



USAGE-NG

Up-skilling Agricultural Engineering
Next Generation

**Creating partnerships in smart farming education and
setting up a future education agenda**

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1 Executive Summary

Activity 3.2 focused on the development of modular learning units and curriculum guidelines for Smart Farming education, applying a micro-credential approach in line with Erasmus+ priorities on digital education, lifelong learning and green transition. Building on the needs identified in Activity 3.1, this activity translated research-based insights into structured, practice-oriented and transferable educational concepts.

The development process was strongly informed by two academic studies conducted within the project as well as by pilot teaching activities implemented in Activity 4.3. This ensured that the developed modules and curriculum guidelines are evidence-based, learner-centred, flexible and suitable for integration into higher education and lifelong learning programmes.

2 Overview

The objective of Activity 3.2 was to enable learners in agricultural and related disciplines to acquire relevant competences in Smart Farming technologies and to support informed decision-making regarding the adoption of digital solutions in agriculture. Instead of developing a single standardised course, the activity focused on establishing a modular framework that reflects the heterogeneity of agricultural systems, learner profiles and educational contexts.

The activity combined didactic evaluation of digital learning formats, empirical analysis of training demand and barriers in agricultural practice, and validation through existing higher education courses. This integrated approach ensured both academic quality and relevance for professional practice

3 Modules Development

The modules developed within Activity 3.2 are designed as modular and stackable learning units. They can be offered as stand-alone micro-credentials or combined into certificate programmes, bachelor's or master's curricula.

Didactic evidence from digital learning evaluation

The bachelor's thesis conducted within the project analysed the didactic effectiveness of a video-based digital learning unit on GNSS technology in Smart Farming. The evaluation showed that short, clearly structured video units significantly support the understanding of complex technical topics. Visual explanations, concrete use cases and self-assessment elements such as quizzes increased learner engagement and perceived learning success. At the same time, the study identified limitations of purely online formats and highlighted the added value of interaction and applied elements. These findings directly informed the modular design of learning units, combining digital introductory content with options for blended and applied learning.

Practice-oriented requirements from agricultural stakeholders

The master's thesis provided a comprehensive analysis of Smart Farming training needs from

the perspective of agricultural practitioners. The study identified a clear gap between high interest in Smart Farming technologies and comparatively low participation in training programmes. Key barriers included limited time availability, high operational workload, costs and uncertainty regarding the concrete benefits of digital solutions. Importantly, the study demonstrated that participation in targeted Smart Farming training increases acceptance of digital technologies and positively influences investment decisions. These findings emphasised the importance of decision-relevant, application-oriented content in module development.

Validation through pilot courses

The conceptual module framework was validated and refined through pilot courses implemented in Activity 4.3. The bachelor-level course *Technical Basics of Smart Farming* demonstrated how core technological topics such as GNSS, sensor systems, connectivity, data management, drones and field robotics can be delivered in a modular format combining lectures, laboratory work and field application. The master-level course *Intercultural Communication & Academic Entrepreneurship in Agricultural Engineering* illustrated how Smart Farming education can be complemented by innovation, entrepreneurship and intercultural competences. Together, these pilot implementations confirmed the suitability of modular and blended learning formats for Smart Farming education in higher education.

4 Guidelines for Curriculum Development

Based on the empirical findings of both academic studies and the practical experience gained through pilot teaching, the following guidelines for curriculum development were derived.

Learner-centred orientation

Curricula should clearly define target groups and align learning objectives with professional practice and real-world agricultural decision-making processes.

Modularity and micro-credential compatibility

Learning units should be designed as clearly defined modules with transparent learning outcomes, workload and assessment criteria, enabling flexible learning pathways and recognition.

Clear relevance for practice

Training content should explicitly demonstrate the benefits, costs and limitations of Smart Farming technologies in order to support informed and realistic adoption decisions.

Blended learning approaches

Digital learning units are particularly suitable for introductory and conceptual content, while applied exercises, laboratory work and field demonstrations are essential for deeper competence development and learner acceptance.

Progressive competence development

Curricula should allow learners to progress from foundational knowledge to advanced, innovation-oriented competences, supporting continuous upskilling and reskilling.

5 Results

The main results of Activity 3.2 include:

- a modular framework for Smart Farming learning units grounded in empirical research,
- curriculum development guidelines based on learner feedback and practitioner needs,
- validated module structures drawing on existing higher education courses,
- and a robust foundation for micro-credential-oriented Smart Farming education

6 Conclusion

Activity 3.2 successfully translated empirical research and teaching experience into a structured and flexible framework for Smart Farming module and curriculum development. By systematically integrating findings from didactic evaluation and practitioner-oriented analysis, the activity ensured that educational concepts address real learning needs and practical decision-making challenges.

The outcomes of Activity 3.2 provide a solid basis for subsequent pilot implementation, dissemination and long-term integration of Smart Farming education into higher education and lifelong learning systems within and beyond the USAGE-NG project.