



Co-funded by
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Using Farms as an Ecological and Pedagogical Education
Environment-Gamified-STEAM-Based Learning Approach

Model

{SCHOOL TO FARM}

Competency Framework for Farmers

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School to Farm ERASMUS+ PROJECT

Context of the Project

The objective of the School to Farm project is to develop a collection of STEAM activities that are place-based and gamified, with the aim of utilizing farms as an environmental education resource for out-of-school learning purposes that can complement formal education. The project centers around three key contexts:

- 1) employing farms as a pedagogical and ecological learning environment (place-based learning) in order to promote environmental awareness,
- 2) creating innovative educational games within the context of STEAM through interdisciplinary approaches (as opposed to discipline-specific), and
- 3) enhancing environmental education by establishing ecological competency-based learning that aligns with the requirements of formal schooling.

Placed-based learning and School to Farm Approach

Using farms as ecological and pedagogical environments is considered by the context of place-based education in the literature, but it hasn't been referred to or studied like outdoor education. The "School to Farm" approach can be found in some projects and academic literature (Helmi Risku-Norja,2014). In some form, farms are used in outside-classroom teaching in some schools, although the practices have not been necessarily recorded in the curricula (Risku-Norja 2006).

L. B. Sharp, a pioneer of place-based education, has stated that pupils cannot fully understand what they are learning without experiencing it (Knapp, 2000). The learning environment and its various elements, actors, and activities all have an essential function for learning. Another aspect of farm education relates to entrepreneurship education because of decreasing numbers of farmers and farming families.

Objectives and Work Pages:

WP1 Project Management

WP2 School to Farm Competency Framework in the context of the STEAM discipline + TPM1

WP3 Game-Based and STEAM-focused Learning Resources to be used in Farming Education+ LTT.

WP4 Digitally-enriched educational games in the context of farm-based environmental education+TPM2



WP5 Engagement of Results & Sustainability+TPM3

Partners:

Institution	Country	Acronym
Szkola Podstawowa z Oddziałami Dwujęzycznymi nr 20 im. Jana Gutenberga Fundacji Szkolnej w Warszawie	Poland	Szkola Podstawowa
Osmangazi İlçe Milli Eğitim Müdürlüğü	Turkey	OMEM
Polygonal North oy	Finland	Polygonal
SMART UMBRELLA MANAGEMENT SOLUTIONS E.E.	Greece	Smart Umbrella
Osmangazi Municipality	Turkey	OM
Grundzāles pamatskola	Latvia	Grundzāles pamatskola

JUSTIFICATION OF THE COMPETENCY FRAMEWORK

WP2-School to Farm Competency Framework in the context of the STEAM discipline is an attempt to define the concept of "use of farms as an ecological and pedagogical educational environment" and become school-to-farm literate citizens.

The competency framework is dedicated to the specific content of using farms as a pedagogical and ecological education in the STEAM discipline.

School to Farm Competency Framework contributes to the general objective of learning from nature and protecting nature to harness the real potential of green learning in educational



environments and enrich place-based learning (school-to-farm) with interdisciplinary-future-oriented learning materials and curricula which will help to fight climate change and raise awareness of environmental consciousness by prioritizing EU Green Deal. To create educational resources for STEAM-based educational games in farms, we must define a competency area by interviewing STEAM discipline teachers and farmers. Therefore, this competency framework is an innovative feature in terms of eliminating this gap.

1. Overview of the European Qualifications Framework (EQF)

A method of mapping qualifications among EU member states is the European Qualifications Framework (EQF). In April 2008, the European Parliament and the Council formally endorsed the EQF. Its two main goals are to foster lifelong learning for citizens and to encourage their international mobility.

2. Level of Qualification

The definition of learning outcomes within the EQF framework encompasses three main areas: knowledge, skills and responsibility/autonomy.

- **Knowledge** refers to the theoretical and factual understanding of a subject.
- **Skills** encompass both cognitive abilities (such as logical, intuitive and creative thinking) and practical abilities (such as manual dexterity and the use of tools).
- **Responsibility and autonomy** refer to a learner's ability to apply their knowledge and skills independently, while also taking responsibility for their actions.

FARM-BASED STEAM APPROACH

STEAM education is an approach to teaching and learning that integrates science, technology, engineering, art, and math. It emphasizes hands-on, project-based learning that helps students develop critical thinking, problem-solving, and collaboration skills.

For farmers, STEAM education can be particularly important because it can help them stay up-to-date with the latest agricultural technologies and practices. For example, farmers who understand the principles of engineering can use that knowledge to design and build more efficient irrigation systems or other equipment. Those who understand the principles of science can use that knowledge to select the best crop varieties, fertilizers, and pesticides for their particular growing conditions. Those who understand the principles of math can use that knowledge to optimize their crop yields and manage their finances more effectively.



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Moreover, art and creativity also play an important role in farming, as farmers often need to design and innovate in order to adapt to changing weather patterns or market conditions. By incorporating art into their education, farmers can develop their creativity and design thinking skills, which can help them to develop new products, marketing strategies, and ways to solve complex problems.

In conclusion, STEAM education can provide farmers with the knowledge and skills they need to stay competitive in an increasingly technology-driven and complex agricultural industry.

Moreover, additional points about the importance of STEAM education for farmers:

1. **Sustainable agriculture:** STEAM education can help farmers understand the principles of sustainable agriculture, which can improve soil health, reduce water consumption, and minimize the use of chemicals. By incorporating STEAM principles into their farming practices, farmers can promote long-term sustainability and protect the environment.
2. **Innovative solutions:** The agriculture industry is constantly evolving, and farmers need to be able to adapt to new challenges and opportunities. STEAM education can help farmers develop innovative solutions to complex problems, such as developing new crop varieties that are resistant to disease, designing more efficient irrigation systems, or using drones to monitor crops.
3. **Improved productivity:** By incorporating STEAM principles into their farming practices, farmers can optimize their production processes, reduce waste, and increase efficiency. For example, farmers who understand the principles of math and engineering can use precision agriculture techniques to plant and harvest crops more efficiently, resulting in higher yields and profits.
4. **New business opportunities:** STEAM education can help farmers identify new business opportunities and diversify their revenue streams. For example, farmers who understand the principles of art and design can create value-added products such as

artisanal cheeses or craft beers, while those who understand the principles of technology can develop new apps or software tools to help manage their farms more effectively.

Overall, STEAM education can help farmers become more knowledgeable, innovative, and competitive in the global marketplace. By incorporating STEAM principles into their farming practices, farmers can improve sustainability, productivity, and profitability, while also contributing to the advancement of the agriculture industry as a whole.

ROLE OF THE FARMERS IN THE THIS PROJECT

Learning STEAM education for farmers with teachers through project-based learning can be a great way to develop the skills and knowledge necessary to excel in the agricultural industry. Here are some steps that teachers and farmers can take to implement STEAM education projects:

- 1. Identify learning goals:** Before starting a project, it's important to identify the learning goals and outcomes that you want to achieve. For example, you might want to teach farmers how to design and build an efficient irrigation system, or how to use data analytics to optimize crop yields.
- 2. Select a project:** Once you have identified your learning goals, you can select a project that will help you achieve those goals. The project should be hands-on and interactive, and it should involve multiple STEAM disciplines.
- 3. Gather resources:** Next, you will need to gather resources that will help you teach the project. This might include textbooks, online resources, or instructional videos.
- 4. Design the project:** Once you have gathered your resources, you can begin to design the project. The project should be structured in a way that allows farmers to learn through hands-on experimentation and problem-solving.
- 5. Implement the project:** With the project designed, it's time to implement it. This might involve working with a group of farmers to build and test an irrigation system, or it

might involve teaching farmers how to use data analytics software to optimize their crop yields.

6. **Assess learning:** Finally, it's important to assess learning outcomes to ensure that the project has been successful in achieving its goals. This might involve testing farmers on their knowledge and skills, or it might involve analyzing data on crop yields or other performance metrics.

By following these steps, teachers and farmers can work together to develop STEAM education projects that are engaging, informative, and effective at improving the knowledge and skills of farmers.

ANALYSIS OF STATISTICAL DATA

In the analysis of these studies, the data were clarified by using SPSS, MAXQDA, and CONTENT ANALYSIS, which serve for both qualitative and quantitative data analysis.

A total of 14 farmers were involved in the survey study, wherein they were requested to indicate their level of agreement or disagreement with the questions posed using a 5-point Likert-type scale.

Upon analysis of the study data, several themes were identified in the responses provided by the farmers. These themes were subsequently cross-referenced with existing literature on varying sample populations and study groups, resulting in the following subcategories.

STEAM EXAMPLES THAT CAN TEACH FARMERS AT A SIMPLE LEVEL

1. **Soil Testing:** This project aims to educate farmers on the scientific process of soil testing and its potential benefits in evaluating soil health. It involves the collection of soil samples and their analysis through fundamental chemistry techniques. The project seeks to equip farmers with the knowledge to understand the results of soil tests and make informed decisions regarding soil improvement.



2. **Crop Rotation:** This project aims to educate farmers on the fundamental principles of plant biology and how these can be applied through crop rotation techniques to enhance the quality and quantity of their crops. The project entails selecting diverse crops to cultivate in designated fields annually, while monitoring their yields and condition over a period.
3. **Weather Monitoring:** This project provides an opportunity for farmers to enhance their understanding of meteorological principles and the potential benefits of utilizing weather data to optimize crop management strategies. The project entails the establishment of a basic weather station that collects temperature, humidity, and precipitation data, which can then be utilized to inform decisions regarding irrigation, fertilization, and pest control.
4. **Irrigation Design:** This project provides farmers with an opportunity to acquire knowledge on engineering principles and develop skills in designing irrigation systems that are efficient and effective. The project entails the creation of a basic irrigation system using common materials including PVC pipes, fittings, and valves. Farmers can learn how to calculate key design parameters such as flow rates and pressure drops to ensure that their irrigation system is tailored to their specific requirements.
5. **Harvesting and Processing:** This project aims to educate farmers on the principles of art and design, illustrating how these can be applied to enhance the value of their crops. The initiative encompasses the creation of recipes for producing preserved products, such as jams and pickles, while also emphasizing the importance of designing visually appealing packaging and branding for these items.

DISCUSSION and CONCLUSION

Incorporating STEAM principles into farming practices can improve sustainability, productivity, and profitability of farmers, while also contributing to the advancement of the agriculture industry. The practical and engaging approach taken by simple STEAM projects provides farmers with an opportunity to learn about the principles of science, technology,



engineering, art, and math. These projects serve as effective tools for educating farmers about STEAM principles in a way that is relatable to their profession.

No:	Competence Area
1	Agricultural Practices
2	Soil Analysis
3	Plant Protection
4	Agricultural Technology
5	Agricultural Marketing

COMPETENCY FRAMEWORK STRUCTURE

1- Agricultural Practices

Competence Area	Agricultural Practices
Competence Statement	<p>To give practical information to teachers about the management of agricultural activities, tillage, plant growing, and harvesting processes.</p> <p>To learn how to deal with real-world problems by examining farmers' practices.</p>



Knowledge and scientific data

1. Crop production: These involve growing and harvesting crops using various methods and techniques. The skills involved include:
 - to be aware of crop science and agronomy.
 - to understand irrigation and fertilization techniques.
2. Livestock management: These involve raising and caring for animals for food, fiber, and other products. The skills involved include:
 - to know animal husbandry and veterinary science.
 - to understand breeding and genetics.
3. Farm equipment operation and maintenance: These involve operating and maintaining farm machinery and equipment, such as tractors, combines, and irrigation systems. The skills involved include:
 - to know farm machinery and equipment operation and maintenance.
 - to understand safety regulations and procedures.
4. Pest and disease management: These involve managing pests and diseases that can damage crops and reduce yields. The skills involved include:
 - to know integrated pest management and disease control.
 - to understand pesticide safety and regulations.
5. Soil and water conservation: These involve implementing practices to conserve soil and water resources, such as conservation tillage, cover cropping, and water management. The skills involved include:
 - to be aware of soil science and water management.



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	<ul style="list-style-type: none"> to understand erosion control and nutrient management.
<p>Skills = abilities (what can I do)</p>	<ul style="list-style-type: none"> Crop rotation: to be able to select appropriate crop varieties and planting methods. Livestock management: to be able to manage animal health and nutrition. Farm equipment operation and maintenance: to be able to identify troubleshoot and repair equipment. Pest and disease management: to be able to identify and monitor pests and diseases. Soil and water conservation: to be able to implement soil and water conservation practices.
<p>Responsibility and Autonomy</p>	<ol style="list-style-type: none"> Project planning and organization: These involve planning and organizing STEAM education projects, such as robotics competitions, coding challenges, or engineering design challenges. The skills involved include: <ul style="list-style-type: none"> to know project management principles and techniques to be able to develop project objectives, timelines, and deliverables.



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	<ul style="list-style-type: none"> to understand how to manage project resources, such as materials and equipment. <p>2. Self-directed learning: These involve fostering self-directed learning in STEAM education projects by encouraging students to take ownership of their learning and develop their own strategies for acquiring knowledge and skills. The skills involved include:</p> <ul style="list-style-type: none"> to know learning theories and principles. to be able to design learning experiences that promote self-direction. to be aware of how to facilitate self-directed learning through feedback and support.
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2- Soil Analysis

Competence Area	Soil Analysis
Competence Statement	<p>To inform teachers about analyzing soil samples.</p> <p>To determine soil structure, pH, texture, and nutrient content.</p> <p>To increase students' awareness of soil health for sustainable agriculture.</p>
Knowledge and scientific data	<p>1. Soil sampling and analysis: These involve collecting soil samples and analyzing them to determine their physical and chemical properties. The skills involved include:</p> <ul style="list-style-type: none"> to know soil sampling methods and techniques to understand soil fertility and nutrient management



- 2. Soil health assessment: These involve evaluating soil health and quality using various methods and indicators, such as soil organic matter, aggregate stability, and microbial activity. The skills involved include:
 - to know soil health assessment methods and tools.
 - to be aware of the role of soil health in sustainable agriculture.
- 3. Geographic information systems (GIS): These involve using GIS technology to analyze and visualize soil data, such as soil type, texture, and depth. The skills involved include:
 - to know GIS software and mapping techniques.
 - to explain spatial analysis and modeling.
- 4. Research and development: These involve conducting research on soil science and developing new soil analysis methods and tools. The skills involved include:
 - to know soil science research methods and techniques.
 - to understand statistical analysis and data interpretation.
- 5. Communication and collaboration: These involve communicating soil analysis findings and recommendations to stakeholders and collaborating with other professionals, such as agronomists and farmers. The skills involved include:
 - to know effective communication and collaboration techniques.
 - to understand stakeholder engagement and relationship building.



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<p>Skills = abilities (what can I do)</p>	<ul style="list-style-type: none"> • Soil sampling and analysis: to be able to collect and interpret soil test results. • Soil health assessment: to be able to interpret soil health indicators and make recommendations for improvement. • Geographic information systems (GIS): to be able to create and analyze soil maps and data layers. • Research and development: to be able to design and conduct experiments. • Communication and collaboration: to be able to present technical information in a clear and understandable manner.
<p>Responsibility and Autonomy</p>	<p>Teamwork and collaboration: These involve promoting teamwork and collaboration in STEAM education projects by encouraging students to work together to solve problems and achieve project objectives. The skills involved include:</p> <ul style="list-style-type: none"> • to know team dynamics and collaboration strategies • to be able to facilitate effective communication and cooperation among team members. • to understand how to manage conflicts and differences within teams.



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3- Plant Protection

Competence Area	Plant Protection
<p>Competence Statement</p>	<p>To inform teachers about various plant protection methods. These methods may include the control of pests and diseases, the use of natural enemies, and chemical interventions.</p> <p>To use this information, students can examine the effects of various plant protection methods.</p>
<p>Knowledge and scientific data</p>	<ol style="list-style-type: none"> 1. Pest and disease identification: These involve identifying pests and diseases that affect plants and crops. The skills involved include: <ul style="list-style-type: none"> • to know pest and disease symptoms and characteristics. • to understand the life cycles and behavior of pests and diseases. 2. Integrated pest management (IPM): These involve using a combination of biological, cultural, and chemical control methods to manage pests and diseases in a sustainable way. The skills involved include: <ul style="list-style-type: none"> • to know IPM principles and practices. • to understand pesticide safety and regulations. 3. Biological control: These involve using natural enemies, such as predators, parasites, and pathogens, to control pests and diseases. The skills involved include: <ul style="list-style-type: none"> • to know biological control agents and their behavior. • to understand the role of biological control in sustainable agriculture.

	<p>4. Chemical control: These involve using pesticides and other chemicals to control pests and diseases. The skills involved include:</p> <ul style="list-style-type: none"> • to know pesticide formulations and application methods. • to understand pesticide resistance and management. <p>5. Plant quarantine and biosecurity: These involve preventing the introduction and spread of pests and diseases through quarantine and biosecurity measures. The skills involved include:</p> <ul style="list-style-type: none"> • to know plant quarantine and biosecurity regulations and procedures. • to understand the risks and impacts of invasive pests and diseases. <p>4. to know genetic engineering techniques and biotechnology tools.</p> <p>5. to explain ethical and regulatory considerations related to plant biotechnology.</p>
Skills = abilities (what can I do)	<ul style="list-style-type: none"> • Pest and disease identification: to be able to identify pests and diseases using field and laboratory techniques. • Integrated pest management (IPM): to be able to develop and implement IPM plans. • Biological control: to be able to select and release biological control agents. • Chemical control: to be able to select and apply pesticides safely and effectively. • Plant quarantine and biosecurity: to be able to implement and enforce quarantine and biosecurity measures.

Responsibility and Autonomy	<p>Reflection and self-assessment: These involve promoting reflection and self-assessment in STEAM education projects by encouraging students to reflect on their learning experiences and assess their progress towards project objectives. The skills involved include:</p> <ul style="list-style-type: none"> • to know reflection and self-assessment principles and techniques. • to be able to facilitate reflective discussions and self-assessment activities. • to understand how to provide feedback and support for self-assessment.
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4- Agricultural Technology

Competence Area	Agricultural Technology
Competence Statement	<p>To inform teachers about agricultural technology and mechanization. These topics may include tractors, irrigation systems, and fertilizing machinery.</p> <p>To develop equipment suitable for sustainable agriculture by studying the design and construction of agricultural equipment,</p>
Knowledge and scientific data	<p>1. Precision agriculture: These involve using technology, such as sensors, drones, and GPS, to collect and analyze data on soil, crops, and weather to optimize farm management practices. The skills involved include:</p> <ul style="list-style-type: none"> • to know precision agriculture technologies and tools. • to understand how to use precision agriculture to improve yields and reduce inputs.



	<p>2. Farm machinery operation and maintenance: These involve operating and maintaining farm machinery, such as tractors, combines, and harvesters. The skills involved include:</p> <ul style="list-style-type: none">• to know farm machinery operation and safety.• to understand how to use farm machinery to optimize farm management practices. <p>3. Data analysis and management: These involve collecting, managing, and analyzing data related to farm management practices, such as crop yields, inputs, and weather patterns. The skills involved include:</p> <ul style="list-style-type: none">• to know data collection and management systems.• to understand how to use data to make informed decisions about farm management practices. <p>4. Biotechnology: These involve using biotechnology, such as genetic engineering and plant breeding, to improve crop yields, quality, and resilience. The skills involved include:</p> <ul style="list-style-type: none">• to know biotechnology techniques and tools.• to understand biotechnology regulations and ethical considerations. <p>5. Agricultural software and apps: These involve using software and apps to manage and optimize farm management practices, such as crop planning, inventory management, and marketing. The skills involved include:</p> <ul style="list-style-type: none">• to know agricultural software and app platforms.• to understand how to integrate software and apps into farm management practices.
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<p>Skills = abilities (what can I do)</p>	<ul style="list-style-type: none"> • Precision agriculture: to be able to collect and analyze data using precision agriculture techniques. • Farm machinery operation and maintenance: to be able maintain and repair farm machinery. • Data analysis and management: to be able to analyze and interpret data using statistical methods. • Biotechnology: to be able to conduct genetic engineering and plant breeding experiments. • Agricultural software and apps: to be able to use software and apps to manage farm operations.
<p>Responsibility and Autonomy</p>	<p>Entrepreneurship and business skills: These involve developing entrepreneurship and business skills in STEAM education projects, such as developing business plans or marketing strategies for projects. The skills involved include:</p> <ol style="list-style-type: none"> 1. to know entrepreneurship and business principles and strategies. 2. to be able to develop business plans and marketing strategies. 3. to understand how to evaluate the market potential and financial viability of a project.

5- Agricultural Marketing

Competence Area	Agricultural Marketing
Competence Statement	<p>To inform teachers about agricultural marketing strategies and business models. (These topics may include farming, direct selling, and internet marketing to the local market.)</p> <p>To develop appropriate marketing strategies for sustainable agriculture by examining the marketing methods of farmers.</p>
Knowledge and scientific data	<ol style="list-style-type: none"> 1. Market research and analysis: These involve conducting research on market trends, consumer preferences, and competitors to inform marketing strategies. The skills involved include: <ul style="list-style-type: none"> • to know market research methods and techniques. • to understand consumer behavior and preferences. 2. Branding and product development: These involve creating and developing brands and products that appeal to target markets. The skills involved include: <ul style="list-style-type: none"> • to know branding and product development principles and strategies. • to understand how to position brands and products in the marketplace. 3. Sales and distribution: These involve selling and distributing agricultural products to customers, such as wholesalers, retailers, and consumers. The skills involved include: <ul style="list-style-type: none"> • to know sales and distribution channels and strategies. • to understand logistics and supply chain management.



	<p>4. Advertising and promotion: These involve creating and implementing advertising and promotional campaigns to raise awareness and drive sales. The skills involved include:</p> <ul style="list-style-type: none"> • to know advertising and promotion strategies and channels • to understand how to measure and evaluate advertising and promotional effectiveness. <p>5. Relationship management: These involve building and maintaining relationships with customers, suppliers, and partners. The skills involved include:</p> <ul style="list-style-type: none"> • to know customer relationship management principles and techniques. • to understand how to build and maintain trust and credibility in relationships.
<p>Skills = abilities (what can I do)</p>	<ul style="list-style-type: none"> • Market research and analysis: to be able to analyze market data and trends • Branding and product development: to be able to conduct market research to inform branding and product development • Sales and distribution: to be able to negotiate and close sales deals • Advertising and promotion: to be able to create and design advertising and promotional materials • Relationship management: to be able to communicate effectively with customers, suppliers, and partners



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<p>Responsibility and Autonomy</p>	<p>Ethics and social responsibility: These involve promoting ethics and social responsibility in STEAM education projects by encouraging students to consider the ethical implications of their work and the potential social impact of their projects. The skills involved include:</p> <ul style="list-style-type: none"> • to know ethics and social responsibility principles and values. • to be able to facilitate ethical discussions and decision-making. • to understand how to promote a culture of social responsibility and ethical awareness within the project team.
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