WP4

D4.6: Innovative teaching methods

Co-funded by
the European Union

101144027 — SEBCoVE — ERASMUS-EDU-2023-PEX-COVE

SEBCoVE
SMART ELECTRICITY FOR BUILDINGS

D4.6: Innovative Teaching Methods

SMART ELECTRICITY FOR BUILDINGS

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Education and Culture Executive Agency (EACEA). Neither the European Union nor EACEA can be held responsible for them.

Erasmus + EU Solidarity Corps
101144027-SEBCoVE ERASMUS-EDU-2023-PEX-COVE

Co-funded by the European Union

Executive Summary

The purpose of this report is to present the methodological framework and recommended teaching approaches developed under Task T4.6 of the SEBCoVE project (101144027—ERASMUS-EDU-2023-PEX-COVE). It aims to support Vocational Education and Training (VET) providers in the Smart Electricity for Buildings (SEB) sector by integrating innovative, learner-centred, and technology-enhanced methodologies into the SEBCoVE microcredential curricula. The overarching objective is to align VET practices with modern pedagogical standards, labour market needs, and the European vision for Centres of Vocational Excellence (CoVEs).

The report begins with an introduction to the task's objectives and policy context, followed by a detailed account of the methodology used to define, test, and validate innovative teaching strategies. It offers a comprehensive analysis of the pedagogical framework and criteria for selecting effective methodologies, including project-based learning, simulation, flipped classrooms, inquiry-based learning, and work-based learning. A final section maps these methodologies to the learning outcomes of the 11 SEBCoVE microcredentials, ensuring a coherent link between pedagogical strategy and vocational competence development.

By establishing a validated and adaptable teaching framework, the report contributes to the modernization and enhancement of VET delivery across the SEB sector. It fosters improved learning outcomes, greater learner engagement, and stronger alignment between training and industry demands. Additionally, the proposed hybrid teaching model and digital tools promote accessibility, personalization, and scalability, allowing SEBCoVE's methodological innovations to be replicated in other regional, national, and

Co-funded by the European Union

European VET systems. The report also informs the preparation of Training-of-Trainers seminars and provides a foundation for quality assurance and continuous improvement in pedagogical practices.

The report is intended for a wide range of stakeholders in the VET ecosystem, including:

- **VET providers and educators** seeking to implement modern, effective teaching methods;
- **Curriculum designers and education policy makers** involved in aligning VET with CoVE principles;
- **Industry partners and employers** contributing to competency definition and work-based learning integration;
- **Regional and national authorities** aiming to scale and institutionalize innovative teaching practices;
- **Learners** who will benefit directly from more engaging, flexible, and relevant vocational training opportunities in the SEB sector.

Co-funded by the European Union

Abstract

The SEBCoVE Innovative Teaching Methodologies report, developed within the project (101144027-SEBCoVE ERASMUS-EDU-2023-PEX-COVE), presents the outcomes of Task T4.6 of the SEBCoVE project (101144027—ERASMUS-EDU-2023-PEX-COVE), focused on the design and implementation of innovative teaching methodologies for Vocational Education and Training (VET) in the Smart Electricity for Buildings (SEB) sector. Aligned with the goals of Centres of Vocational Excellence (CoVEs) and European VET policy, the report outlines a learner-centred, technology-enhanced, and hybrid pedagogical model supporting SEBCoVE's modular microcredential curricula. It synthesizes research-based strategies, stakeholder feedback, and educational technologies—such as project-based learning, simulations, flipped classrooms, and serious games—tailored to the evolving needs of SEB learners and labour markets. The framework emphasizes experiential and work-based learning, flexible and accessible delivery, and personalized instruction. A detailed methodology–microcredential mapping demonstrates how each approach supports the acquisition of specific technical and transversal competencies. The report concludes by affirming the scalability and transferability of the proposed methodologies across European VET systems, aiming to foster pedagogical innovation and workforce excellence in the SEB sector.

Keywords

Vocational Education and Training (VET)

Education and training programs designed to equip learners with practical and occupational skills aligned with labour market needs. In SEBCoVE, VET focuses on preparing learners for careers in Smart Electricity for Buildings.

Centres of Vocational Excellence (CoVEs)

Collaborative regional hubs that bring together VET providers, industry, and other stakeholders to drive innovation, quality, and relevance in vocational training. CoVEs are a strategic pillar of EU VET policy and a core focus of SEBCoVE.

Microcredential

A certified, modular learning unit focused on specific skills or competencies. SEBCoVE's microcredentials are tailored to the SEB sector and designed for stackable and flexible learning pathways.

Innovative Teaching Methodologies

Pedagogical approaches that enhance learning outcomes through active, learner-centred, and technology-supported strategies. Examples include project-based learning, flipped classrooms, and immersive simulations.

Learner-Centred Approach

An educational philosophy that places learners at the core of the teaching process, emphasizing personalized, participatory, and competency-driven learning experiences.

Technology-Enhanced Learning (TEL)

The use of digital tools and platforms—such as simulators, learning management systems, XR, and AI—to enrich teaching, increase accessibility, and improve engagement and outcomes.

Blended/Hybrid Learning

A flexible training model that combines face-to-face instruction, online learning, and work-based experiences. It is central to SEBCoVE's pedagogical model to address diverse learner needs and contexts.

Project-Based Learning (PjBL)

A method in which learners gain knowledge and skills by working on real-world projects that require planning, problem-solving, and collaboration. Widely used in SEBCoVE microcredentials to simulate job tasks.

Simulation-Based Learning (SimBL)

A teaching strategy using virtual or physical simulations to replicate real-life systems and scenarios. It allows learners to practice skills in safe, controlled environments.

Flipped Classroom

An instructional model where foundational content is learned independently (e.g., online) before class, and class time is used for practical, interactive activities.

Work-Based Learning (WBL)

A pedagogical method that embeds learning in real-world work environments through internships, apprenticeships, or industry projects, allowing learners to develop practical and professional skills.

Inquiry-Based Learning (IBL)

A student-centred approach that encourages learners to explore, investigate, and solve open-ended problems, promoting critical thinking and autonomy.

Gamification

The use of game elements and serious games in educational contexts to enhance learner motivation, engagement, and retention of complex content.

Training-of-Trainers (ToT)

A capacity-building process that equips educators and instructors with the knowledge, tools, and methodologies needed to implement innovative teaching practices effectively.

Smart Electricity for Buildings (SEB)

A sector encompassing technologies and systems that enable intelligent energy use, automation, and integration of renewable energy in buildings—central to SEBCoVE's curriculum and skills development goals.

Erasmus + EU Solidarity Corps
101144027-SEBCoVE ERASMUS-EDU-2023-PEX-COVE

Co-funded by the European Union

Contents

Co-funded by the European Union

Revision History

Rev	Date	Author	Document Sponsor	Revision Summary
1.	25/02/2025	JR, MA	Jesus Rosel. MLA	First Edition / Draft version
2.	10/05/2025	Konstantinos Androulakis	Jesus Rosel. MLA	Machining learning outcomes in microcredentials with specific teaching methodologies
3.	15/5/2025	Konstantinos Androulakis	Jesus Rosel. MLA	Updating innovative teaching methodology

Reviewers

Rev.	Date	Reviewer	Document Sponsor	Reviewed
1	21/5/2025	Professor Emmanouel Karapidakis	Jesus Rosel. MLA	YES
3	27/5/2025	Constantinos Andronis	Jesus Rosel. MLA	YES

INNOVATIVE TEACHINING METHODOLOGIES FOR SEBCOVE TRAINING

Introduction

This report presents the implementation of Task T4.6 "**Innovative Teaching Methodologies**," a core component of the SEBCoVE project dedicated to advancing pedagogical excellence within the field of Smart Electricity for Buildings (SEB) Vocational Education and Training (VET). The task is grounded in the broader ambition of SEBCoVE to promote Centres of Vocational Excellence (CoVEs) as key enablers of innovation, responsiveness, and quality in VET across Europe.

Task T4.6 focuses on the design, development, and dissemination of a **common and comprehensive methodological framework (Deliverable D4.3)** to support the implementation of the SEBCoVE microcredential curricula. This framework is aligned with the pedagogical principles endorsed by European VET policy and the Erasmus+ programme, emphasizing a **holistic, learner-centred, and technology-enhanced approach** to teaching and learning. It aims to support VET institutions across SEBCoVE's regional hubs in selecting and adopting methodologies and digital tools that suit their specific contexts and learners' needs.

The framework acknowledges the increasing complexity and variability of contemporary learning environments and supports the integration of **hybrid learning models**—a deliberate combination of face-to-face, online, and work-based learning. This modality is essential for ensuring the **flexibility, efficiency, and effectiveness** of training in the SEB sector, where learners must be equipped with a dynamic set of knowledge, skills, and attitudes applicable to real-world, evolving occupational settings.

Throughout the task, special emphasis has been placed on identifying and promoting **innovative and pedagogically sound methods**, including project-based learning, flipped classrooms, serious games, immersive simulations, and roleplay. These approaches are especially relevant for delivering **integral and authentic learning experiences**, enabling learners to progressively assume ownership of their learning while developing the occupational competences required in the sector.

In parallel, the task introduces and integrates advanced digital learning tools. The **Augmented Reality (AR) application** developed under T4.6 supports real-time, interactive engagement with complex technical content, enriching the learning experience with enhanced visualizations and dynamic data interaction. Furthermore, **serious games** and **animated videos** have been created as self-directed e-learning resources, allowing for flexible, engaging, and accessible learning pathways that extend beyond the traditional classroom.

Finally, this report details the methodological planning, pedagogical definition, selection and validation of teaching methods, and the collaborative development of training content. It also outlines the preparation for the **Training-of-Trainers (ToT) seminar** and the process of **revising the framework based on pilot feedback**, ensuring its adaptability and relevance to the diverse realities of SEBCoVE's VET providers.

By synthesizing research-based insights, practitioner feedback, and technological innovation, Task T4.6 contributes significantly to the overall goal of establishing **sustainable and transferable models of vocational excellence** in the Smart Electricity for Buildings sector and beyond.

Aims and Objectives

The aim of this report is to design and present a comprehensive, innovative, and transferable methodological framework to support the effective implementation of the SEBCoVE microcredential curriculum in the Smart Electricity for Buildings (SEB) sector. It seeks to guide Vocational Education and Training (VET) providers in adopting learner-centred, competency-based, and technology-enhanced teaching methodologies aligned with European VET policies and the principles of Centres of Vocational Excellence (CoVEs).

Objectives

To achieve this aim, the report pursues the following specific objectives:

1. **To define a pedagogical approach** that aligns with the competency requirements and occupational profiles identified in the SEB sector through industry consultation and curriculum development (Deliverables D4.1 and D4.2).
2. **To identify and recommend innovative teaching methodologies**—including project-based learning, simulation, inquiry-based learning, flipped classroom models, and work-based learning—suitable for both initial and continuing VET (IVET and CVET) settings.
3. **To integrate educational technologies** such as XR simulators, serious games, remote labs, and digital learning tools that enhance learner engagement, personalization, and flexibility.
4. **To align each methodology with the learning outcomes** of the SEBCoVE microcredentials, ensuring pedagogical coherence and effectiveness in delivering technical, transversal, and professional skills.
5. **To provide criteria for selecting and adapting methodologies** based on relevance, effectiveness, scalability, and alignment with learner needs and institutional capacity.
6. **To support the implementation of a blended/hybrid VET model** combining face-to-face, online, and work-based components, tailored to regional and sectoral contexts.

7. **To prepare the groundwork for Training-of-Trainers (ToT) activities** and the eventual institutionalization of the SEBCoVE methodological model within national and European VET systems.

Methodology used.

The development of the teaching methodologies for SEBCoVE training is grounded in two foundational documents: the **SEBCoVE Microcredential Curricula (D4.2)** and the **Innovative Teaching Methodologies report (D3.2)**.

The **SEBCoVE Microcredential Curricula** were created through a structured, evidence-based process that ensures both alignment with European quality standards and relevance to labor market needs. Curriculum development began with the definition of professional profiles, as presented in **Deliverable D4.1: "Professional Profiles Definition."** These profiles resulted from a rigorous, multi-stage research and consultation process conducted in an earlier phase of the project.

The **Innovative Teaching Methodologies report (D3.2)**, developed in an earlier phase, serves as a key input and reference for this methodological framework. It explores a wide range of innovative approaches tailored specifically for Vocational Education and Training (VET) in the Smart Electricity for Buildings (SEB) sector. Through comprehensive desk research, the report identifies effective teaching methodologies designed to enhance learning outcomes and training effectiveness.

This study places strong emphasis on modern paradigms in learning and teaching, including **technology-enhanced learning** and **learner-centered approaches**, in line with European VET policy. It highlights the importance of aligning training with industry needs, fostering learner engagement, and ensuring high-quality occupational performance. Moreover, it underscores the value of collaboration between VET institutions and industry in developing innovative teaching and learning frameworks.

The report concludes with a general recommendation to adopt a **common, hybrid teaching model** that is **learner-centered** and **technology-supported**. This model is proposed as a basis for innovative teaching practices in SEB education and training and can serve as a set of good practices for VET institutions and systems engaged in the SEB sector.

ANALYSIS AND RECOMMENDATIKONS ON EDUCATIONAL METHODOLOGIES

This section provides a description for innovative teaching in the provision of education and training for the Smart Electricity for Buildings (SEB) sector. This training has been conceived and developed within the SEBCoVE project.

Basically, the innovative teaching in the SEBCoVE project, (1) is focused on a **methodological transformation** that (2) happens within **a certain educational model** (classifiable as IVET or CVET).

This innovation is expected to generate evidence of good practice in technical and vocational education "of excellence" (according to CoVEs Initiative) for the SEB sector, which may be promoted, adopted and generalized. The section starts with a brief general analysis of this innovative teaching, then, focused on the pedagogical approach, suggest some operating criteria for delimiting it based on methodologies and educational technology. Finally, it provides a list with recommended methodologies for this methodological transformation.

General analysis

The analysis and decision-making process regarding the pedagogical approach for the SEBCoVE's VET is informed by the following information:

• The SEBCoVE's project objectives framed within the European CoVE Initiative and its expected impacts (i.e., the Context of this research). specially, the goals related with education and training of excellence.

• The Research and Benchmarking findings, including:

- The European VET landscape and its trends, particularly regarding innovation.
- Contemporary teaching and learning paradigms, especially in technical and vocational training, addressing both young and adult learners.
- Evidence-based teaching methodologies, alongside proven and emerging educational technologies.
- Best practices in VET innovation, especially those related to
- methodological transformation applied to the SEB sector, or in other close ones.

Essentially, the SEBCoVE's VET model must ensure that learners (including students, workers, and the unemployed) will be optimally equipped with technical, vocational, and employability competencies required to meet the current and future demands of the SEB sector, as they have been identified with the collaboration of industry. Remarkably, this goal can be achieved with the "innovative" traits provided by the methodological stance, and coherent methodologies, adopted along with other necessary features (e.g. quality management of the whole teaching process). When
applied to methodology, "innovative" means ways of enhancing the learning experience in particular contexts making this process more effective, efficient and/or
engaging.

The following conditions will shape this innovative teaching in general. So, to ensure the innovation is effective, it should consider:

1. Alignment with industry. The training curricula, the programs offered and the promoted teaching in the SEBCoVE's VET will be oriented towards sector specific competency requirements and occupational roles, to reduce current and future competency gaps caused by technological trends, and other factors.

2. Training service. The teaching approach, including principles, methodologies, methods and resources, will be suited to the education or training service offered, including purposes, certificates, pathways, courses and delivery modes. At the same time, innovative features will be highlighted.

3. Alignment with proven methodologies. The pedagogical approach, including methodologies, method and educational technology, will be consistent with modern learning and teaching paradigms, particularly those applied in adult learning, VET and HE, and will consider the pedagogical recommendations for VET from European authorities.

4. Capability building. Trained teachers and instructors, resources, documented teaching processes and a quality management model will be required to support the innovative service.

Empirically tested. The teaching conceived (as a service), with its innovative features, will be developed, implemented, piloted and validated in real training/education settings provided by the regional CoVEs constituted and developed within the project.

6. Scalable and **transferable**. Finally, the training with its components will be documented and configured as a comprehensive process with details about flexibilities and conditions for institutionalization. This is to say, to be potentially adopted within regional and national VET systems, and in other European VET systems.

Criteria for adoption of an innovative methodology

In this point the focus is put on the methodological stance of the SEBCoVE's VET. To ensure relevance, effectiveness, and sustainability (long-term viability and effectiveness of the methodological change) the following criteria have been identified that can guide the selection of innovative teaching methodologies:

Co-funded by the European Union

C1. Alignment with SEB sector competencies and occupational roles.

• Learners will develop expertise in competency areas related with the energy management in (smart) buildings, including, **understandings** of building automation, IoT integration, energy management, integration of RES and ESS, smart grids, and cybersecurity areas, as well as design, development, management and maintenance **skills** applied to solutions in each area, along with **attitudinal behaviours** and other relevant occupational knowledge. In essence, the aggregation of these competencies developed at different levels will result in certifications of important roles for the labour market. Coherently, **the methodological approach should be practical, competency-based** to promote this complex knowledge to the minimum standards required.

• To better ensure that training is aligned with real-world tasks and applications, **close collaboration with industry partners will be kept reaching several forms of active involvement** in design, development or implementation. This involvement can represent an innovative trait by itself.

C2. Holistic learner-centred teaching

Occupational roles and competencies will be translated into a training offer that in general (SEBCoVE's VET model) is levelled, certifiable, cumulable, flexible, adaptable, and work-based. **The teaching approach and the supporting technology will suit these features.**

• A holistic learner-centred teaching, promoted in Europe for VET, should be considered as a "teaching philosophy". This means that **learners are put at the core of the teaching process addressing their professional development** where not only the technical proficiency matters, but also employability and critical thinking, preparing them for a dynamic job market.

• Active, student-driven learning fostered by proper methodologies, methods and technology will improve retention and engagement. This is another feature of this learner-centred teaching framework that covers **competency/mastery-based/practical, experiential, work-based, collaborative, reflective and personalized learning.**

• Also, by combining personalized and inclusive learning, **learner-centred, supportive and equitable training environments** may be implemented.

C3. Practical, hands-on learning approaches

• Courses and qualification pathways, independently of structure and delivery models (school-based, online, with WBL, etc.), **should emphasize an experiential learning, meaning that, as far as possible, whole-task, project-based or inquiry-based learning are adopted** to give learners better opportunities for practical, authentic and reflective learning representing the referential competencies and occupational roles in the SEB sector.

• Coherently, the educational technology used (encompassing learning materials, resources and teaching & learning environments), will be chosen and managed to **facilitate the acquisition of both, partial (understandings, skills) and integrated learning (competencies).**

C4. Integration of advanced technology for improved technology-enhanced learning.

• Another aspect of the training is a general blended/hybrid model where presential, distant and work-based components can be combined to configure optimal training solutions, accounting with specificities of the application context. This model is necessarily supported on technology, particularly educational technology impacting the core teaching and learning process.

• **Optimal LMS** for distant/online and flexible learning delivery will be used. By extension, **teaching management tools** should be adopted to ensure quality and efficiency of each component (school-based, WBL, online) of the generic blended model.

• **Digital or computer-based learning tools will be adopted to enhance skill acquisition, improve engagement and increase time-on-task** of "SEB electricians" during skilling, reskilling and upskilling training. In general, these tools will improve (supplement, substitute, scale, etc.) traditional technologies and learning environments (such as workshops, laboratories, learning platforms, etc.), and allow reductions in some investments required, among other affordances.

• **Advanced simulators and other educational technology, such as immersive simulators (XR-based) or AI-driven tools, will be used** to extend individual and collaborative problem solving, self-directed learning, decision-making and other occupational skills development, with safe access to real-like work scenarios and systems, and at reduced costs.

Co-funded by the European Union

C5. Flexibility and accessibility.

• Flexibility ensures accessibility to the VET offer for different learner profiles, including workers, unemployed, young people and others seeking reskilling/upskilling and initial skilling opportunities in the SEB sector. To ensure this, **VET programs should basically offer modular learning**

options certifiable (meaning, occupational relevance, including microcredentials), **cumulative certifications** (meaning, eligible learning pathways with their prerequisites), and b**lended learning options for better accommodation** to learners' preferable/available times, calendar, place and eventually other constraints. Technology, such as learning platforms that allow easy access to digital materials and support laboratories remotely accessible or advanced proctoring resources, contribute significantly to materialize these flexibilities.

C6. Learning personalization

• Learning personalization is a relevant feature of the holistic learner-centred teaching paradigm. In the VET offering and courses for the SEB sector it can be implemented by **adapting some instructional methods, content and pace to meet individual learner needs**, while maintaining compliance with the standardized curricula and formal qualifications. This can be achieved leveraging some flexibilities of the model, such as modularity, stackable micro-credentials, mastery-based approaches (rather than learning subject to fixed timelines) and customization of learning routes in WBL settings.

• Also, tutoring and mentoring are essential for personalizing learning experiences for they generically provide individualized support, guidance, and skill development to ensure learners are retained, progress effectively and get successful. They happen in school-based learning settings and WBL within VET programs. In school-based learning settings, tutoring is usually offered by teachers, instructors, or peer tutors, focusing on content, behaviours and other non-academical aspects. In WBL, mentoring is typically provided by appointed experienced workers, ensuring learners acquire job-specific competencies and desirable work habits in real-world settings. **Tutoring and mentoring should be instantiated in the SEBCoVE's VET model and**

pedagogical approach.

• Technology plays a role in enhancing tutoring & mentoring approaches for a more supportive and personalized instruction. For example, these technologies may improve effectiveness and scalability of tutoring/mentoring: digital learning portfolios to document mentees' growth and competencies over time, AI-driven learning analytics to monitor learner progress and suggest personalized interventions, virtual mentoring platforms for remote guidance, or XR simulations for mentored hands-on training in school-based settings.

It is worth noting, that these criteria are general and can be used to define a common and innovative methodological stance characteristic of the SEBCoVEs' VET model. However, not all of them will be of application to a particular education or teaching case necessarily.

Recommended teaching methodologies

Drawing on the criteria previously outlined, the following list presents selected teaching methodologies discussed in this report. These approaches are designed to support the methodological transformation envisioned in the SEBCoVE VET model for the Smart Electricity for Buildings (SEB) sector. While their application may vary across specific contexts, each methodology aligns with the project's emphasis on effectiveness, learner engagement, technological integration, and responsiveness to industry needs. Together, they contribute to the development of an innovative, personalized, and future-oriented VET experience.

Methodologies for Fostering Varied Learning Outcomes

- These methodologies are essential for supporting the **acquisition of partial knowledge—**such as foundational concepts, discrete skills, or procedural steps.
- They also enable the development of **integrated learning outcomes**, which reflect the full scope of competencies and occupational roles targeted by SEBCoVE curricula. Such outcomes are best achieved through holistic (rather than purely analytical) teaching approaches.
- **Educational technologies** should be selected based on the learning outcome they support. For example, **simulators** are particularly effective in promoting technical skill development within realistic, risk-free environments.

Project Based Learning (PjBL)/Whole Task Learning (WTL)

• Indicated for developing integrated learning outcomes.

• Provide opportunities of collaborative and social learning.

• Based on real or realistic Projects and Tasks.

• Specially indicated for school-based training, or more structured training.

• Acquisition, use and completion of partial knowledge can be organized around.

• Associated technologies. Professional resources, management tools, learning spaces as laboratories and workshops, maker spaces for prototypes, etc.

Simulation Based Learning (SimBL) and Scenario Based Learning (SBL)

- Specially indicated for skills development. Physical, cognitive and social.
- Simulation do not require the real system or tool.
- Scenarios support decision-making skills and more social skills.
- Case-Based Learning (CBL) is a sort of SBL.
- Both may be used for collaborative skills.
- Advanced simulations provide immersive features, more engaging.
- Provide opportunities of collaborative and social learning.
- Associated technologies. XR simulators, traditional simulators, technology trainers, process/services simulators, etc.

Flipped Classroom models

• Overarching models to strength learning and maximize the practical application of acquired knowledge (integrated learning) in-class settings.

• Associated technologies. e-Learning/multimedia materials for pre-classroom study, remote laboratories, simulators, etc.

Gamification

• Based on serious games.

• Associated technologies. Digital learning, advanced simulations, etc.

Inquiry-based learning approaches

• Including Problem-Based Learning (PBL) and other instances of experiential or exploratory learning, especially in open-ended challenging scenarios.

• Support research, decision taking, collaboration and problem solving of real issues.

• Support development of social and self-management skills.

• Associated technologies. Professional resources and information, laboratories and other integrated learning environments.

Work Based Learning (WBL)

• Different models or instantiations: internships, industry projects, apprenticeships…

• To acquire, complete, extend… technical and vocational competencies.

• Work under the supervision and mentoring of professionals.

• Remarkably supported on professional tools, persons, information, interactions.

Conclusion

This section of the report analysed various evidence-based pedagogical approaches to teaching and learning, emphasizing the importance of competency-based learning aligned with the industry needs and occupational referents, experiential methods for complex integrated learning, and modern educational technology. All these, to enhance technical and vocational training actions and their associated learning experiences from the learners' perspective. Also, the context of this research was the European framework of VET policies.

Based on this study, the report recommends for the SEBCoVE's VET adopting **(1) a holistic learner-centred teaching paradigm,** that can be materialized with innovative features in **(2) technology-enhanced learning methodologies** applicable to **(3) a generic blended or hybrid model of training provision** (meaning the combination of presential, online and work-based components).

Diverse complementary teaching methodologies, such as PjBL, have been suggested that leverage traditional and emerging educational technologies such as digital and advanced XR simulations. Additionally, the report highlights the necessity of strong collaboration

Co-funded by the European Union

between educational institutions and industry to explore how to better instantiate this methodological transformation.

Co-funded by the European Union

TEACHING METHODOLOGIES FOR THE SEBCOVE MICROCREDENTIAL CURRICULUM

To effectively integrate the recommended methodologies outlined in **ARR_4.6_Analysis and Recommendations** with the microcredentials defined in the **SEBCoVE Curriculum (PED_4.2)**, a systematic alignment process is required.

This involves mapping each **teaching methodology** to the corresponding **learning outcomes** of each microcredential. The alignment must be pedagogically justified, ensuring that the selected methodology supports the **development of technical, transversal, and occupational competencies** as targeted by the curriculum.

The following section presents a detailed **analytical mapping** of methodologies to learning outcomes, highlighting their relevance and educational effectiveness.

Micro-Credential 1: Smart Electrical Installations in Buildings

Key Learning Outcomes:

- Design, installation, and maintenance of smart electrical circuits.
- Understanding of low-voltage systems, IoT integration, and smart meters.
- Application of safety and regulatory standards.

Recommended Methodologies:

1. **Project-Based Learning (PjBL) / Whole Task Learning (WTL).** Learners simulate real installation projects, plan wiring layouts, or develop IoT-enabled panels. This holistic approach mirrors real job tasks, supports the integration of partial skills, and fosters team-based problem solving.

Co-funded by the European Union

2. **Simulation-Based Learning (SimBL).** Use of virtual labs or XR tools enables safe, scalable training for electrical work—especially for practising installation under different conditions without material risk.
3. **Work-Based Learning (WBL).** Reinforces workplace competence by allowing learners to carry out installations under mentorship in actual building projects, solidifying procedural accuracy and safety awareness.

Micro-Credential 2: Building Automation and Control Systems

Key Learning Outcomes:

- Programming and configuring automation systems (KNX, BACnet, etc.).
- Integration of HVAC, lighting, and energy monitoring systems.
- Troubleshooting automated subsystems.

Recommended Methodologies:

1. **Simulation-Based & Scenario-Based Learning (SBL).** Enables learners to run scenarios such as temperature variation, occupancy simulation, or load failure. This supports system-level thinking and decision-making.
2. **Flipped Classroom.** Basic theory and software tutorials are delivered before class through multimedia, reserving class time for practice with automation controllers and collaborative configuration tasks.
3. **Gamification.** Serious games with virtual automation environments increase motivation and engagement, useful especially in complex logic configuration challenges.

Erasmus + EU Solidarity Corps
101144027-SEBCoVE ERASMUS-EDU-2023-PEX-COVE

Co-funded by the European Union

Micro-Credential 3: Energy Management and Integration of RES

Key Learning Outcomes:

- Monitor and optimize energy usage.
- Integrate solar panels, batteries, and grid-tied systems.
- Apply energy efficiency regulations.

Recommended Methodologies:

1. **Inquiry-Based Learning (IBL) / Problem-Based Learning (PBL).** Learners tackle real problems such as "How to reduce energy consumption in a school using RES?" encouraging analysis, solution development, and system design.
2. **Case-Based Learning (CBL).** Review of actual building retrofitting projects helps transfer knowledge to practical decisions, especially in retrofitting for energy efficiency.
3. **Work-Based Learning (WBL).** Field-based energy audits or PV system deployment give hands-on experience and workplace integration of knowledge.

Micro-Credential 4: Cybersecurity in Smart Electrical Systems

Key Learning Outcomes:

- Identify vulnerabilities in IoT and automation systems.
- Apply protocols for data protection and system integrity.
- Monitor and respond to security threats in building systems.

Recommended Methodologies:

1. **Scenario-Based Learning (SBL).** Learners practice responses to simulated cyber-attacks or system failures in controlled environments—excellent for developing judgment, awareness, and proactive strategies.
2. **Gamification.** Cybersecurity training often uses “capture the flag” games and challenge-based simulations to improve engagement with complex, abstract topics.
3. **Flipped Classroom.** Cybersecurity theories and tools can be studied at home, while class time is devoted to guided labs or simulated intrusion detection activities.

Micro-Credential 5: Professional Skills for SEB Electricians

Key Learning Outcomes:

- Communication with clients and teams.
- Problem-solving and digital collaboration.
- Continuous learning and adaptability.

Recommended Methodologies:

1. **Inquiry-Based Learning (IBL).** Open-ended group tasks (e.g., proposing smart solutions to client problems) promote social, analytical, and innovation skills.
2. **Project-Based Learning (PjBL).** Multidisciplinary projects require communication, scheduling, and team collaboration—mirroring real industry dynamics.
3. **Work-Based Learning (WBL).** Direct interaction with customers, site engineers, and peers allows professional conduct and communication skills to emerge authentically.

Co-funded by the European Union

Micro-Credential 06: Integration of Electric Vehicles (EV) in Smart Buildings

Learning Outcomes:

- Understand EV charging infrastructure and grid integration.
- Design and implement EV-ready building systems.
- Apply safety and energy management principles.

Recommended Methodologies:

1. **Project-Based Learning (PjBL) / Whole Task Learning (WTL).** Learners can simulate or co-design EV charging systems integrated into smart buildings. These complex, real-world tasks require understanding electrical systems, control units, and user interaction.
2. **Simulation-Based Learning (SimBL).** Digital or XR-based simulators can model energy flow, charging behaviours, or load-balancing, offering a risk-free yet realistic environment to experiment with infrastructure configurations.
3. **Work-Based Learning (WBL).** Workplace learning offers hands-on opportunities to assist in real EV infrastructure setups or audits in commercial or residential buildings.

Micro-Credential 07: Smart Grid and Energy Storage Systems (ESS)

Learning Outcomes:

- Design and maintain smart grid components.
- Integrate energy storage technologies (e.g., batteries, BMS).
- Monitor and optimise energy flows.

Recommended Methodologies:

1. **Simulation & Scenario-Based Learning (SBL).** Smart grids and ESS require system-level thinking. Simulated scenarios can help learners practice responding to energy spikes, load shifts, or backup scenarios.
2. **Flipped Classroom.** Complex theory about grids and ESS dynamics can be absorbed before class. In-person time focuses on scenario walkthroughs, collaborative modeling, and troubleshooting.
3. **Gamification.** Serious games can illustrate storage balancing, tariff optimization, and system design choices in an engaging format, supporting iterative learning.

Micro-Credential 08: Smart Lighting Systems

Learning Outcomes:

- Configure and install automated lighting systems.
- Optimise lighting for efficiency, comfort, and safety.
- Program sensors and user interfaces.

Recommended Methodologies:

1. **Project-Based Learning (PjBL).** Learners can design lighting layouts for smart homes or commercial spaces, integrating automation and daylight harvesting strategies.
2. **Simulation-Based Learning (SimBL).** Software simulations can help students virtually install, configure, and test smart lighting systems and settings without needing full physical labs.

Co-funded by the European Union

3. **Inquiry-Based Learning (IBL).** Learners investigate lighting impacts on user behaviour or energy savings, promoting analytical thinking and user-centred design perspectives.

Micro-Credential 09: Monitoring and Control Systems for Smart Buildings

Learning Outcomes:

- Use Building Management Systems (BMS) and IoT dashboards.
- Collect, interpret, and act on sensor data.
- Configure alerts and predictive maintenance systems.

Recommended Methodologies:

1. **Flipped Classroom.** Learners can explore interface tutorials, manuals, and IoT protocols beforehand, using classroom time for real-time dashboard interaction and troubleshooting.
2. **Scenario-Based Learning (SBL).** Realistic failure scenarios—like temperature spikes or air quality degradation—can train learners in decision-making and rapid response using control systems.
3. **Gamification.** Scoring systems based on building performance (e.g., energy efficiency, user satisfaction) can motivate learners to iterate and improve smart building performance strategies.

Micro-Credential 10: Technical English for SEB Electricians

Learning Outcomes:

- Communicate effectively using technical vocabulary.
- Understand manuals, standards, and documentation.
- Interact professionally in international and multilingual teams.

Recommended Methodologies:

1. **Inquiry-Based Learning (IBL).** Learners engage in language tasks that involve researching technical specifications or conducting mock installations with English documentation.
2. **Project-Based Learning (PjBL).** Team projects simulate international work environments where learners must communicate in English—writing reports, giving briefings, or troubleshooting.
3. **Flipped Classroom.** Grammar and vocabulary practice are done independently, with class time reserved for active communication, peer feedback, and role-playing.

Micro-Credential 11: Entrepreneurship and Innovation in the SEB Sector

Learning Outcomes:

- Identify opportunities for SEB-related services or products.
- Develop business models and sustainability strategies.
- Pitch innovations and manage early-stage projects.

Recommended Methodologies:

1. **Project-Based Learning (PjBL).** Learners develop mini-business plans or SEB solution prototypes, incorporating user feedback, market analysis, and financial planning.
2. **Inquiry-Based Learning (IBL) / Problem-Based Learning (PBL).** Real-world challenges ("How can we make smart buildings more accessible to SMEs?") encourage critical thinking, research, and innovative solution generation.
3. **Work-Based Learning (WBL).** Placements in startups or innovation hubs expose learners to entrepreneurial culture and allow them to observe or participate in early-stage SEB solution development.

Summary

The table below highlights the core **methodology–microcredential,** showing the recommended **teaching methodology–microcredential fit** for the 11 **Microcredentials analysed in the SEBCoVE curriculum**, aligned with the respective learning outcomes of each microcredential:

Co-funded by the European Union

TEACHING METHODOLOGY–MICROCREDENTIAL MAPPING

Micro-Credential	PjBL / WTL	SimBL / SBL	IBL / PBL	Flipped Class	Gamification	WBL
MC01 – Smart Electrical Installations	✅	✅				✅
MC02 – Building Automation & Control Systems		✅		✅	✅	
MC03 – Energy Management & RES Integration			✅			✅
MC04 – Cybersecurity in Smart Electrical Systems		✅		✅	✅	
MC05 – Professional Skills for SEB Electricians	✅		✅			✅
MC06 – EV Integration in Smart Buildings	✅	✅				✅
MC07 – Smart Grid & Energy Storage Systems		✅		✅	✅	
MC08 – Smart Lighting Systems	✅	✅	✅			
MC09 – Monitoring & Control Systems		✅		✅	✅	
MC10 – Technical English for SEB Electricians	✅		✅	✅		
MC11 – Entrepreneurship & Innovation in SEB	✅		✅			✅

Erasmus + EU Solidarity Corps
101144027-SEBCoVE ERASMUS-EDU-2023-PEX-COVE

Co-funded by the European Union

CONCLUSION

The SEBCoVE Innovative Teaching Methodologies framework marks a significant advancement in aligning vocational training with the demands of the Smart Electricity for Buildings (SEB) sector and the strategic vision of the Centres of Vocational Excellence (CoVEs). By integrating evidence-based pedagogical approaches—such as project-based learning, simulation, flipped classroom models, and work-based learning—into a coherent, learner-centred, and technology-enhanced framework, the report addresses both current educational challenges and future workforce needs.

The proposed hybrid model, adaptable across various learning environments, promotes flexibility, accessibility, and personalization. It supports the development of technical, transversal, and professional competencies aligned with occupational roles and industry expectations. Importantly, the methodologies have been mapped directly to the learning outcomes of the SEBCoVE microcredentials, providing a clear, practical pathway for implementation and replication.

NEXT STEPS

To ensure effective deployment and long-term impact, the following next steps are recommended:

1. **Finalization and Validation of the Methodological Framework.** Final refinements to the framework should incorporate feedback from pilot implementations and regional CoVE partners to ensure contextual relevance and operational feasibility.

2. **Training of Trainers (ToT) Implementation.** Prepare and deliver ToT seminars to build the capacity of VET educators across SEBCoVE hubs. This will ensure consistent adoption of the innovative methodologies and promote peer learning and pedagogical leadership.
3. **Monitoring and Quality Assurance Mechanisms.** Establish continuous monitoring processes to evaluate the effectiveness of teaching methodologies during implementation. Use feedback loops to update the framework and ensure alignment with emerging technologies and pedagogical research.
4. **Institutionalization and Policy Alignment.** Support the integration of the methodological framework into regional and national VET systems through policy dialogue, institutional agreements, and alignment with existing accreditation schemes.
5. **Scalability and Transferability Planning.** Document flexible and adaptable implementation models, including good practices, lessons learned, and digital toolkits, to facilitate transferability across sectors and European VET contexts.
6. **Dissemination and Stakeholder Engagement.** Actively disseminate findings, tools, and success stories through SEBCoVE's communication channels, peer networks, and EU-wide policy platforms to encourage broad adoption and foster a culture of teaching excellence in VET.

Co-funded by the European Union

GERMANY

GREECE

ITALY

NETHERLANDS

NORTH MACEDONIA

PORTUGAL

SPAIN

Co-funded by the European Union

101144027 — SEBCoVE — ERASMUS-EDU-2023-PEX-COVE

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Education and Culture Executive Agency (EACEA). Neither the European Union nor EACEA can be held responsible for them.

SEBCoVE.eu

LinkedIn

Facebook