Development of a Hybrid Human-AI Personalised Learning Path for VET for Innovation in Agriculture

Persona.

Project N. 101140019

D1.3 - micro-credentials common system for Agricultural TVET Education

micro-credential common system for the recognition and validation of learning outcomes in Agricultural TVET Education

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Versions and Editing History

Version	Date	Author	Institution	Status
0.1	12.12.2024	Ruben Abarca	EVTA	Draft
0.2	20.12.2024	Ruben Abarca	EVTA	(Finalized)

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1. Executive Summary

The **Common Framework for the Recognition and Validation of Micro-credentials in Agricultural TVET Education** establishes a comprehensive system to design, deliver, and recognize micro-credentials. These credentials are aimed at addressing the dynamic growing demands of the agricultural sector by offering modular, targeted, and flexible learning pathways. This framework aligns with the European Qualifications Framework (EQF) up to Level 5 and is informed by European Union policies and international quality assurance standards, facilitating trust, transparency, and portability of learning achievements.

Micro-credentials play a pivotal role in equipping learners with specific competencies needed for sustainable agriculture, digital precision farming, biosecurity, and supply chain management. This framework supports their integration into national qualifications frameworks (NQFs), ensuring alignment with labor market needs and fostering lifelong learning opportunities. By addressing barriers such as low uptake, quality assurance challenges, and limited international recognition, this framework serves both as a catalogue and as a roadmap for policymakers, training providers, and employers in adopting micro-credentials for Agricultural TVET education, while showcasing a selection of case studies that promote the harmonisation and alignment of educational standards and recognition that will support the sector in adopting micro-credentials in Agricultural TVET Education.

2. Introduction

2.1 A European approach to micro-credentials

In the last decade, there has arisen a critical need for short, flexible learning experiences that are learner-centered and widely recognized to effectively address the evolving demands of the labor market and support lifelong learning for all individuals. According to the OECD, on the five major learning platforms the number of micro-credentials has increased from around 600 in 2018, to 1900 in 2022 (OECD, 2023). However, there is still "uncertainty linked to the naming and function of microcredentials" (Cedefop, 2022) due to the lack of a clear and common definition of the term, leading to a variety of interpretations and constant changes. Additionally, at the national level, the specific 'micro-credential' term is not commonly used. Although they coin other terms such as open badges or small volume certificates. According to Cedefop's survey conducted in 2022, consulting whether the term 'micro-credential' was used at the national level, 55% of the respondents indicated that the term is not used, whereas 14% did not know the answer. In this regard, only 31% expressed that the term is used, while 38% of respondents indicated that in their countries, they use other terms that correspond to the European Commission's definition of micro-credentials (European Commission, 2020a).

Cedefop (2023) has drafted an exhaustive list of terms that fit partially or totally in the EC's definition of micro-credentials. The most common replies included:

- Badges
- Certificates
- Module certificates
- Partial qualifications
- Micro-qualifications
- Supplementary qualifications

Therefore, a European approach has become more necessary than ever due to:

- A need for short learning experiences to acquire targeted competencies and skills: There is an urgent and growing demand for short learning experiences that allow individuals to acquire specific competencies and skills quickly. This need has been amplified by the fast-paced changes in the labor market and the impact of automation, which is expected to significantly affect many sectors in the upcoming years (OECD, 2023). As a result, many people are seeking flexible alternatives to traditional qualifications to update their skills and meet current educational and training needs. This results in the proliferation of alternative types of credentials seeking recognition for a

specific knowledge or skills development. In this regard, there are different models used such as Nano Degrees, MicroMasters or Micro-degrees, among others.

- A need for learning and training to be more learner-centered and accessible: There is a growing emphasis on making learning and training more learner-centered and accessible to a diverse range of individuals. This approach aims to cater to the varying needs of learners, including those with fewer opportunities, by providing flexible and tailored educational pathways. The goal is to ensure that all learners can engage in lifelong learning and skill development.

- A need for ensuring trust, recognition, validation, and portability of these short learning experiences: To maximize the impact of short learning experiences, it is essential to establish trust in the credentials awarded. This includes ensuring their recognition, validation, and portability across different countries and sectors. Currently, the lack of a transparent and common framework of micro-credentials, has evidenced the difficulties in terms of value, reliability, recognition and standardization of learning outcomes.

To address these challenges, it is key to establish a common European approach to micro-credentials that would help address these issues by creating a framework that ensures a harmonized quality assurance process and facilitates the recognition of skills and qualifications. Such definition has the power to promote trust, enable recognition mechanisms, and ensure the portability of micro-credentials as a trusted skills currency, fostering their further development and broader adoption. This common approach does not seek for uniformity in programmes or a unified European curricula, but rather looks for the common points of reference, convergence and common understanding among the different national qualification systems.

2.2 Need for an EU approach

By fostering a unified understanding in how micro-credentials are perceived and utilized, an EU approach can pave the way for their wider adoption and integration into existing education and training systems at the national levels. This can be done through three specific pillars:

- **Establishing a common definition**: The current lack of a shared definition leads to fragmentation and inconsistent understanding of the micro-credentials concept, challenging their recognition and portability across borders. A standardized approach has the potential to ensure clarity and alignment, building trust among stakeholders, thus facilitating their broader adoption.
- **Building trust and transparency**: Aligning micro-credentials with established frameworks, such as the European Qualifications Framework (EQF), can ensure quality, reliability, and comparability across different programs. This fosters trust among

learners, employers, and education providers, making micro-credentials a credible alternative to traditional qualifications.

- **Facilitating international recognition**: A harmonized European framework enhances learners' opportunities for further education and employment by ensuring that micro-credentials are recognized across borders, which is crucial for mobility and employability in a globalized economy.

Despite the great potential of micro-credentials, several structural barriers impede the widespread adoption of micro-credentials across the EU. One of the primary challenges is the lack of standardization, as the absence of a common definition and standardized recognition mechanisms limits broader understanding and acceptance. Structural constraints within existing education systems, which predominantly offer full qualifications, further impede the integration of micro-credentials. Additionally, varying perceptions of the value of micro-credentials among employers and learners affect their willingness to invest time and resources.

According to Cedefop (2022), funding limitations also pose significant obstacles, particularly in countries like Bulgaria, where limited financial resources prevent employers and individuals from investing in micro-credential-based training. This issue is exacerbated within small and medium-sized enterprises (SMEs), which often struggle to allocate funds for employee upskilling (Council of the European Union, 2022). Similarly, individuals may find it financially challenging to pursue micro-credentials independently, especially when training groups are too small to make such initiatives profitable for VET centers.

Moreover, uncertainties regarding the quality and credibility of micro-credentials, especially those outside formal systems, reduce trust and uptake among stakeholders. Employers and learners may perceive micro-credentials as supplementary rather than equivalent to full qualifications, affecting their investment in such credentials (Cedefop, 2022). According to the EC (2021) trade unions have expressed concerns that micro-credentials focusing solely on specific skills may not provide comprehensive qualifications, advocating for standardized training sizes and clear explanations of how micro-credentials fit into larger qualification frameworks.

3. Policy Framework Review

3.1 EU Policy Review

As discussed in the previous section, micro-credentials have emerged as a pivotal component in the European Union's educational and vocational training landscape. This policy review provides a comprehensive analysis of the current state of micro-credentials within the EU, examining

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their purposes, implementation across member states, integration with national frameworks, quality assurance mechanisms, policy developments, barriers to adoption, and the potential for accumulation and combination.

The adoption of micro-credentials within the EU is driven by several key objectives. Primarily, on the one hand, micro-credentials enhance labor market responsiveness by equipping individuals with specific, up-to-date skills and competences that are aligned with the skills demands of various industries. This is particularly relevant in sectors experiencing rapid technological advancements, legislative changes, societal shifts, or environmental transformations, often referred to as Europe's twin transitions towards greening and digitization.

Furthermore, micro-credentials offer flexible learning pathways, allowing learners to choose how, when, and at what pace they engage in educational activities. This flexibility accommodates diverse personal and professional schedules, making education more accessible to a broader population. Additionally, micro-credentials facilitate the recognition of prior learning by providing mechanisms to acknowledge and validate previously acquired knowledge and skills. This not only enhances the visibility and portability of individual competences but also supports the upskilling and reskilling of the workforce, thereby improving employability and enabling quicker career advancements.

Employability is a recurring theme in the literature on micro-credentials, with scholars such as Brown and Souto-Otero (2018) and Wheelahan and Moodie (2021) highlighting the increasing responsibility placed on individuals to manage their career paths and develop relevant skill profiles. micro-credentials thus serve as a strategic tool for individuals to enhance their employability by building targeted skills that meet current labor market needs.

3.2 EU-Level Initiatives and Definitions

At the EU level, significant efforts have been made to standardize and promote the use of micro-credentials through comprehensive policy initiatives. A pivotal initiative was the establishment of the Higher Education Consultation Group by the European Commission, which published the final report titled "A European Approach to Micro-credentials" in December 2021. This report culminated in a European Council recommendation that outlines concrete measures for member states to develop a cohesive micro-credential ecosystem, enhancing lifelong learning and employability. The recommendation emphasizes the importance of creating an environment that supports lifelong learning and employability through the effective implementation of micro-credentials.

As reviewed before, the EU defines a micro-credential as a record of learning outcomes that a learner has acquired through a small volume of learning, assessed against transparent and clearly defined criteria. Key attributes of micro-credentials include their portability, ownership by the learner, and the potential for stackability into larger qualifications. Despite the growing utilization of micro-credentials, the lack of a unified definition and standardized quality criteria remains a significant challenge, limiting broader acceptance and understanding across member states.

The framework for micro-credentials integrates insights from multiple key policy documents, ensuring a robust and comparative approach to implementation. The "Proposal for a Council Recommendation on a European Approach to Micro-credentials" (COM/2021/770) identifies micro-credentials as essential enablers for advancing digital skills and fostering sustainable practices in alignment with the European Green Deal. It encourages member states to integrate micro-credentials into their education and training systems, thereby supporting lifelong learning and improving access for disadvantaged groups. This proposal also highlights the importance of developing ecosystems through public funding and platforms like Europass, which facilitate the authentication and sharing of micro-credentials. Additionally, it establishes standardized design and issuance principles to ensure transparency, recognition, and alignment with the European Qualifications Framework (EQF).

The "Proposal for a Council Recommendation on Individual Learning Accounts" (COM/2021/773) complements this approach by focusing on modular learning and personalization. It advocates for hybrid Human-AI learning pathways and proposes digital portals integrated with Europass to offer tailored guidance for learners. This proposal places particular emphasis on supporting small and medium-sized enterprises (SMEs) and vulnerable groups, designing pathways for low-skilled individuals and those affected by digital and green transitions. It also addresses funding models, promoting public-private cost-sharing strategies, including employer contributions for digital infrastructure. Furthermore, it encourages recognition through micro-credentials by aligning modular, competency-based frameworks with industry standards, especially for sectors like agriculture. Continuous monitoring through systematic evaluation using indicators such as participation rates and skill acquisition outcomes is also proposed.

The "Council Resolution on a Strategic Framework for European Cooperation in Education and Training Towards the European Education Area" (2021/C66/01) underscores strategic priorities such as inclusivity, modular education, and sustainability as pillars for modernizing vocational education and training (VET) and supporting micro-credentials. It aligns with the post-pandemic emphasis on digital and blended learning environments and advocates for the validation of informal and non-formal learning to ensure that micro-credentials serve diverse learners. The

resolution supports the integration of sustainability principles and digital tools in agricultural education, aligning with broader innovation goals.

Despite the Council recommendation to the member states to adopt and integrate micro-credentials into their education and training systems, the implementation and integration of micro-credentials varies significantly among EU member states, according to Cedefop (2023) this reflects diverse educational traditions and policy priorities. In countries such as Cyprus, Czechia, Greece, Iceland, and Portugal, the incorporation of micro-credentials into formal education systems is still in a premature stage. In these nations, efforts are often confined within the education sector, with varying levels of understanding and acceptance among vocational education and training (VET) stakeholders.

Alternatively, as Cedefop (2022) has found out, countries like Ireland and Malta demonstrate more advanced integration of micro-credentials, maintaining long-standing traditions even if the terminology is less prevalent. These countries typically feature well-structured frameworks that support the issuance and recognition of micro-credentials within national qualifications systems. Additionally, Belgium, Finland, and the Netherlands are actively exploring the integration of micro-credentials into official policy documents. These countries are revising their VET policies to prioritize educational flexibility and lifelong learning opportunities, supported by dedicated consultation groups and regulatory discussions focused on quality assurance and recognition.

The launch of the European Commission's consultation on micro-credentials has further stimulated discussions in several member states, promoting the development of standardized approaches and fostering cross-border recognition. This EU-level initiative underscores the importance of creating a unified framework that supports the effective implementation and recognition of micro-credentials across diverse national contexts.

3.3 Current Qualifications Frameworks

At the EU level, there coexist two different qualification frameworks, namely: the European Qualifications Framework (EQF) for Lifelong Learning; and the Overarching Framework of Qualifications of the European Higher Education Area. Both are fully compatible with each other, and they have enabled the creation of mutual zones of trust by providing a translation tool to make national qualifications easier to understand and compare (Young & Allais, 2013, from EC, 2021).

The EQF is a reference framework for qualifications based on 8 level descriptors for learning outcomes, applicable to all levels of qualifications. Therefore, it already provides a potential basis for the inclusion of micro-credentials. In this regard, if member states wish to include micro-credentials in their national qualification frameworks, the EQF can serve as a

comprehensive referencing tool, based on outcomes of learning, to indicate the level of micro-credentials. Although the inclusion of micro-credentials in national qualification frameworks is currently at a premature stage in the international landscape, som trends at the EU level have been observed, as reviewed in (D1.1 Trends on micro-credentials), most of the member states "are opening up national qualifications frameworks to other forms of provision" (European Commission, 2021) rather than the traditional full qualifications offered by formal education and training centers, especially considering those qualifications with a higher relevance for the labour market. Given the urgent need to enable some form of micro-credentials within the overall education and training systems, a common Qualification Framework has the potential to establish the pathway to a transparent and recognized education and training ecosystem within the Union.

4. The Common European Framework (adapted to EQF level 5)

This framework seeks to facilitate the validation, recognition and portability of micro-credentials in the international agricultural educational landscape, while promoting lifelong learning by supporting learners at all career stages in upskilling and reskilling processes, as well as equipping them with sustainable and entrepreneurial skills, ensuring quality assurance through pre-established standards. This is only possible by fostering the alignment of micro-credentials with national qualification frameworks and European qualification frameworks that can provide coherence, trust and standardisation.

4.1 A Common Definition of Micro-credentials

Based on the insights gathered from multiple key policy documents and comprehensive research, a common definition of micro-credentials can be proposed as follows:

Micro-credentials are records of learning outcomes that a learner has acquired through short, targeted learning experiences. These experiences are designed to develop subject-specific and/or generic competences, expressed in well-articulated learning outcomes. The workload duration, assessment mode, and assessment authority are clearly defined, ensuring that the certification provides an explicit overview of the acquired knowledge and skills, along with a reliable estimation of the time involved. In the context of EU higher education, this time is typically expressed in ECTS credits, where one ECTS credit reflects 25 to 30 hours of combined instruction and self-learning, including assessment. The certification can be issued as a written and signed transcript or as a digital badge, both of which should indicate that the

learner has achieved a certain level of mastery in a definable skillset or competency. These badges are offered by certified providers recognized by national authorities. micro-credentials encompass both the learning activities and the resulting certifications and may be referred to by various terms such as alternative credentials, digital badges, micro-certifications, mini-degrees, and nano-degrees. They are characterized by their flexible delivery modes, range of providers, and the potential for both credit-bearing and non-credit-bearing options. Additionally, micro-credentials are flexible, portable, and stackable, providing learners with opportunities to combine them into larger qualifications or use them independently to address immediate labor market needs, support continuing education, and recognize previously acquired competences.

This framework proposes, in alignment with the Recommendation of the Council of Europe (2022), the definition as well as the standard elements for describing micro-credentials, while establishing the principles for designing and issuing micro-credentials.

4.2 Standard Elements

The basis for trust in micro-credentials lies in transparency regarding what they represent. This includes clear and accessible information about the learning outcomes achieved, the methods of assessment used, and the quality assurance measures in place. Micro-credentials and the certificates awarded upon their completion should be clearly identified as such and unmistakably differentiated from full degrees, such as bachelor's, master's, or doctoral qualifications.

A specific list of critical information elements has been established, forming a proposed EU standard for micro-credentials. This standard was outlined in the NESET background report prepared by Orr et al. (2020) and is designed to ensure transparency across all levels of education and training within the context of lifelong learning.

According to COM 2021/770 (Annex 1), the following common Union standard elements should be used to describe micro-credentials, which are incorporated into the European Learning Model (ELM):

Mandatory elements:

- Identification of the learner
- Title of the micro-credential
- Country/region of the issuer
- Awarding body
- Date of issuing
- Learning outcomes

- Notional workload needed to achieve the learning outcomes (in ECTS credits, wherever possible)
- Level (and cycle, if applicable) of the learning experience leading to the micro-credential (EQF, QF-EHEA, if applicable)
- Type of assessment
- Form of participation in the learning activity
- Type of quality assurance used to underpin the micro-credential

Optional elements (non-exhaustive):

- Prerequisites needed to enroll in the learning activity
- Supervision and identity verification during assessment (unsupervised with no identity verification, supervised with no identity verification, supervised online, or onsite with identity verification)
- Grade achieved
- Integration/stackability options (standalone, independent micro-credential/integrated, stackable towards another credential)
- Further information

These elements will form the basis of a Union data model, specifying a common format for describing micro-credentials. This data model will be openly available to micro-credential providers, supporting interoperability and facilitating easier exchange of data.

Issuers must address these elements when issuing micro-credentials. Those issued through the Europass Digital Credentials Infrastructure will inherently include these elements, as they are embedded within the data model.

A presentation by the MicroHE Consortium highlighted the need for additional information about the content of micro-credentials, particularly for interdisciplinary credentials. It was recommended to detail the thematic area of each micro-credential using frameworks such as the International Standard Classification of Education level F (ISCED-F) to enhance transparency. This would also address the challenge posed by varying qualification levels across thematic areas.

Furthermore, these elements are underpinned by Annex VI of the EQF Recommendation, which specifies data fields for electronically publishing information on qualifications with an EQF level. These fields form the foundation of the Europass Digital Credentials Infrastructure, ensuring consistency and clarity in the presentation and exchange of micro-credential data.

Asd a result of this common framework, micro-credentials on Agricultural Education can be further developed, used and compared in a coherent and cohesive way among EU member states, stakeholders and different providers, fostering the building of trust on micro-credentials.

4.3 Integration of micro-credentials with National and European Qualifications Frameworks

Linking micro-credentials to national (NQFs) and European Qualifications Frameworks (EQFs) is essential for their recognition, transferability, and mobility across diverse education and training systems. Within the agricultural TVET context, this alignment ensures that sector-specific learning outcomes are standardized and integrated into formal qualifications, meeting the unique needs of the sector and labor market.

According to Wagenaar (2024), when discussing Qualifications Frameworks, it is important to distinguish between overarching Qualifications Reference Frameworks (QRFs) and sectoral or subject area-specific QRFs. Overarching frameworks provide general indicators of expected learning levels, whereas sectoral QRFs offer detailed insights into the knowledge, skills, and competences specific to fields such as sustainable agriculture, digital farming technologies, and supply chain management.

In Europe, the alignment of national qualifications frameworks with the European Qualifications Framework facilitates the comparability and recognition of qualifications across member states. This alignment is particularly critical for agricultural TVET learners, as the sector often requires cross-border mobility to address seasonal labor demands, international trade requirements, and knowledge-sharing opportunities for innovative farming techniques. Thus, the agricultural sector present unique challenges and opportunities for micro-credential integration, namely:

- Micro-credentials in agricultural TVET should include competencies that are directly linked to EQF level descriptors, emphasizing the acquisition of practical, relevant and demanded skills such as: operating precision farming equipment, applying sustainable irrigation techniques, or implementing biosecurity measures.
- Agricultural TVET qualifications should be integrated in subject-specific frameworks. In this regard, the European Skills, Competencies, Qualifications, and Occupations (ESCO) could serve as a database to align the learning outcomes with labor market demands, ensuring that micro-credentials reflect the specific technical skills and competencies that are needed in the current labor market.

As observed in the Council Recommendation, the evolution of education and training systems has increasingly shifted focus from traditional input-based learning approaches that emphasized

the duration, location, and methods of learning, to outcome-oriented learning approaches that prioritize what learners achieve through their learning experience. This shift aligns with the European Union's commitment to creating transparent, flexible, and learner-centered systems that recognize and validate diverse pathways to skills acquisition.

Within Agricultural TVET, the learning outcomes can provide a structured framework for defining sector-specific competencies, particularly at EQF Level 5, which corresponds to short-cycle qualifications such as (1) short/associated degrees, (2) certificates of Higher Education, or (3) diplomas. These qualifications often require between 60 to 120 ECTS (European Credit Transfer and Accumulation System) credits and are designed to provide both vocational and academic training, serving as a bridge between secondary education and higher education or between higher education and the labor market.

These competencies encompass a range of technical, transversal, and digital skills that are directly applicable to the workplace. These types of approaches also support the inclusion of non-traditional learner groups, such as older adults, individuals with special educational needs, or those re-entering the workforce, recognising and guaranteeing diverse pathways to skills acquisition, while empowering learners to demonstrate their competencies across various contexts.

4.4 Integration in the Qualifications Frameworks for Agricultural TVET

In Europe, the indicators and descriptors of national qualifications frameworks are aligned with the European ones, thus facilitating comparability and recognition across its 27 member states. In this sense, the EU operates with two primary qualifications frameworks, namely: (1) the Framework of Qualifications for the European Higher Education Area (FQ-EHEA), established through the Bologna Process, which focuses primarily on the process of learning, outlining the structure and progression within higher education cycles. And (2) the European Qualifications Framework (EQF) for Lifelong Learning that emphasizes the outcomes of the learning process, providing clear descriptors of learning achievements in terms of knowledge, skills, and competences.

However, continuous developments over the past two decades have outlined existing frameworks less suitable for current and future needs, particularly concerning the integration of micro-credentials. Recognizing this gap, a new generation of Qualifications Reference Frameworks has been developed, both for overarching levels and for specific subject areas. The Tuning-CALOHEE reference frameworks represent a merger of the FQ-EHEA and EQF frameworks. This new framework offers more detailed descriptors, accommodating current and future educational developments and ensuring that micro-credentials are effectively integrated

into the qualifications landscape. These frameworks align with EQF levels 5 to 8 covering Short/Associated Degrees, Bachelor, Master, and Doctorate/PhD cycles, and are supported by comprehensive Learning Outcomes/Assessment Frameworks that offer formal alignment with EQF levels, and directional indicators of mastery (related to the type of learning activities and competencies achieved). For Agricultural TVET at EQF level 5, this means integrating sector-specific competencies that bridge vocational and academic training, aligning with labor market needs and the EU's goals of innovation, sustainability, and digital transformation.

4.4.1 Core Sector-Specific Competencies in Agricultural TVET (EQF level 5)

Learners at EQF level 5 are expected to develop competencies in three intertwined progression levels:

Knowledge	Skills	Responsibility & autonomy
Comprehensive, specialised, factual and theoretical knowledge within a field of work or study and an awareness of the boundaries of that knowledge	A comprehensive range of cognitive and practical skills required to develop creative solutions to abstract problems	Exercise management and supervision in contexts of work or study activities where there is unpredictable change; review and develop performance of self and others

This, translated to the Agricultural TVET sector, in accordance with the EQF reference and the Tuning-CALOHEE frameworks, means that at EQF level 5 in agricultural education, learners will incorporate:

- **Knowledge acquisition:** agricultural learners could focus on technical knowledge of crop management, soil science, or climate-resilient farming techniques.
- **Knowledge and skills application:** learners could demonstrate the ability to use digital farming tools such as drones or IoT devices, and manage data-driven decision-making for a better and more efficient resource use.
- **Autonomy and responsibility:** micro-credentials could validate skills such as leading sustainability initiatives, managing farm operations, and ensuring compliance with EU agricultural policies and regulations.

4.4.2 Validated learning outcomes for Agricultural TVET

In addition to the ESCO database on skills and competencies demanded in the labor market for the agricultural sector, the PERSONA consortium has identified a detailed framework of sector-specific competencies tailored to Agricultural TVET, that include technical, transversal, and digital skills, which are directly applicable, alongside key attitudes that are key in supporting innovation and sustainability in the sector. These sets of skills, competencies and attitudes are the result of the findings from the research conducted in Ireland, Italy, Czech Republic and Spain. These competencies have been categorized into:

Skills across multiple areas	**Knowledge Areas that underpin skills development**	**Essential attitudes for empowering learners and promoting long-term innovation**
Digital and Technological skills	Agricultural innovation and technology adoption	Innovation awareness and training
Agronomy and sustainable farming	Sustainable and regenerative farming practices	Hands-on learning and demonstration
Data and analytical skills	Digital and IT knowledge	Entrepreneurial and innovative mindset
Communication and interpersonal skills	Policy and regulatory knowledge	Commitment to Sustainability
Systematic problem-solving and critical thinking abilities	Climate change and environmental impact	Mentorship and Support Systems

Business and financial management	Theoretical knowledge	Farmer Empowerment and Self-Reliance
Entrepreneurship thinking and marketing strategies	Advisor and student engagement	Collaboration and Knowledge Sharing
Training and education	Technical knowledge	Future-Oriented Vision and Growth
Networking and relationship building		
Managerial and leadership skills for team and project management		

These validated learning outcomes ensure alignment with industry standards and practical relevance, providing a roadmap for integrating micro-credentials into qualifications frameworks. These outcomes, detailed in the PERSONA_D1.2-Database, bridge the gap between traditional education and the evolving needs of the agricultural sector.

Additionally, the PERSONA consortium will developed a total of 6 learning modules focusing on specific skills and competencies that were identified in the needs analysis conducted at the national levels and that can be accessed in the PERSONA Combined Competencies document, namely:

Modules	Learning outcomes
1. Robotics in Agriculture	• Should meet desired skills, knowledge and attitudes • Understand the role robotics can play in an ever-evolving agricultural sphere • Assess the economic viability of robotic investments on farm

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	• Gain a better understanding of farmers mindset towards adopting new robotic technologies on farm
2. Agricultural Software Support Tools	• Gain a better understanding of how farmers can utilise software support as a means of decision support tools on farm • Understand how software support can be used to improve farm efficiency, productivity and profitability • Gain insights into how support tools can be used to improve environmental and sustainability performance on farms
3. Agricultural Sustainability	• Gain a better understanding of the principles of sustainable agricultural practices • Consider the sustainable practices and techniques that can be implemented at farm level • Understand policies around agricultural production
4. Farm Entrepreneurship	• Ascertain how entrepreneurship can future proof farm viability • Understand the mindset of an entrepreneur • Identify emerging innovative/entrepreneurial ideas and how they can be implemented on farm
5. Agricultural Financial Management	• Gain an understanding of the key financial principles in agriculture • Understand the measures farmers can take to future proof farm incomes • Understand the basic financial management principles for farmers
6. Groups in Agricultural Extension	• Ascertain an understanding for the importance of group meetings/sessions in agriculture • Gain experience in how to lead and coordinate a group session with farmers • Understand the principles around group development and progression

Linking these sector-specific competencies to qualification frameworks ensures the precise positioning of micro-credentials. The Tuning-CALOHEE frameworks use both EQF level

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descriptors and directional learning indicators to align micro-credentials with the intended level of mastery and learning outcomes. This dual approach allows micro-credentials to reflect the dynamic balance between knowledge acquisition, skills application, and autonomy, making them a central component of modern Agricultural TVET education. By integrating validated sector-specific competencies within overarching qualifications frameworks, the EU ensures that Agricultural TVET learners are equipped to meet the challenges of digitalization, sustainability, and innovation in agriculture. This comprehensive approach supports lifelong learning, cross-border mobility, and the alignment of education with labor market needs, empowering learners and strengthening the agricultural workforce.

4.5 Alignment with Quality Assurance Standards

The agricultural sector's educational programs, whether vocational or higher education, often differ in their structure and focus based on national contexts and pathways. To ensure their quality and alignment with European standards, selecting the appropriate quality assurance (QA) framework depends on the program's objectives and delivery methods.

For instance, for vocational training programs emphasizing practical skills and competencies directly related to agricultural practices, the EQAVET framework is particularly relevant. EQAVET provides a comprehensive quality assurance approach that ensures vocational programs meet labor market needs, maintain high standards of vocational training, and promote mutual recognition of qualifications across the EU. When applied to the agricultural sector, EQAVET can be tailored to evaluate how effectively training programs integrate sector-specific competencies, such as sustainable farming methods, technological advancements like precision agriculture, and climate-smart practices. Additionally, EQAVET processes could assess the extent to which learners are engaged in practical training environments, such as farms or agri-tech facilities, and how stakeholder input from agricultural associations, cooperatives, and businesses is incorporated into program design and evaluation.

In contrast, when agricultural programs are embedded within higher education institutions and offer academic credentials such as certificates of higher education in agricultural sciences, the ESG framework becomes more suitable. ESG ensures that programs adhere to rigorous academic quality standards, fostering mobility within the European Higher Education Area (EHEA) and promoting excellence in education. For agricultural higher education, ESG can emphasize the importance of incorporating research-based learning, particularly in emerging areas such as agronomy, biosecurity, and digital farming technologies. The framework could also evaluate how effectively these programs align with international agricultural standards, such as GlobalGAP and EU Organic Certification, to enhance the global relevance of the credentials offered. Moreover, ESG offers the potential of focusing on partnerships with research

institutions and innovation hubs, ensuring that learners are exposed to cutting-edge developments in agriculture and that academic knowledge is seamlessly connected to practical applications in the field.

Both EQAVET and ESG frameworks provide strong foundational principles for quality assurance, but their application in the agricultural context requires additional development to address the sector's unique characteristics. Agricultural education places a strong emphasis on practical, field-based learning, and any QA process must evaluate the effectiveness of such components in equipping learners with skills directly applicable to their roles in the agricultural workforce. Furthermore, the sector's reliance on sustainability, technological adaptation, and compliance with regulatory standards means that QA frameworks must also consider how well these critical areas are integrated into the educational programs.

4.6 Integration of Digital Solutions for issuing, storing and sharing micro-credentials

The European Digital Credentials for Learning (EDCs) initiative marks a significant step forward in the digital transformation of education and vocational training, particularly in the agricultural sector. It is crucial to distinguish between micro-credentials, which detail specific learning outcomes, and digital credentials, which serve as the technological medium for issuing, storing, and sharing these outcomes. For Agricultural TVET, digital solutions play an essential role in validating specialized skills, fostering cross-border recognition, and supporting sector-specific mobility.

Digital credentials offer a secure and standardized framework for verifying and disseminating micro-credentials, ensuring that agricultural learners' achievements maintain their integrity and comparability across diverse educational and professional contexts. In the agricultural sector, where competencies can range from practical farm management to high-tech skills such as operating drones or precision farming tools, the digitalization of credentials enhances trust and transparency among employers, training providers, and learners. Essentially, while micro-credentials define the "what" of learning, meaning, the specific skills such as sustainable crop management or irrigation techniques; Digital credentials address the "how" by providing reliable methods to document and distribute these skills, ensuring their accessibility across the agriculture labor market, thus facilitating their delivery, storage, and distribution.

The EDC infrastructure provides open-source online tools to create, issue, store, and share digital credentials. Key features such as electronic seals (e-seals) ensure the authenticity of credentials, fostering trust and facilitating international recognition. These tools are particularly

valuable in agriculture, where skills verification may involve seasonal workers, cross-border employment, and varied levels of formal education among participants.

European Digital Credentials for Learning are electronically sealed digital records that certify an individual's completed learning activities. These credentials can be awarded from a wide range of learning experiences, including formal education, vocational training, online courses, and volunteering activities. Educational institutions and training providers across Europe can utilize the EDC infrastructure to issue these credentials at no cost, securing them with their unique e-seals. Once issued, credentials can be distributed to learners via email or directly integrated into their Europass profiles, facilitating sharing and recognition.

By leveraging the EDC infrastructure, the EU ensures that micro-credentials are not only defined by their learning outcomes but also supported by digital solutions that enhance their accessibility, reliability, and recognition. This integration fosters a cohesive and trustworthy system for lifelong learning and employability, aligning with the broader goals of educational innovation, inclusivity, and sustainability within the European educational landscape.

4.6.1 Leveraging EDC infrastructure for Agricultural TVET Education

For Agricultural TVET, EDC infrastructure can facilitate: (1) the Issuance of micro-credentials certifying practical skills such as operating agricultural machinery. (2) The storage and sharing of micro-credentials. These can be stored digitally and integrated into learners' Europass profiles making them accessible to employers, certification bodies, and educational institutions across Europe. And (3) the authentication of micro-credentials. This is due to the e-sealing which enhances the credibility of sector-specific certifications, such as organic farming qualifications.

Digital credentials also address sector-specific applications effectively. They enable the recognition of informal and non-formal learning, such as apprenticeships on family farms or practical experience gained through community-based agricultural projects. Additionally, they integrate seamlessly with agri-tech platforms that monitor and analyze farm operations, allowing learners to demonstrate their competencies in using digital tools like IoT devices, GIS systems, and blockchain for supply chain management. For seasonal agricultural workers, digital credentials facilitate cross-border mobility by ensuring qualifications are recognized and valued across EU countries.

By leveraging the EDC infrastructure, stakeholders in agricultural TVET can enhance trust, accessibility, and sustainability. Employers can rely on secure digital records to validate skills, reducing the risk of credential fraud. Learners in rural or remote areas benefit from the accessibility of digital issuance and storage, addressing barriers posed by traditional education systems. Furthermore, digital credentials support the EU's transition to a green and digital

economy by promoting environmentally friendly practices in agricultural education and reducing reliance on paper-based certification systems. These features ensure that micro-credentials are trusted, accessible, and aligned with the evolving needs of the agricultural workforce. Additionally, the integration of digital solutions in Agricultural TVET aligns with the broader EU goals of lifelong learning, inclusivity, and sustainability. These solutions not only enable the recognition of critical skills needed for modern agriculture but also position learners and workers to contribute effectively to a sector undergoing rapid technological and environmental changes.

By embracing the full potential of the EDC infrastructure, the agricultural TVET sector can ensure that micro-credentials are recognized, trusted, and accessible across Europe in supporting the sustainable growth of the agricultural workforce.

5. Best practices and initiatives in Agricultural TVET education

The integration of micro-credentials into the agricultural TVET sector offers unique opportunities to address labor market demands, promote lifelong learning, and equip learners with the specialized skills needed for modern agriculture. This section explores best practices, initiatives, and case studies that demonstrate innovative applications of micro-credentials aligned with EQF Level 5. Each example has been analyzed and adapted to reflect the specific challenges and opportunities within Agricultural TVET, ensuring alignment with sector-specific competences, digital transformation, sustainability goals, and global labor market trends.

By drawing on these models, stakeholders can design robust micro-credential systems that validate a wide range of skills, from traditional farming methods to cutting-edge digital agriculture technologies. These initiatives also emphasize flexibility, scalability, and alignment with both national and European qualifications frameworks, ensuring that agricultural learners are empowered to thrive in a dynamic and evolving sector.

Initiative /Practice /Case Study	Description	Application to Agricultural TVET

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Badge+ Project (Poland)	The Badge+ project, part of Poland's Integrated Qualification System (IQS), establishes an IT infrastructure for the creation and management of digital badges. These badges serve as verifiable indicators of specific skills, supporting the recognition of informal and non-formal learning.	In the context of Agricultural TVET at EQF Level 5, Badge+ offers an effective mechanism for validating practical competences critical to the agricultural sector. This credential would validate the learner's ability to identify, apply and adhere to environmental regulations. Moreover, by integrating Badge+ into the agricultural sector, stakeholders can enhance the visibility and portability of learners' competences, ensuring that they are recognized across EU member states.
Common Micro-Credentials Framework (CMF)	The CMF, developed by the European MOOC Consortium (EMC), provides a structured approach to developing, delivering, and recognizing micro-credentials using Bologna tools such as EQF and ECTS. The framework emphasizes clarity in learning outcomes, workload, and assessment methods, making it a valuable tool for aligning short-term educational offerings with formal qualifications.	In Agricultural TVET, the CMF could standardize courses on sustainable farming practices, agroforestry, or digital farm management. For example, a learner completing a modular program on climate-resilient agriculture could receive a CMF-aligned micro-credential that specifies EQF Level 5 alignment. This credential would serve as a standalone validation of skills or contribute to a broader qualification, promoting lifelong learning and cross-border mobility.
Open Virtual Mobility (OpenVM)	The Open Virtual Mobility (OpenVM) initiative promotes the development of virtual mobility skills through scalable learning environments. By leveraging digital tools, OpenVM facilitates collaborative, cross-border	OpenVM can be adapted to Agricultural TVET by creating virtual collaboration opportunities where learners design sustainable farm management strategies or conduct joint analyses of agricultural case studies. For instance, learners from different EU regions could collaborate on

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	educational experiences that align with modern labor market needs.	a virtual project addressing soil degradation challenges, earning micro-credentials that validate their problem-solving, teamwork, and digital literacy skills. This approach integrates real-world problem-solving into EQF Level 5 learning pathways.
SPINAKER Program	The SPINAKER program supports internationalization in education by offering short online courses for foreign learners. It aims to enhance accessibility and mobility, making it an ideal model for the agricultural sector, which often involves cross-border collaboration and workforce mobility.	Agricultural TVET could leverage SPINAKER to offer micro-credentials in areas such as international trade regulations, export logistics for agricultural goods, or agroecology. For example, a course on export logistics could provide learners with the skills to navigate international markets, optimize supply chains, and comply with global trade standards. The resulting micro-credentials, aligned with EQF Level 5, would support learners in building expertise relevant to global agricultural challenges.
Erasmus Virtual Exchange	The Erasmus Virtual Exchange initiative emphasizes intercultural learning and collaboration through online facilitated dialogues and interactive courses. These experiences enhance employability by developing skills such as critical thinking, intercultural communication, and teamwork.	In Agricultural TVET, Erasmus Virtual Exchange can be adapted to engage learners in discussions on global agricultural issues, such as food security or climate change. For instance, a course could pair learners from different countries to analyze and propose solutions to water scarcity challenges in agriculture. Micro-credentials issued upon completion would validate their

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		technical and intercultural skills, aligned with EQF Level 5.
MOOCs for Agricultural Skills	Massive Open Online Courses (MOOCs), structured under frameworks like the CMF, offer scalable learning opportunities that can address sector-specific needs. By focusing on modular and flexible education, MOOCs ensure accessibility for diverse learners.	MOOCs tailored to agriculture could teach skills such as GIS mapping for precision farming or blockchain technology for supply chain transparency. For example, a learner completing a MOOC on blockchain applications in agriculture could earn a micro-credential validating their ability to design and implement traceability systems for agricultural products. These credentials would be aligned with EQF Level 5, ensuring recognition across the EU.
Digital Credentials for Agriculture (Europass)	The Europass Digital Credentials Infrastructure provides a secure and standardized system for issuing digital credentials. It enhances the portability and verifiability of qualifications, addressing the needs of a mobile and dynamic workforce.	In agriculture, Europass credentials could validate competences such as soil health assessment, compliance with EU organic certification standards, or basic knowledge of sustainable crop rotation. For instance, a learner completing a hands-on training program in soil health management could receive a Europass credential, ensuring their skills are recognized both nationally and internationally.
Flexible and Scalable Short Learning	Derived from compendium models, Short Learning Programs (SLPs) offer modular education that allows learners to build competences progressively. SLPs are particularly suited to Agricultural TVET, where	SLPs in agriculture could focus on topics like regenerative farming, smart irrigation systems, or agribusiness management. For instance, a learner completing an SLP on agribusiness could earn micro-credentials validating skills in financial planning, marketing strategies,

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Programs (SLPs)	learners often require specific, targeted training.	and supply chain management. These micro-credentials would align with EQF Level 5, forming part of a comprehensive qualification pathway.

6. Policy Recommendations for the integration of micro-credentials in Agricultural TVET Education

As viewed, the integration of micro-credentials into Agricultural TVET education presents significant opportunities to address labor market demands, promote lifelong learning, and foster sustainability in the agricultural sector. However, these opportunities require strategic policy support at all levels. Policies must align micro-credential implementation with national and European qualification frameworks, address sector-specific challenges, and ensure the scalability and quality of these credentials.

This section provides actionable policy recommendations designed to guide stakeholders in developing robust systems for micro-credentials in Agricultural TVET. These recommendations consider the unique needs of the sector, such as the importance of practical skills, alignment with sustainability goals, and the role of digital innovation in agriculture:

- Educational institutions should engage with farmers' associations, agribusinesses, and agri-tech providers to co-design micro-credentials that address specific labor market needs, ensuring that both content and delivery mode are aligned with industry standards, improving the employability of learners.
- Educational institutions should map how individual micro-credentials align with broader programmes or qualifications at EQF level 5. This could be done by promoting modular micro-credentials that can be stackable, enabling learners to accumulate credentials that can lead to a formal qualification such as a diploma, or a certificate in agricultural practices.
- Following the Council of Europe's Recommendation, the overall landscape of micro-credentials at the EU level should be harmonized, therefore, member states should integrate micro-credentials into their National Qualifications Frameworks, linking them to the EQF, as a reference point, to ensure comparability and equal recognition, thus facilitating cross-border mobility for agricultural workers, especially for seasonal employees.
- Dedicated funding streams should support the development and implementation of micro-credentials in Agricultural TVET.

- Governments should enhance mechanisms for recognizing prior informal and non-formal learning in agriculture, such as hands-on experience or apprenticeships. Policies should enable learners to use Recognition of Prior Learning (RPL) to earn micro-credentials or gain exemptions from certain program requirements.
- EU-level programs, such as Erasmus+ and Horizon Europe, should prioritize funding for projects that develop cross-border micro-credential initiatives in agriculture. These collaborations can address shared challenges like climate change, food security, and sustainable resource use.

7. Conclusions

The development of a common system for micro-credentials in Agricultural TVET education represents a significant step toward addressing the evolving demands of the agricultural sector, especially considering the twin transitions. By offering targeted, modular learning opportunities, the framework directly responds to the need for continuous upskilling and reskilling in areas such as sustainable agriculture, precision farming, biosecurity, and supply chain management.

This framework has been harmonized with existing European and national qualifications frameworks, particularly the European Qualifications Framework (EQF) and the various National Qualifications Frameworks (NQFs). This alignment not only promotes trust and transparency in the recognition of micro-credentials but also enhances their portability across different education systems and professional sectors within the EU.

The emphasis on quality assurance is another critical aspect of this framework. By aligning with established systems such as EQAVET for vocational education and training and ESG for higher education, the framework considers rigorous standards for the design, delivery, and assessment of micro-credentials. Furthermore, the integration of digital tools, including the European Digital Credentials (EDC) infrastructure, provides a secure and standardized method for issuing, storing, and sharing credentials.

The framework also addresses critical barriers to the adoption of micro-credentials, such as the lack of standardization and limited recognition mechanisms. By establishing a cohesive European approach, it strengthens the credibility and acceptance of micro-credentials across stakeholders. The inclusion of sector-specific competencies, validated through the PERSONA consortium, ensures alignment with industry standards and highlights the relevance of micro-credentials in addressing the unique challenges of modern agriculture.

Moreover, this system is forward-looking, incorporating innovative elements such as the Tuning-CALOHEE qualifications reference frameworks to ensure adaptability to future educational and sectoral developments. By aligning with the EU's twin transitions of digitalization and sustainability, the framework positions itself as a vital tool in preparing the workforce for the technological and environmental transformations shaping the agricultural sector.

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