GREEN WELD

User Guide for Training Implementation

Outcome of WP3 Development and adaptation of Welders Training programs and materials

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1. About Greenweld Project

GREENWELD, Green Welding Certificates focuses on developing curricula to address green skills for welders and how to adapt learning methods with a greener point of view training (e.g., use of welding simulators) where education can be implemented greener.

In relation to the above, the current Green Skills Needs and new Learning Approaches for Welders have been identified, which are going to be absorbed to training programs that need to respond quickly to the new competence requirements. The developed training program, which now is focused to green skills, will be implemented in 3 different countries (Denmark, Greece, and Spain), reaching 20 students per country. The program will focus on students who want to become welders, but also on current welders who may need the green skills to meet the market needs. At the end of the pilot activities, green welding certificates will be awarded to candidates, providing an added value for European qualifications.

Focusing on welding technology and the sectors for which this technology is used, for the digital and green transition, it is necessary to address the issue of key competencies such as green, digital, and sustainable skills, and develop strategies to overcome these needs. Vocational and Educational Training (VET) centres are the forerunners of this digital and green transition, as they are a pillar for the training and education of the current and future workforce.

Where the welding process is concerned, a whole range of factors have an impact on sustainability. These include details of the welding technology like system costs, raw materials, filler materials or energy efficiency.

GREENWELD project (Green Welding Certificates) using sustainability of the implementation of the training as example, virtual training, gamification or welding simulation that novice welders are used to complete the training in basic skills.

2. The Green Curricula and the Green Skills

The introduction of green topics, such as energy efficiency practices or the importance of minimising energy consumption, can raise awareness for sustainable action principles. Training thus makes an essential contribution to a greener and more sustainable industry.

The two additional competence units in GREENWELD project are an example of this raising awareness in training, in the field of welding. The following table presents a summary of the knowledge and skills to be presented as additional to the European / International Welder Qualification. Although, welders that are already working in industry and have certification on EN ISO 9606, EN ISO 14732 or similar can also apply for the up-skilling process of having the record of achievement for Environmental Awareness for a Greener Welding and GREENWELD Impact Measurement.

GREENWELD Competence Units			
Proficiency Level /	Knowledge	Skills	Autonomy and Responsibility
Basic /Aligned with EQF level 3	Basic facts, principles, processes, and general concepts on green awareness and green procedures applied to welding and related technologies.	Be able to check and follow information on greener procedures. Carry our action previously defined that can reduce the impact of welding.	Work under supervision, taking personal responsibility for own actions and having self-awareness of the impact of their own actions on the environment.

Table 1 - Summary of Knowledge and Skills for the GREENWELD CUs

3. Pedagogical Framework for Green Skills

Having identified the green skills and knowledge needed to achieve these learning outcomes, it is also important to address innovative pedagogical practices that could complement the training of green skills.

3.1 – Theoretical presentation of Innovative teaching methodologies

3.1.1 – Introduction

This section provides a theoretical presentation of various innovative teaching methodologies. It includes brief descriptions of each teaching and learning approach, highlighting their key benefits. Additionally, the section showcases exemplary projects/approaches for each methodology. By illustrating the presented methodologies through these examples, it aims to inspire and guide potential actions in educational settings.

3.1.2 – Flipped Classroom

The Flipped Classroom is an innovative teaching approach that reverses the traditional learning model, where teachers present and instruct during class. In a Flipped Classroom, students are provided with pre-class materials, which can include videos or readings, to review before attending classes. During class time, students actively engage in discussions, problem-solving, and the application of knowledge, with teachers serving as guides.

Below are some of the key benefits of Flipped classroom listed:

- **Student-Centered:** Shifts focus from the teacher to the student.
- **Active Learning:** Promotes engagement and higher-order thinking.
- **Individual Pacing:** Allows students to learn at their own speed.
- **Flexible:** Suitable for various subjects and adaptable to diverse learning styles.
- **Technology Integration:** Utilizes technology for content delivery.

University of Barcelona, Spain

Course: Biodiversity Conservation

Flipped Approach: Students access online materials covering biodiversity hotspots, conservation strategies, and the impact of climate change on ecosystems. Classroom activities include group projects where students develop conservation plans, participate in debates on environmental policies, and engage in role-playing scenarios related to biodiversity management.

3.1.3 - Problem-Based Learning (PBL)

Problem-Based Learning (PBL) is centered around using real-world problems as the main point of student learning. Students are presented with complex, open-ended, and real-life problems to solve. After the problem is presented, students take the initiative to research, study, and gather relevant information to address the presented problem and find a solution. This approach often encourages group collaboration and increases motivation, as students must find their own solutions to real-life problems, thereby enabling them to learn in their own way.

Below are some of the key benefits of Problem-Based Learning (PBL) listed:

- **Relevance:** PBL emphasizes the practical application of knowledge to real-life situations.
- **Critical Thinking:** Encourages the development of problem-solving skills and critical thinking.
- **Student Engagement:** Engages students through curiosity, exploration, and teamwork.
- **Interdisciplinary Learning:** Often incorporates multiple subject areas.
- **Preparation for the Real World:** Preparing students for challenges they may encounter in their future careers.

Ecocampus in Denmark

Approach: The University of Southern Denmark has embraced the concept of an "Ecocampus." This involves integrating sustainability principles into the physical campus infrastructure, curriculum, and daily operations.

Innovative Method: The university employs a problem-based learning (PBL) approach, where students collaborate on real-world sustainability challenges. This hands-on method allows them to apply theoretical knowledge to practical situations.

3.1.4 – Project-Based Learning (PrBL)

Project-Based Learning (PrBL) is an educational approach centered around acquiring knowledge through practical, real-world projects or tasks. While it shares commonalities with Problem-Based Learning (PBL), PrBL stands out due to its more structured framework tied to a particular project. Nevertheless, the core of the approach remains grounded in project-centered learning, where students actively immerse themselves in real-world challenges. This, in turn, fosters problem-solving skills, critical thinking, collaboration, and creativity among students.

Below are some of the key benefits of Project-Based Learning (PrBL) listed:

- **Relevance:** Project-Based Learning makes learning more relevant by being connected to real-world projects.
- **Ownership of Learning:** Students take ownership of their learning and develop.
- **Interdisciplinary Skills:** Promotes the development of a wide range of skills, including research, communication, and teamwork.
- **Preparation for the Real World:** Helps students build the skills they will need in their future careers.

Eco-campus at Uppsala University, Sweden

Approach: Uppsala University has implemented an Eco-campus initiative to reduce the environmental impact of its operations and promote sustainability.
Innovative Method: The university integrates sustainability into various courses and programs, including engineering and environmental sciences. Students participate in projects related to sustainable development, such as energy efficiency improvements on campus.

3.1.5 – Game-Based Learning

Game-Based Learning integrate games and interactive simulations as its primary educational instruments. By engaging in gaming and competitions, students have the opportunity to dynamically and engagingly apply theoretical concepts. This process supports the development of critical thinking skills and teamwork. Game-Based Learning usually motivates students and makes them more engaged. These games often offer situations and problems that require students to make decisions, solve issues, and think critically. All of this happens in a fun and stress-free gaming environment.

Below are some of the key benefits of Game-Based Learning listed:

- **Engagement:** Game-Based Learning makes learning highly engaging and enjoyable, which can boost participation.
- **Motivation:** The game-like elements motivate students to learn and understand.
- **Problem-Solving Skills:** Game-Based Learning enhances problem-solving and decision-making abilities.
- **Interactive Learning:** It promotes active participation, collaboration, and hands-on learning.

"SustainCity Simulator", Master's in Sustainable Development, University of Lisbon, Portugal

Approach: The University of Lisbon, within its Master's in Sustainable Development program, has implemented a game-based learning initiative called "SustainCity Simulator." This game is designed to immerse students in the complexities of sustainable urban development. The objective is to provide a dynamic and interactive experience that reinforces theoretical knowledge and encourages critical thinking.

Gameplay: The game encourages collaboration among students from different academic backgrounds, such as environmental science, architecture, economics, and social sciences. Students make decisions regarding city infrastructure, policies, and resource allocation. The game simulates the consequences of these decisions on the city's environmental, economic, and social indicators.

3.1.6 – Peer Teaching and Peer Learning

Peer Teaching and Peer Learning are approaches centred around students teaching and learning from one another. This means that students take on the role of teachers, instructing their peers. This can be achieved through peer-led discussions, presentations, or tutoring. When students are engaged in the learning process by teaching and learning from their peers, it creates a two-way flow of knowledge and emphasizes collaboration. Furthermore, teaching a peer can deepen the understanding of a subject, as explaining concepts often requires a higher level of comprehension. It can also increase engagement because the students feel a sense of responsibility for their peers.

Below are some of the key benefits of Peer Teaching and Peer Learning listed:

- **Active Participation:** Both approaches promote active involvement in the learning process, which can lead to better comprehension and retention of material.
- **Communication Skills:** Peer Teaching enhances communication skills, while Peer Learning develops the ability to listen, absorb, and apply information effectively.

- **Variety of Perspectives:** Students benefit from different teaching styles and perspectives, potentially making complex concepts more accessible.
- **Mutual Support:** Peer interactions create a supportive learning environment, as students encourage and help each other succeed.

Peer Review of Sustainability Projects - Aalto University, Finland

Approach: Aalto University incorporates peer review into sustainability project assessments. Implementation: Students work on sustainability projects, and their work is reviewed by their peers. This process not only provides valuable feedback but also encourages students to critically evaluate and learn from each other's ideas and approaches.

3.1.7 – Collaborative Learning

Collaborative Learning allows students to be working together to achieve shared learning objectives. Students engage in collaborative activities where they jointly explore, discuss, and solve problems. These activities can take the form of group projects, discussions, or problem-solving tasks. When using Collaborative Learning, there is a shared responsibility among the involved students for their collective learning. Furthermore, it promotes active communication and interaction among students, possibly with diverse skills, allowing them to learn from more than one perspective.

Below are some of the key benefits of Collaborative Learning listed:

- **Critical Thinking:** Collaborative Learning encourages critical thinking and problem-solving skills as students work together to find solutions and make decisions.
- **Social Skills:** It enhances interpersonal and social skills, helping students develop effective communication, and leadership abilities.
- **Diverse Ideas:** Students are exposed to a range of ideas and perspectives, broadening their understanding of the subject matter.

- **Mutual Support:** Collaborative Learning creates a supportive learning environment where students help each other succeed.

Baltic University Programme (BUP)

Approach: The Baltic University Programme is a network of universities in the Baltic Sea region that collaborates on sustainability education and research.
Innovative Method: BUP emphasizes interdisciplinary and problem-oriented learning. Students engage in collaborative projects that address regional sustainability challenges. This approach fosters a holistic understanding of sustainability issues.

3.1.8 – Multimodal Learning (traditional)

Traditional Multimodal Learning is an educational approach that recognizes and caters to diverse learning styles and preferences by presenting information through various sensory modalities. It combines visual, auditory, kinesthetic, and other sensory modes, encompassing reading, listening, hands-on activities, and more. This way of teaching understands that everyone learns in their own way. It makes learning more exciting and helps you understand better. Teachers use many different methods and materials like talking, showing pictures, doing activities, and having discussions. This makes sure that everyone can learn in the way they like best, based on their own strengths and preferences.

Below are some of the key benefits of Traditional Multimodal Learning listed:

- **Tailored Learning:** Multimodal Learning allows educators to tailor their teaching to reach a broader range of students and address varied learning preferences.
- **Improved understanding:** Students tend to understand information better when it's presented in a way that aligns with their preferred learning modality.
- **Including approach:** This approach welcomes all kinds of learners, making sure that more students can do well in their studies.

Virtual Field Trips - University of Copenhagen, Denmark

Approach: The University of Copenhagen utilizes virtual field trips to teach sustainability concepts.
Implementation: Through virtual reality (VR) or immersive online platforms, students can "visit" environmentally significant locations. This multimodal approach allows them to understand the impact of human activities visually and experientially on ecosystems.

3.1.9 – Reflective Practice and Journaling

Reflective Practice and Journaling are learning methods that regularly involve reflection and keeping a personal journal about individual learning experiences, challenges, and progress. Reflecting on personal experiences and writing them down helps students gain a deeper understanding of what they've learned over a specific timeline. It helps clearly demonstrate the value and purpose of what students do, both for themselves and on a societal level.

Below are some of the key benefits of Reflective Practice and Journaling listed:

- **Improved Learning:** Reflecting on your experiences and writing them down can make learning more effective and personal.
- **Self-Discovery:** You get to know yourself better and understand your strengths and areas where you can improve.
- **Tracking Progress:** Keeping a journal helps you track your progress and set new goals.

Technical University of Munich, Germany:

Course: Sustainable Engineering Practices
Reflective Practice Approach: Students engage in reflective journaling after participating in sustainability-focused engineering projects. They document their problem-solving processes, challenges encountered, and lessons learned. In-class discussions involve sharing insights from the reflective journals, fostering a deeper understanding of sustainable engineering principles.

3.1.10 – Inquiry-Based Learning

Inquiry-Based Learning encourages students to be curious and ask questions. They actively engage in research and investigations to find answers. It's an active learning approach where students learn by being curious and doing things.

Below are some of the key benefits of Reflective Practice and Journaling listed:

- **Curiosity:** Encourages students to be curious and inquisitive about the given tasks.
- **Independence:** Promotes independent learning as students take charge of their inquiries.

Field-Based Learning - University of Bergen, Norway

Approach: The University of Bergen incorporates field-based learning in sustainability courses.
Implementation: Students engage in field trips to natural environments, where they observe ecosystems, collect data, and analyse the impact of human activities. This inquiry-based approach connects theoretical knowledge to real-world scenarios.

3.1.11 – XR tools

Using Extended Reality (XR) tools in educational training involves technologies like virtual reality (VR) and augmented reality (AR) to enhance the learning experience. XR is a common term that describes VR, AR, and MR (mixed reality). These tools enable students to practice, explore, and interact in an environment where they can manipulate objects or perform tasks in a virtual or augmented setting. Furthermore, students can engage in real-world simulations, which can be particularly useful for training in complex or dangerous scenarios.

Below are some of the key benefits of Extended Reality (XR) tools listed:

- **Practical Experience:** Students gain practical experience and skills through hands-on learning in safe and controlled virtual environments.
- **Adaptability:** XR tools can be tailored to various educational settings.
- **Problem-Solving:** Students can engage in problem-solving and critical thinking by interacting with XR simulations.

AR Wildlife Identification - University of Patras, Greece

Description: The University of Patras employs AR for wildlife identification.
Implementation: Students use AR applications to identify plant and animal species in their natural habitats. This interactive approach enhances ecological literacy and encourages a deeper connection to local ecosystems.

4. Lesson Planning

A lesson plan is a detailed plan that guides trainers in facilitating the training process. It serves as a roadmap for delivering a lesson or a series of lessons effectively. The key aspects of a lesson plan are the following:

Learning Outcomes: Clearly defined learning outcomes that learners should be able to accomplish by the end of the lesson. These will guide the content and activities of the lesson.

Training Methodology: Detailed descriptions of training methods, techniques, and activities that help trainers to effectively transfer information and engage with learners. This may include lectures, discussions, group work, demonstrations, multimedia presentations, etc.

Media/Tools/Resources: Listing necessary materials, resources, and equipment ensures that the trainer is prepared and can conduct the lesson smoothly.

Evaluation and Assessment: Assessment strategies, such as quizzes, tests, or informal observations, are included to evaluate trainees' understanding and progress towards meeting the objectives or learning outcomes.

Regarding the training phases:

Introduction: An engaging introduction sets the stage for the lesson, grabs learners' attention, and provides context for the topic being taught.

Body/Development: The core content of the lesson, organized logically and sequentially, ensures that trainees receive information in a structured and understandable manner.

Saving Results/Summary: A summary or review of key points reinforces learning and helps trainees connect new information with what they already know.

Figure 1 below presents an example of lesson planning. The template, ready to be used, is in Annex 1.

Lesson Planning

Trainer:	Date:	Starting time/duration:
CU:	Topic:	Country/City:
Learning Outcomes:		

Phases:	Duration: (in minutes)	Training Methodology:	Media/Tools/ Resources: (List of…)	Evaluation and Assessment: (List of…)
Introduction: (List of topics to be explored)				
Body/Development: (List of topics to be explored)				
Saving Results/Summary: (List of topics to be explored)				

Figure 1 - Lesson Planning example

The added values of Lesson Planning are the following:

Organization: Lesson plans help trainers organize their thoughts, materials, and activities, ensuring a clear and coherent presentation of the content.

Efficiency: By outlining the sequence of activities and timing, lesson plans help trainers manage time effectively during the lesson.

Adaptability: While lesson plans provide structure, they also allow for flexibility. Trainers can adapt activities or strategies based on trainees' reactions and needs.

Consistency: Lesson plans promote consistency in training across multiple sessions or instructors, ensuring that all trainees receive the same level of instruction.

Assessment Alignment: Lesson plans help trainers align instructional activities with learning outcomes and assessment strategies, ensuring that learning outcomes are measurable and achievable.

Overall, lesson plans are a valuable tool for trainers, providing structure, guidance, and a framework for effective teaching and learning experiences.

5. Evaluation and Learning Process

The examinations shall take place in a centre previously approved by EWF. For the examinations to be carried out, the examination centre must have a suitable room that meets the conditions of accessibility, lighting, temperature, ventilation, soundproofing and other health and safety conditions that ensure the proper conduct of the examinations. The examination centre must be sufficiently spacious for the location of the students to prevent the visibility of the exams to each other in order to facilitate the supervision of the examination.

The examination shall be conducted according to the following structure:

- **10 multiple-choice questions for each Competence Unit**, with four options for each question and only one correct answer.
- The time allowed is approximately **1 minute per question**, with a total of 10 minutes per examination for each Competence Unit.
- No deduction will be made for unanswered or incorrectly answered questions, only no points will be added.

If, during the course of the examination, the Examining Board detects any fraudulent practice that compromises the security of the examination, it shall verbally reprimand the candidate. If the candidate reoffends again, the examination shall be removed, and the candidate shall fail the examination.

In order to pass the exam **for each Competence Unit**, the candidate must obtain **at least 60 % or more** of the maximum possible score.

Candidates who do not pass the examination have the right to retake it at a **second attempt** within **15 days after** the date on which they took the first examination.

Candidates who meet all requirements will be processed for approval and issuance of the corresponding **Record of Achievement** (in Digital Certificate format) **for each Competence Unit**. The training centre secretariat will keep an updated record of the digital certificates issued.

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