stimulating and entertaining, increasing the retention of information and acquisition of knowledge, both considered as key outcomes of a successful educational method.

Gamification

The application of typical elements of game playing (e.g., point scoring, competition with others, rules of play) to other areas of activity, typically as an online marketing technique to encourage engagement with a product or service.

To harness this incredible potential of gamification by applying simulation-based learning in work-related activities and environments, the present report provides guidelines on the design of online training scenarios that will facilitate the acquisition and development of sustainable and green insulation skills of construction workers. More specifically, this report will elaborate on a scenario-based learning methodology that will define the pedagogical principles and instructional design of the GRINSCO training scenarios in the form of a simulation game. It will also provide instructions and tools for partners, to guide the creation of real-life working scenarios (R3-T2) to be used for work-based learning in the construction/ insulation sector.

The GRINSCO training scenarios and simulation game will be designed to match the curriculum's learning outcomes and will be provided as a market ready training solution, to be adopted by relevant VET & WBL providers and construction/ insulation sector

employers and integrated into their training offerings. From a pedagogical point of view, the simulation game will assist in enhancing apprentices' confidence, improve the services they provide and ultimately enhance their CV with new skills and abilities that can prove particularly useful in their present or future career choices, particularly given the increasing environmental concern and introduced regulations within the construction/ insulation sector. Moreover, the scenarios are designed to increase the motivation of learners, foster new skills development and help learners understand green insulation applications and functions by simulating actual workplace tasks and procedures.
Additionally, online training scenarios will help workers & learners undergoing WBL acquire new skills/experience acquire green insulation skills. These scenarios will be used digitally and complementarily with other educational resources. Workers will assume a role in a practical 'real life' workplace situation (e.g. selection of proper green insulation materials, application in buildings) to make informed decisions about the best way to perform their work duties in terms of sustainability. It will also be possible for learners (workers and/or apprentices) to obtain a score for their overall performance.

1.2 Structure of the report

The report is structured as follows: The 1st section presents the background and objectives of the report. The 2nd section discusses the educational value of a simulation game with branching scenarios and the specific needs and skills of construction/ insulation sector. The 3rd section presents the role of trainers in the learning process. The 4th section focuses on the instructional design and content specifications for the training scenarios to be developed. The final section focuses on the technical requirements and the necessary parameters for the game design.

Overall, the present methodology aims to provide both conceptual and practical information on the ways scenario-based learning can be applied to enhance green insulation skills for construction workers.

Instructions for the development of the training scenarios will be developed as part of activity R3-T1 of the GRINSCO project will be provided by partner INNOVELA in a distinct document.

2. The educational value of training scenarios in insulation work-based learning (WBL)

2.1 Work-based Learning

Work-based Learning (WBL) represents an educational approach (pedagogical practice) in Vocational, Education and Training (VET) that provides students with on-the-job training, aiming to help learners understand the real workplace requirements, acquire hands-on working experience and develop knowledge, skills and competences that are essential in working life, and cannot be acquired in a conventional classroom/school-based environment. This educational process cannot take the form of a standardised form of education in a classroom-based environment - which mostly relies on transferring key concepts and practical instructions (coupled with examples and exercises) - but an interactive process where knowledge and skills acquisition results from the exploration and direct involvement in practical work tasks and the sharing of knowledge and experience between within the organisation (informal learning). Similarly, learning can be facilitated through the capabilities and innovations offered by simulation games; which further enhance dynamic character of work-based learning.

Fry et al. (2008) define the characteristics/features that a work-based learning environment needs to have to establish conducive to learning conditions and support learners to acquire practical working experience and further develop their knowledge and skills (incl. personal qualities).

- The learning environment should cultivate positive relationships through knowing and valuing each student, promote a culture of value and respect for individuals and their communities, employ strategies to promote students' self-confidence and willingness to take risks with their learning and ensure that each student experiences success through structured support, effort, and recognition of their work.
- Student's needs, background, perspectives, and interests should be reflected in the learning program. To promote that, teachers have to employ strategies that are flexible and responsive to the values, needs and interests of the individual students, use a range of strategies that support different ways of thinking and learning, builds of students' prior experience, knowledge and skills and maximize students experience in the rich world of technology.

- Assessment Practices are an integral part of learning and teaching. Thus, design of assessment practices that reflect the full range of learning program objectives ensure that students receive frequent, constructive feedback that supports further learning, makes assessment criteria precise, use assessment practices that encourage reflection and self-assessment and uses evidence from assessment as feedback for subsequent teaching.
- Learning connects strongly with communities and practice beyond the classroom. In this case, the teacher supports students to engage with contemporary knowledge and practice, plans for students to develop their communication skills, interact with local and broader communities and uses technologies in ways that reflect professional and community practices and can be applied in real-life scenarios.

2.2 Gamification and knowledge acquisition

The important role of gamification in knowledge acquisition is not an entirely new concept. In fact, there is a vast amount of research on the value of educational gamification that examines the impact of gamification on students' engagement, performance, participation or retention. (Dicheva et al. 2015). Additionally, an emergent strand of such research has more recently started to explore the impact on gamification on learning or behavioural outcomes. For example, studies have discussed the outcomes of knowledge acquisition Jang et al., 2015; Laskowski & Badurowicz, 2014; Paiva et al., 2015; Su & Cheng, 2015) its impact on behaviour (Barata et al., 2014; Codish & Ravid, 2015; Hakulinen et al., 2015; Hew et al.,; Pedro et al., 2015b), engagement (Boskic & Hu, 2015; Chang & Wei, 2015; Ibanez et al., 2014; Latulipe et al., 2015; Morschheuser et al., 2014; Poole et al., 2014), motivation (Hasegawa et al., 2015; Herbert et al., 2014; Mekler et al., 2015; Pedro et al., 2015a; Utomo & Santoso, 2015). All this critical mass of research allows us to suggest that gamification is not only an additional method of knowledge acquisition but also that it can be one of the strongest methods to provide Work Based Learning (WBL) as it improves various aspects of learning and knowledge acquisition.

The uniqueness of a simulation-based learning method with branching scenarios for instructing and training apprentices can be further highlighted when compared with the tiring character of the "standardized" educational strategies (i.e., seminars, presentations) learning process that often discourages learners from participating actively, a key component of the learning activity that ensures retention of information and facilitates increased learning.

Gaming can overcome this obstacle as it offers unique structures that can serve as icebreakers and provide innovativeness and diversity in learning procedures. By engaging with gamification methods, learning materials become less tiring and more entertaining to learners as it offers a platform to develop their creativity, critical thinking and innovativeness. More specifically, game-based learning emphasizes the construction of scenarios that simulate real-world problems, offers learners the opportunity to face real world challenges and invites them to actively participate and solve them within a risk-free environment.

From a pedagogical point of view, all learning takes place through direct experience in "real-life" working situations, real-time interactions and working in groups while learners assume an active role in their own learning process. This is another of the strong assets

of a gaming method (and more precisely a simulation) as it addresses the need for knowledge acquisition through direct experience with simulations that can replicate work-based scenarios as realistically as possible from the current technological means. Additionally, it can also accommodate the need for interactions between customers and employees through the use of branching scenarios and dialogues with multiple choices to choose from. In short, gamification methods can be considered as optimal methods for the delivery of WBL courses, as they have the unique asset of simulating real-life working scenarios according to the aims and purposes of any training course.

Simulation games

Simulation games immerse learners in a realistic context and force them to make decisions, act upon them and witness the immediate impact through the reaction of other players in a risk and consequent free environment.

Overall, educational games (as the one proposed in the present report) are designed to increase the motivation of learners, foster new skills development and help learners understand how a specific industry functions by learning within the context of the sector rather that in absentia of. As such, gamification provides a unique opportunity to expand the knowledge and skills of the insulation workers through the development and use of a simulation game, to complement existing learning materials and activities in insulation work-based learning.

2.3 Pedagogical and training needs of insulation workers & apprentices in WBL

The first result (R1) was intended to identify the current and future workplace requirements and skills needs of insulation workers, setting the ground for the formulation of evidence based GRINSCO learning outcomes.

According to the evidence drawn from R1, the following working skills were revealed as fundamental for insulation workers:

- To recognize the need of raising skills in green insulation use.
- To work with requirements in line with European directives and national standards.
- To inspect buildings.
- To identify building materials and systems of green insulations
- To identify building pathology, damages and defects.
- Data collection of all the necessary information, both documentary and within the building (visual information, collection with tools and analytical techniques).
- To interpret proper application of green insulations.
- To make a qualitative assessment.
- To make a quantitative assessment.
- To work and collab with professionals in different subjects.
- To have communication skills (oral and writing)
- To have soft skills: cooperation at work, coordination, and management of workplace.

Learning outcomes

"Statements of what a learner knows, understands and is able to do on completion of a learning process, which are defined in terms of knowledge, skills and competence."

In addition, research findings highlighted the following challenges:

- recruiting difficulties
- training difficulties
- Improving knowledge about green insulation materials and systems
- Improving knowledge and skills in technologies of using green insulation-practical applications
- Improving knowledge about legislation and H&S regulations in EU countries related to insulation works

The results from skills gathering activities helped the partnership conclude with a number of contemporary and future-proof learning outcomes on green insulation work practices. The learning outcomes were at a next stage grouped - with thematical criteria - into 4 broad learning units, providing the skeleton of the GRINSCO curriculum.

Learning unit 1: Knowledge of the qualities of green insulation materials in construction

Upon completion of this unit learners will

Be able to:

- to perform a product assessment
- perform works properly using green insulation materials
- identify proper insulation material for the given work
- account for own and others actions in ensuring that the application is correctly integrated within a complex environment and complies with user/customer needs in terms of selecting proper green insulation materials

Know / Aware of:

- ecological relevance and technical properties of materials and systems
- how to classify insulations
- the necessity of using green materials
- basic concepts of building physics
- most important ecological labels

Learning unit 2: Application of green insulation materials in different construction structures

Upon completion of this unit learners will

Be able to:

- read and comprehend construction plans/ blueprints
- determine amounts and types of insulation needed, based on factors such as location, surface shape and equipment use, energy efficiency etc.
- measure and cut insulation materials to adhere to specifications
- perform quality assurance on site after finalized installation
- execute installation of green insulation materials
- manage construction waste created during insulation works (hazardous materials, sorting, utilization etc.)

Know / Aware of:

- how to apply thermal insulation composite systems or other systems
- health and safety requirements

- differences in construction structures and climate differences in various regions of the EU
- differences in availability of green insulation materials in various countries

Learning unit 3: Maintenance of green insulation materials

Upon completion of this unit learners will
Be able to:

- make use of knowledge about life-cycle of systems and buildings
- to prepare calculations of materials, work, equipment
- perform an assessment and diagnosis of the installed system
- perform a proper maintenance of green insulation materials and facades
- perform regular works, like cleaning or fixing green insulation elements in buildings and structures.

Know / Aware of:

- influence of weather conditions on insulations
- difference between ordinary and extraordinary maintenance
- about different surface textures and renovation techniques
- about ordinary and extraordinary maintenance – how to do it
- how to prepare cost calculation

Learning unit 4: Sustainability objectives and considerations, soft skills, communication, job opportunities, professional development

Upon completion of this unit learners will
Be able to:

- recognize benefits of personal development
- understand ethos of being a construction professional and act according in on a day-to-day basis at work
- put in practice the circular economy concept at work
- to interact and communicate with owner about eco-friendly products being installed and discuss benefits
- communicate effectively with construction manager/ engineer/ site managers/ foreman/ owner
- highlight the advantages of green materials

Know / Aware of:

- importance of professional development and motivation for upskilling and improving competence to keep people competitive on job market
- importance of soft skills meaning at work and how they influence communication and overall performance of work

2.4 Learning objectives of the GRINSCO training scenarios

The GRINSCO training scenarios shall be designed to match the GRINSCO curriculum's learning outcomes – as describe above - and provide a market ready training solution to acquire hands-on experience in insulation work-based learning. To this end, the following learning objectives will be pursued.

1. Understand the ecological relevance and technical properties of green insulation materials: Learners should be able to explain the environmental significance and technical characteristics of different green insulation materials used in construction.

2. Apply knowledge of building physics and insulation: Learners should be able to classify different types of insulation materials based on their properties and understand the fundamental principles of building physics related to insulation.

3. Assess and select appropriate green insulation materials for specific construction projects: Learners should be able to evaluate project requirements, construction plans, and environmental considerations to identify and recommend suitable green insulation materials for different construction structures.

4. Demonstrate knowledge of sustainability objectives and effective communication skills: Learners should understand the importance of sustainability in construction and be able to effectively communicate the benefits of green insulation materials to stakeholders, including owners, construction managers, and site personnel.

3. Trainers' roles and responsibilities

For the learning process to be successful, the role of the trainer is essential and must be clearly defined to ensure that the desired learning outcomes will be achieved. In work-based learning, trainers can be either qualified trainers/mentors or skilled/experienced to act as company mentors, and their primary role/mission should be to establish conditions conducive to learning and oversee practical training of students/workers in the workplace. To this end, trainers must be experts in the field, holding the required knowledge and experience to be able to guide trainees to take the correct decisions and achieve an optimal performance.

As for the use of the GRINSCO training scenarios, trainers should abandon their typical role and mostly act as facilitators. At a first stage, they need to assist learners download and get access to training scenarios - as offered in the form of an online simulation game - and at the same time facilitate the learning process, steering the game-based training experience towards the accomplishment of the desired learning objectives. Motivating trainees to communicate and collaborate or to reflect on decisions and actions is also part of their envisioned role. Trainers shall also have a significant role in learners' feedback provision and evaluation in order to a) foster cognitive processes of reflection b) crystallise newly acquired knowledge and c) establish links between the training experience and real-life situations.

In this light, the responsibilities of the trainers can be summarized with the following points:

- Create conditions conducive to learning.
- Assist the trainee in setting up the appropriate environment.
- Clearly communicate the training expectations.
- Create goals with milestones.
- Assist and guide trainees during the learning experience.
- Support apprentices with learning difficulties through individual design of the training and personalised learning guidance
- Provide constructive feedback.
- Provide an evaluation at the end of each session.
- Assess learners' competences and progress.

4. Instructional design of GRINSCO training scenarios

This section will define the structural elements of the GRINSCO training scenarios that are needed for creating an engaging gaming experience, which will precisely simulate real-life work practices and help achieve the desired learning outcomes. It will set the content specifications that are particularly important to stimulate and retain the interest of apprentices, immerse them into experiential learning and maximise game's learning potential. For the purposes of designing and developing a game, it is important to identify and comprehend the main characteristics of gaming and the prerequisites that must be met in order to successfully create a simulation game. For example, Juul (2003) has formulated a comprehensive framework that describes the main aspects of games, synthesising and drawing upon previously proposed definitions from related fields of research from the 1950s until the beginning of the 21st century. In particular, the following seven (7) definitive game features were identified as essential of any simulation-based game:

1. **Rules**
2. **Variable outcomes**
3. **Values assigned to outcomes**
4. **Branching scenarios**
5. **Assessment criteria**
6. **Grading System**
7. **Provision of feedback**

4.1 Rules

Rules constitute one of the most important parameters as they provide players with a fixed and clear set of guidelines to follow. An important instruction in the formulation of rules is that they should provide players with a clear understanding of the rules of the game without having to demonstrate ingenuity in understanding how to play. Thus, game designers should avoid ambiguous or over-complex rules as they can be perceived as unclear, random-based or open to different interpretation which could produce disagreements and disputes that are frequently encounters while playing in physical world. As such, computer games must provide players with a clear, easily digestible way to explain how the game works for the purpose of immersion into the game without wasting effort in trying to figure out what to do for a long period of time. Thus, the GRINSCO training scenarios should be designed in this manner, especially at the level of dialogues and menu interface.

Indicatively, the GRINSCO simulation game will adhere to the following rules:

- Learner should select game language from the ones available.
- Learner should pick a training scenario to play to start with.
- Course of action, choices made by learners in the form of nodes will result in different possible outcomes and endings.
- Courses of actions/responses will be limited to and guided by the available pre-defined options.
- Specific time available for decision making by the learner at each step of the scenario (e.g., 3 minutes maximum).
- Once a training scenario is completed, learners can choose to repeat the same session (scenario) to achieve a better score or to move to the next session (scenario).

4.2 Variable outcomes

Another one of the characteristics of gaming is the possibility of different outcomes, resulting from mental or physical challenges; different strategies and actions or decisions from players should lead to outcomes that reflect their skills and effort. It is also important not to allow players to identify a strategy that always leads to winning the game; on the contrary, the variability of outcomes, due to a number of factors, is important for retaining high levels of interest and challenge. In the context of the GRINSCO training game, it would be suggested to achieve variability by presenting different difficulty levels that can provide challenging situations to either experienced/skilled or novice players. This will foster re-playability of the game, increase players' entertainment, retain their interest and focus and will inevitably lead to the acquisition of the desired innovative green insulation working skills.

4.3 Values assigned to outcomes

The concept of assigning values involves defining certain outcomes as better than others, including the main goal(s) of the gaming activity. This also allows for keeping score and makes possible (in the case of the GRINSCO training game) to evaluate the trainees and drive them towards attaining the training goals by improving their performance. Positive outcomes are typically harder to reach than negative; this is a prerequisite for making the gaming activity challenging, thus motivating players to play the game until reaching a positive and subsequently rewarding result. This aspect of gaming is well-covered by the concept of branching stories in the GRINSCO training game, since, by definition, the story

can have different endings, both positive and negative. In this specific case, an example of the difference between values could be applied using different green insulation materials in a specific area of construction (for example external insulation system) and participants try to choose the best option based on their previous sessions or feedback from the trainer.

4.4 Branching scenarios

To be easily communicative, highly entertaining, thus re-playable and at the same time educational, the GRINSCO training game will be designed using branching scenarios, as sets of chronological steps. Each set will represent a different situation and will require the application of "green" related decision making and insulation skills for subsequent progression in the next step.

These chronological steps comprising each branch of the game's storyline are basically interconnected decision points. Each user decision leads to another point further down the storyline and each decision has two possible outcomes (i.e., success or failure). A successful attempt to resolve a potential problem (as part of the scenario) will reward points while an unsuccessful attempt will deduct points from the score of the participant. An example of such a branching scenario can be found in Figure 1. At the end of the scenario, the sum of points collected will constitute the final score awarded for completion of the game.

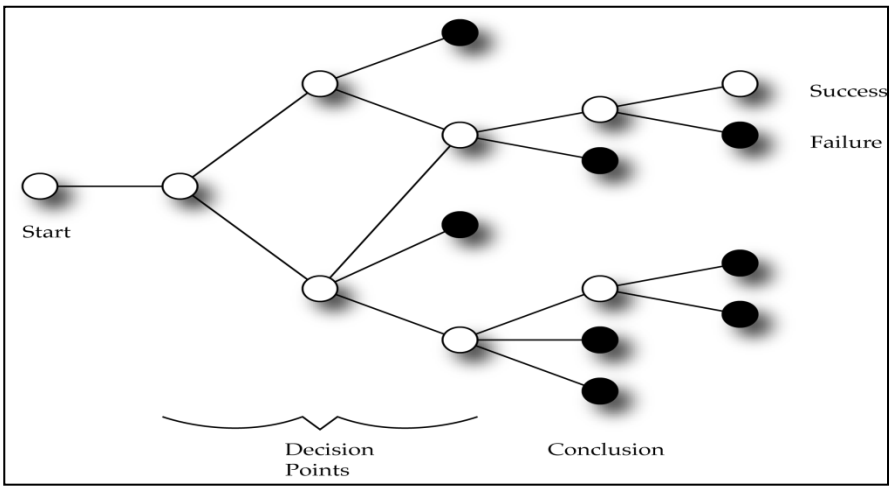

Figure 1: Example of a branching scenario

The basic issues that should be taken into account pedagogically effective branching scenario (at initial level) are the following:

- The beginning and all possible endings must firstly be defined.
- Decision points must be planned chronologically – no backtracking should be allowed because it would be unrealistic to move backwards in time.
- Each branch should to some extent represent an existing pattern of behaviour in relation to green insulation working skills
- Learner paths should be independent of rigidly defined branches - the degree of freedom must allow for unique combinations of decision points, provided that such an interaction would be realistic
- Every possible permutation of the branches mist be checked for any errors or inconsistencies.

In terms of scripting effective and comprehensible dialogues, the following suggestions (derived from International Organization for Standardization – ISO[1]) should be taken into account, especially when authoring the user choices/responses.

- Suitability for the task: the dialogue is suitable for an efficient completion of the task at hand (i.e. exercising of the most appropriate green insulation working technique/skill)
- Self-descriptiveness: the dialogue is self-descriptive when each dialogue step is immediately comprehensible.
- Controllability: the dialogue is controllable when the user is able to initiate and control the direction and pace of the interaction until the point at which the goal has been met.
- Conformity with user expectations: the dialogue conforms with user expectations when it is consistent and corresponds to the user characteristics, such as task knowledge, education, experience and to commonly accepted conventions.
- Suitability for individualisation: the dialogue is capable of individualisation when to better suit the task needs, individual preferences, and skills of the user.

4.4.1 Specifications for the game mechanics

Each training scenario will allow the players/learner to experience a story that will simulate real life situations; realism is important for the depth and breadth of the experimentation and observation. Games are understood as goal-based structures: a) as soon as players end a game session and receive an evaluation, they will also know that they can improve their performance by understanding the game, and b) learners become better at playing

[1] ISO - International Organization for Standardization

by learning the game rules and mechanics. This is an important aspect of all games, including educational ones. It is often described as the feedback loop:

Figure 2: The feedback loop of learning games

The feedback loop shows how the player learns by acting within the game space. The player takes an action and observes the effect. The observed effect will help the player gauge whether or not the action taken was correct and allow the player to plan the next action.

4.5 Assessment criteria of learners' performance

The last step in designing a game is setting up an assessment and feedback scheme. To assess the competency of the simulation game developed in the context of the GRINSCO project, we will follow the established taxonomy by Anderson et al (2005). More specifically, Anderson's taxonomy offers a useful set of criteria that applies in each knowledge unit. According to his taxonomy, 5 criteria, which can be also regarded as sequential steps in applying the necessary skills to perform a task at work, have been formulated to assess the obtained knowledge of the students that can be applied to all training scenarios. These are:

- **Understanding** which skill is required.
- **Remembering** which skills are required for this specific scenario.
- **Analysing** correctly the specific skill required.

- **Evaluating** correctly the ways skills can be applied in specific scenarios.
- **Applying** the specific skill tailored to the situation.

These criteria will guide the assessment of specific skills areas (depending of course on the nature of the real-life working scenario) within the simulation game. Examples of such assessment areas are as followed:

1. Assessment Area: Knowledge and Understanding/ Material Selection and Properties

Criterion: Ability to comprehend and recall the qualities of green insulation materials in construction.

Description: In this assessment area, learners will be presented with various construction scenarios or building projects within the simulation game. They will be required to select the most suitable green insulation materials from a range of options based on specific project requirements such as climate, building type, energy efficiency goals, and sustainability considerations.

2. Assessment Area: Application and Analysis/ Construction integration and implementation

Criterion: Ability to apply green insulation materials effectively in different construction structures and analyze their impact.

Description: In this assessment area, learners will be presented with various construction projects or building structures within the simulation game. They will be required to select and apply green insulation materials appropriately, considering the specific technical requirements, building codes, and industry best practices associated with each structure.

3. Assessment Area: Maintenance and Evaluation/ Maintenance and Troubleshooting

Criterion: Ability to maintain and evaluate the performance of green insulation materials over time.

Description: In this assessment area, learners will be presented with maintenance scenarios or simulated building environments within the simulation game. They will be required to identify common maintenance issues related to green insulation materials, troubleshoot problems, and implement appropriate maintenance techniques to ensure the materials' performance over time.

4. Assessment Area: Sustainability and Professional Skills Application

Criterion: Ability to apply sustainability objectives, demonstrate soft skills, communicate effectively, explore job opportunities, and pursue professional development in relation to green insulation materials.

Description: In this assessment area, learners will engage in scenarios or interactive activities within the simulation game that require them to consider sustainability

objectives, utilize soft skills, communicate effectively, explore job opportunities, and demonstrate a commitment to ongoing professional development in relation to green insulation materials.

4.6 Grading system

A typical grading system in simulation-based games involves 3 main types of scoring:

1. **Direct scoring, points awarded for each correct action.**
2. **Topic-based scoring – scores provided for each distinct skill.**
3. **An overall score at the end of the game, possibly on a percentage scale.**

Amongst the three abovementioned approaches, the first and the last are essentially game-proper, but have less educational value; such an approach would steer the design of the game and the authoring of the scenario towards constantly distinguishing between good and bad player actions (i.e. dialogue responses), at the expense of the ambiguity and the unpredictability of real-life interactions. Most importantly, the concept of branching stories is to enable trainees to learn by evaluating the consequences of their actions through the different paths that the story can take, rather than seeking and finding out which responses award the player with more points. After the end of each scenario, a score is assigned to each player for each of the aforementioned assessment areas and level of success of each trainee.

The personal grading will be in a quantitative measurement manner (1 = You lose, 2 = It's a draw, 3 = You win, 4 = You win ultimately) for each criterion and will also involve an overall score of success in points. The success of the participant (and therefore completion of the scenario) will be based on the total score, where each node will carry an equal weight. For every node or option, the learner is faced with the choice of action will be awarded with 0, 2 or 5 points respectively.
The grading system of each training scenario following the tree chart provided by INNOVELA can indicatively be defined as follows: 1 = You lose (0-5 total score), 2 = It's a draw (6-10 total score), 3 = You win (11-15 total score), 4 = You win ultimately (16-25 total score).

4.7 Provision of feedback

At the end of each training scenario the learner will be evaluated based on the scoring system presented above in section 4.6, on his performance and overall approach to the situation. In this way, it can be determined if the learner has gained sufficient knowledge of each green insulation working skill to have successfully completed the scenario.

Additionally, in qualitative terms, throughout the duration of the scenario the learner will receive feedback while interacting with the construction/ insulation manager (trainer), based on the replies that he selects at each stage of the branching scenario. For example, in the context of the scenario focusing on the properties of green materials and their application in the insulation process, the learner may be asked to select the most appropriate type of green insulation for a particular structure. According to the selected option the construction/ insulation manager may approve the selection, say that it could be used but there are preferable alternatives or express his disappointment, taking the user back to the beginning of the scene.

Finally, trainers will also have the opportunity to provide additional on-the-spot feedback and advice to the learners so that the appropriate guidance is given for further improvement.

5. Content specifications for training scenarios

5.1 Key characteristics of GRINSCO branching scenarios

This section provides guidelines regarding the required content of the training scenarios to be developed in the form of branching scenarios.

Branching scenarios in the context of the GRINSCO project are interactive stories in the form of dialogue simulations, within a gaming environment, where the learner or player assumes the role of the story protagonist. While the starting point of each scenario is common (e.g., the renovation of a building with contains insulation structures), the choices of the player may lead to entirely different interactions, dialogues and outcomes. These interactions are organised in distinct courses of action (on part of the learner) and corresponding consequences, namely the branches of the story. It is possible to move from one branch to the other depending on the actions of the player, since certain actions and consequences are interweaved, but only within the limits of realism and existing workplace experiences.

The main advantage of branching scenarios over linear narratives is that players/trainees can try different things and learn through the consequences, explore different possibilities, learn from both successful and unsuccessful choices, and reflect upon their own choices. Specifically, the scripting of the GRINSCO branching scenarios will focus on green materials insulation working skills and applications, and the knowledge to be acquired will be embedded as goals to be achieved within the game. This necessitates the definition of specific learning objectives, and a clear understanding of which skills will be mostly addressed by each scenario, for the purposes of evaluating and validating the overall project approach.

5.2 Target groups

Within the context of GRINSCO, the main target groups at which result R3-T2 GRINSCO Development of training scenarios aims to reach are the following:

- I-VET, C-VET and WBL learners
- Construction and insulation sector workers
- Apprenticeships of WBL in the construction/ insulation sector

Also, it should be noted that the consortium has commonly agreed to pilot test the simulations games to 10- 15 construction/ insulation workers with fewer opportunities. It will comprise layman versions to overcome linguistic barriers (especially for

migrants/refugees). The simulation games will primarily rely on visual materials such as demonstration videos, infographics, and simple but concisely textual descriptions/ dialogues will be accompanied by visual aids to facilitate learners' understanding.

5.3 GRINSCO Scenario template structure instructions

This section provides instructions to guide partners in the creation of four (4) practical real-life working scenarios, as foreseen in R3-T2. These independent scenarios will be designed in the form of branching scenarios (flowchart stories) that simulate "real-life" working situations and will be applicable to working with green insulation materials at different stages of the construction and insulation process. The scenarios will immerse learners in a realistic context and force them to make informed decisions, act upon them and witness their immediate impact in a consequence-free environment. They need to reflect the interdependence and effects of insulation processes, operational decisions, environmental consequences, and course of actions on green materials processes.

Each scenario will focus on one of the following areas and each partner of the GRINSCO project will develop a practical scenario according to their assigned role and area of expertise. The following is proposed:

Training scenarios	Partners
(LU1) Knowledge of the qualities of green insulation materials in construction	**AEACC, PABM**
(LU2) Application of green insulation materials in different construction structures	**VSRC**
(LU3) Maintenance of green insulation materials	**AEACC, PABM**
(LU4) Sustainability objectives and considerations, soft skills, communication, job opportunities, professional development	**ENEFA, INNOVELA**

The scenario template will be built upon the abovementioned definition (see Section 5.1) and key characteristics of branching scenarios. Therefore, apart from certain identification fields, it includes the following basic information:

1. Define the objective - learning outcomes of the training scenario. What knowledge should learners be familiar with and be able to understand upon completion of the game?
2. Define the main target group(s).
3. Describe the plot/overview in a brief paragraph.
4. Define the instructional design of the scenarios (i.e. the protagonist and characters, rules, variable outcomes)
5. Define the assessment criteria and provision of feedback method for the learners.

6. Use the template provided by INNOVELA for the development of dialogues.
7. Each branch should be presented as a separate section. Develop the different possible outcomes (as separate branches) of the scenario.
8. Follow the tree diagram provided by INNOVELA, to clearly represent the interdependency of each node/possible option and consequence of each response chosen by the learner.
9. Develop its online format in English.
10. Fine-tune the dialogues if necessary.
11. Develop national languages based on the English template.

Typically, each scenario should consist of 4-5 branches which will contain different options and outcomes according to the choices made by the learner.

Each scenario should lead to a single correct outcome, which when followed the learner will have successfully completed and "won" or "ultimately won" the game. Additionally, in each scenario the learner will have the possibility to select the 2nd best option, which will lead the learner to "draw" the game. Respectively one or more options leading to the least favourable decision in the specific scenario, will result in the learner to have "lost" the game (as indicated in figure 3).

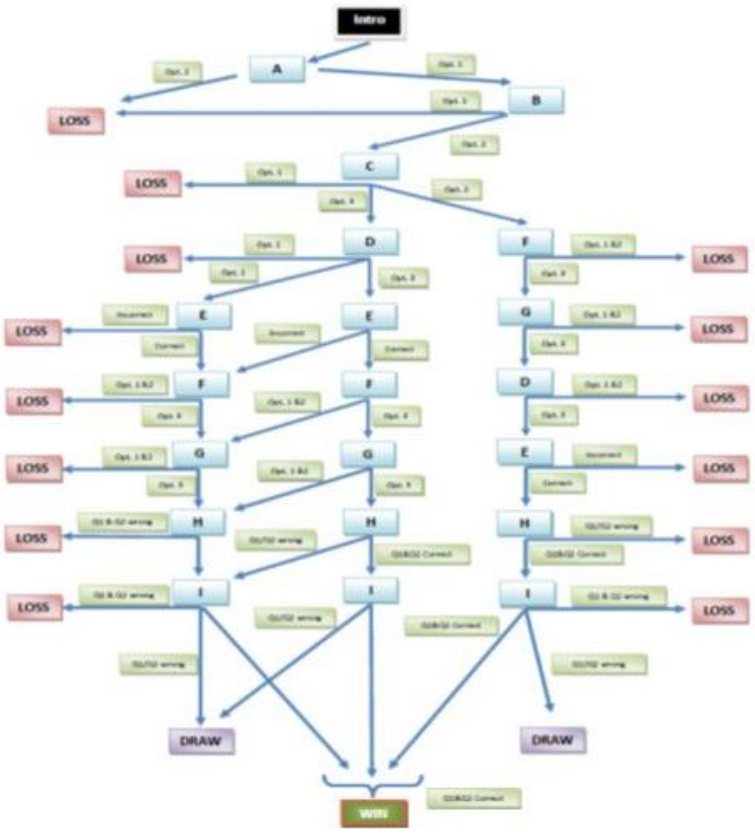

FIGURE 3: STORYLINE CONTENT – POSSIBLE OUTCOMES

6. Technical requirements & platform specifications

GRINSCO Result 3 "Online Training Scenarios" aims at creating an online training tool that will help workers and apprentices undergoing WBL acquire new skills/experience. The GRINSCO training scenarios will be offered in the form of a simulation game that can be accessed offline and should have the following minimum technical specifications. These specifications will also guide the selection of the e-learning platform to host the GRINSCO simulation game.

6.4 Support different languages

The platform should support content in different languages, taking into consideration that it would be for the best of the GRINSCO project if the training scenarios could be released in all consortium languages:

a. English
b. French
c. Polish
d. Lithuanian
e. Greek
f. Italian

6.5 Authoring tool and Branching story

The method selected to generate content and improve is the branching story. The root of this game is the generation of interactive stories, which can be decided by the user depending on the selection carried out. The selected platform will provide the necessary tools to create these stories and interconnect them.

6.6 Animation

Animation is essential to create an engaging and fun game and secure learners' retention in the learning process while contributing to make the branching scenarios (stories) flow smoothly and more realistically. To provide an appealing and user-friendly environment, an animation library will be set on specific parts of the graphics. This library will be provided for specific visual content and it will not be editable on the web application. The technology used to produce the animation will be Articulate Storyline 2.

6.7 Tree connection

The task of creating a story will be concluded by the connection of the single nodes. Hence, it will be implemented a linked tool to create the flow of the story by connecting the single nodes. This connection will be limited depending on the type of the node and the maximum connection between nodes selected.

6.8 Content Management

The online platform will contain several tools to create and edit a branching story, these tools will provide management of the content by allowing the administrator to upload visual content, audio content and, edit dialogue. Furthermore, after the edition of the branching story, it will be required to save the position of each element in the single node. This information will be requested every time that the node has to be edited, obtaining the exact same position of the elements as the last save.

6.9 User story visualisation

Once the story has been built, the platform will provide a tool to visualize the complete story and allow the use to interact with it. This module is focused on the trainees and the communication between the story and the decision taken by them. As it is expected, all the components and animations included on the editable phase of the story will be shown during the visualization of the story.

6.10 Internet requirements & web technology

It is possible to develop and edit the training scenarios offline on Articulate Storyline, therefore internet access is only required to download the software program package and installing it on the device. No further requirements are necessary once the program has been successfully installed.

6.11 Recommended Software: Articulate Storyline

Articulate Storyline is a popular software for creating interactive online courses and one of the world's most popular applications for online training[2]. Articulate Storyline is an easy authoring software and has an intuitive user interface requiring no specific training for the

[2] https://articulate.com/perpetual/storyline-3

user. In particular and with reference to the GRINSCO training scenarios, Articulate Storyline gives the user the option to develop a storyline in the form of flowcharts.

Amongst other interesting features Articulate Storyline has a library of templates which facilitates the development process, including slide templates, colours, photographic and illustrated customised characters, a significant variety of fonts and themes.

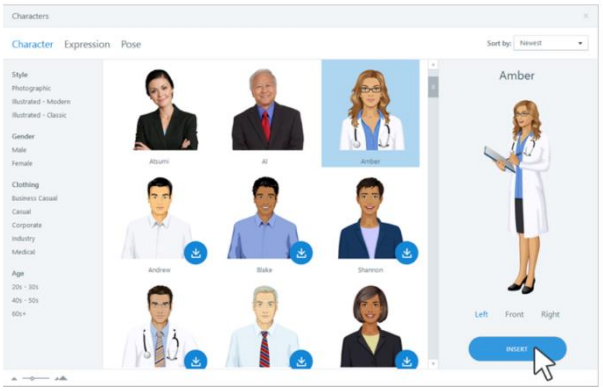

Figure 4: Creation of characters in Articulate Storyline

Modifications and text editing can be carried out quickly and easily, in a similar way to that in PowerPoint documents. Useful tools such as format painter, allows the user to format any object on a slide, then copy the formatting to text boxes, shapes, buttons, or characters.

Additionally, the timeline option allows the user to make objects, animations, trigger events and other elements appear in the right time and place, via an intuitive visual timeline.
Other features potentially applicable to the GRINSCO simulation game include:

- Content importing possibilities
- Hyperlinks insertion
- Slide numbers
- Slide layers
- Translation features
- Time limit options
- Customizable feedback
- Object editing enhancements
- Triggers
- Buttons
- Multiple publishing options (see Section 6.10)

- Mobile user friendly

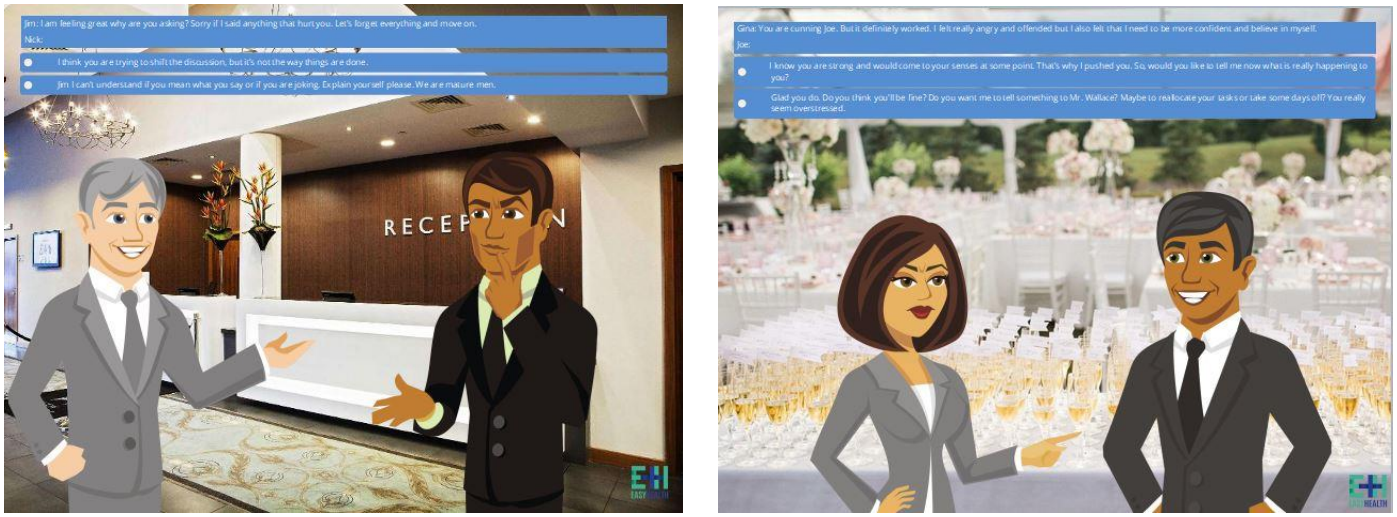

Figure 5: Articulate Storyline – example slides

To be able to install the Articulate Storyline programme, the following software characteristics are required:

- Operating system: Windows 10 (32-bit or 64-bit)
  Windows 8.1 (32-bit or 64-bit)
  Mac OS X (latest version) with Parallels Desktop (latest version) or VMware Fusion (latest version)

- .NET Runtime: Microsoft .NET Framework 4.5.2 or later
- Visual C++: Microsoft Visual C++ 2019 Redistributable

6.12 Hardware

To be able to install the Articulate Storyline, the following hardware characteristics are required on a physical computer[3]:

- CPU 2: GHZ processor or higher (32-bit or 64-bit)
- Memory: 2GB minimum
- Available disk space: 1 GB minimum
- Display:1,280 * 800 screen resolution or higher

[3] https://articulate.com/support/article/System-Requirements-for-Articulate-Storyline-360#hardware

6.13 Storybuilder Authoring Module

Articulate Storyline is the storybuilder to be used for the development of the scenarios in the form of flowcharts, which will be connected via nodes. Figure 6 illustrates a mockup of the storybuilder interface made on Articulate Storyline.

From the "Insert" menu of the different resources can be selected and loaded from the library. Characters and animations can be *inserted, audio and videos* can be added to create a scenario. Slides can be added as scenes, thereby building-up the overall progress and alternative outcomes of the scenario (see Figure 7). Nodes can easily be added by clicking on the "New slide" option from the "Insert" menu or deleted simply by selecting the specific slide and pressing "Delete".

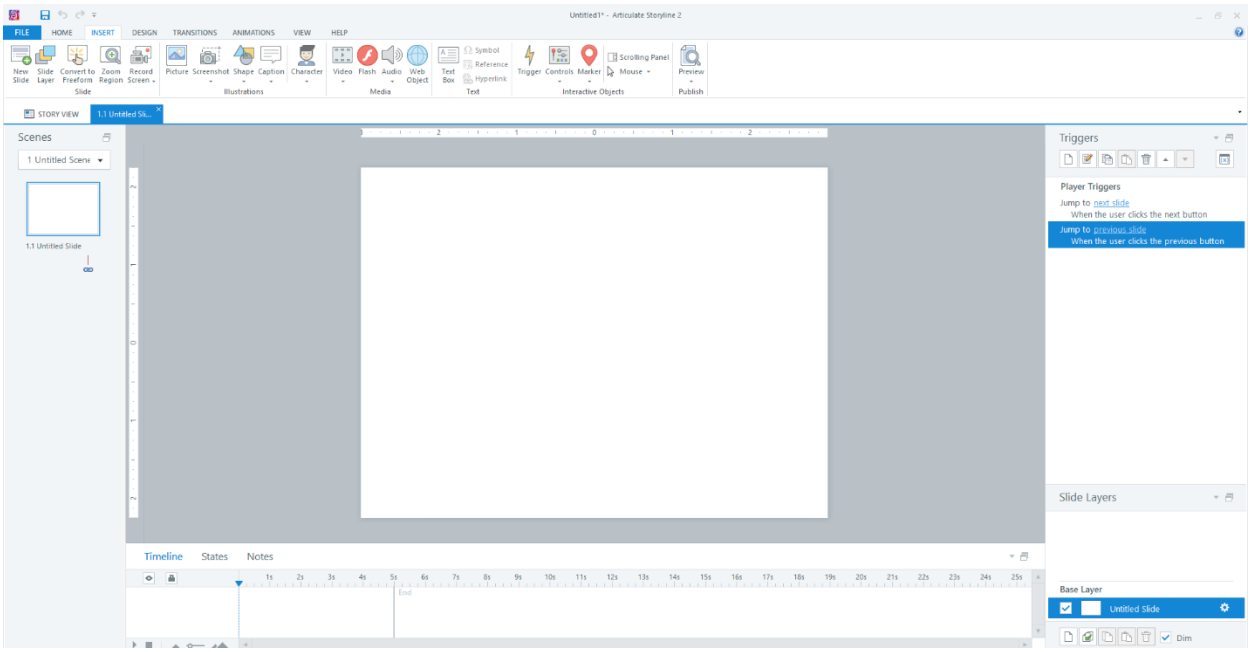

Figure 6: Articulate Storyline interface

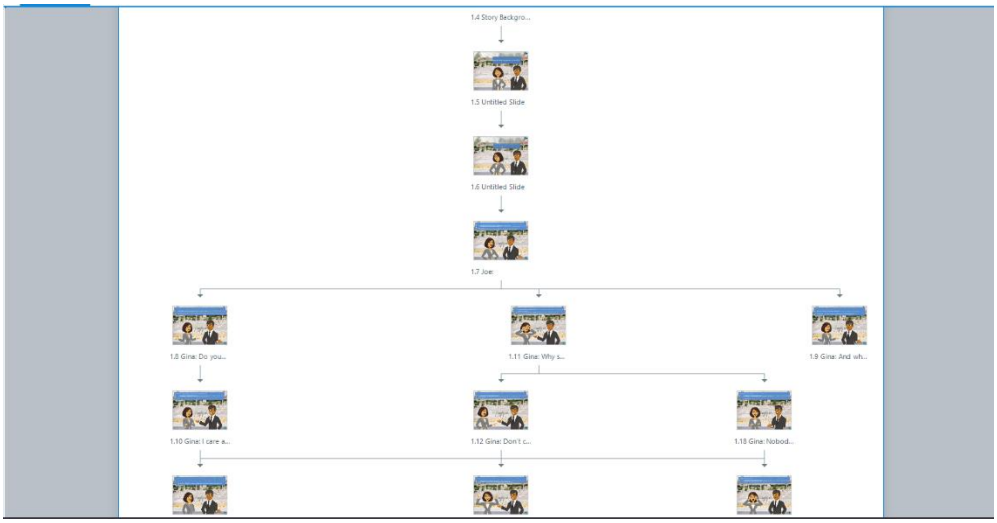

Figure 7: Nodes & possible outcomes of a branching scenario

After all the nodes have been created, Articulate Storyline allows you to publish and export the scenario in various formats including web HTLM5 (compatible with Android and iOS devices), online, word and Scorm LMS format.

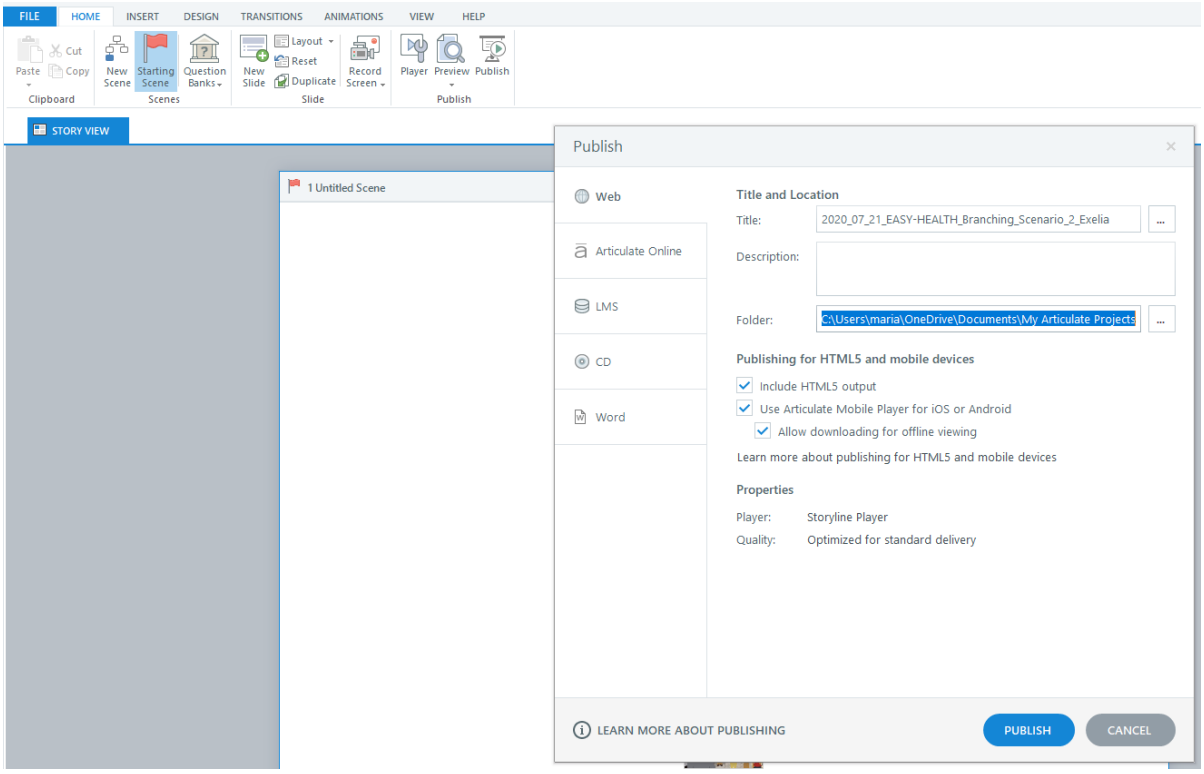

Figure 8: Publishing & exporting options

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