Co-funded by the Erasmus+ Programme of the European Union

Addressing the current and Future skIll needs for sustainability, digitalization and the bio-Economy in agricuLture: European skills agenDa and Strategy

D3.1: Training methodologies	
Document description	This task consists in defining the pedagogical approach that will be used to develop the training programme in order to enhance farmer learning of technological and soft skills.
Work package title	New tools and training design
Task title	Methodology definition
Status*	F
Partner responsible	UNITO
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Date	28/02/2022

F: final; D: draft; RD: revised draft

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1 Introduction

With the objective to support innovation and sustainable development in the agricultural, food-industry and forestry sector, a variety of methods for teaching content and processes that enhance farmer learning of technological and soft skills may be applied. This task consists in defining the pedagogical approach that will be used to develop the training programme in order to enhance the learning process.

The material developed for the curricula, will be used in two ways: by farmers, foresters and farm advisors, interested in the skill and not in the ECVET certification, and by students, wishing to later work in the sector. The latest will get ECVET certification through a completion of the whole chosen curriculum. The first group, interested in the skills, can access a personalised pattern, following only the modules they need. Several methodologies will be considered: online learning, microlearning, gamification, flipped classroom, blended learning, peer learning, on-farm demonstration activities, action-based and participatory learning. Also, the principle adopted to schedule the training (online and in-class activities, work-based periods) will be defined in this task, to maximise the engagement of the learners, and to provide a modular training schedule.

In this task UNITO will compare different open-source Learning management systems, to pick the one(s) to be used to implement the training material and to manage the training and will define the technical specification of the online platform which will be used to implement the training material. The specifications will consider platforms that could work online on smartphones, tablets and PCs. Moreover, only web standard platforms (meaning technologies that don't require any special software) will be used in order to ensure the sustainability of the project.

This handbook on learning methodologies will be released and made available as part of the strategy design as well as integrated in the platform for future use by VET and education providers. It will also serve as a basis for the FIELDS pilot training content creation and conduction.

For the decision about the training platform the following points from Erasmus+ were regarded:

1.1 Erasmus+ Open Access and Open License Requirement

The Erasmus+ Programme Guide stipulates Open Access and Open Licence requirements for all outputs produced with the support of the Programme:

1.1.1 Open Access Requirement

"Erasmus+ promotes the open access of project outputs to support learning, teaching, training, and youth work. This serves both to ensure that publicly funded materials provide value to the general public, to increase the value, visibility and reuse of the insights and work of a project, and to ensure long-term access to the results, even if e.g. a beneficiary consortium ceases to exist.

In particular, the Erasmus+ programme commits its beneficiaries to make any educational resources produced as part of projects - documents, media, software or other materials - freely available for the public under an open license. Such materials are known as Open Educational Resources (OER). In addition, beneficiaries must

ensure that these OER are shared in an editable digital form, freely accessible through the internet (without cost, registration or other restriction), and whenever possible shared on a suitable and freely accessible platform, thus not just a project or institution specific website. The open access requirement is obligatory and is without prejudice to the intellectual property rights of the grant beneficiaries."[1]

1.1.2 Open License

"An open license is a way for the copyright holder (creator or other rights holder) to grant the general public the legal permission to use their work. The applied open license is usually indicated directly on the work and wherever the work is shared. As in the case of other licenses, these ones do not imply a transfer of copyright or other intellectual property rights. Someone granting an open license for their work still remains the copyright holder of their materials and can themselves use the materials as they wish, e.g. to commercialise their project outcomes. Specifically, an open license applied to educational resources produced with support of Erasmus+, must allow the public (i.e. any third parties) at the minimum to freely:

- Use the work;
- Adapt the work as needed (e.g. translate, shorten, modify for local contexts, etc.);
- Reproduce and share the original or adapted work with others (e.g. with students in the classroom, online, with peers, etc.).

While Erasmus+ encourages beneficiaries to apply the most open licenses[2] to ensure the maximum impact of their works, beneficiaries may choose ones with specific conditions, in particular:

- That the creator has to be indicated whenever the work or a derivative is used or shared;
- That the work cannot be used commercially (e.g. sold by others, integrated in a commercial textbook, etc.);
- That any derivatives have to be shared under the same license or licensing terms.

While beneficiaries are free to choose any open license or even develop their own open license, to avoid duplication of work, ensure legal certainty, and ensure the possibility to combine several works, Erasmus+ beneficiaries are strongly encouraged to make use of well-known existing licenses suitable for the type of resource. The license cannot contain any conditions which limit the user group, which forces users to register, participate, or otherwise undertake any specific activity, or which specifies that the use has to be requested or reported."[3]

[1] Source: https://ec.europa.eu/programmes/erasmus-plus/programme-guide/part-c/important-contractual-provisions/open-access-requirement_en

[2] E.g. the widely used Creative Commons Attribution or Creative Commons Attribution-Share Alike licenses for creative works, the GNU Public License and GNU Lesser Public License for software, or the Open Database License for databases.

[3] Source: https://ec.europa.eu/programmes/erasmus-plus/programme-guide/part-c/important-contractual-provisions/open-licence-intellectual-property-rights_en

2 Pedagogical approaches

Online learning has been broadly recognized as strategically important to address global needs of education. As early as 1998 UNESCO articulated a vision and framework for priority action for change and development in higher education (UNESCO, 1998). As information technology (IT) made access to information ubiquitous, its importance to support and enable strategic actions at national levels became evident. The US National Technology Plan (US Department of Education, 2010) proposed a technology-enabled learning model based on the assumption that advances in learning sciences and understanding how people learn, combined with rapidly evolving technological developments, create new challenges and opportunities for higher education. The European Commission (2010) stated that innovation and modernisation are essential for Europe to become a competitive and inclusive economy. Similarly, EU countries and China (World Bank, 2007) have used IT into their education strategies as well as IT-enabled programs to boost research and education outcomes.

As a result, investments in education IT must not only increase learning results but also lower the cost of instruction. Previous experience has shown that with the correct investments and use of IT in education, this is possible. An assessment of 156 modified courses involving 195 institutions and 250,000 students found that learning outcomes improved in 72 % of the courses, while there were no gains in 28 %. Furthermore, the cost of instruction was decreased by 34 % on average (NCAT, 2014). Top-ranked universities' strategic plans for teaching and learning in higher education now include online delivery. This is frequently linked to better learning outcomes, lower instructional costs, and teaching/learning innovation (Williams *et al.*, 2012).

It is undeniable that online teaching and learning is effective. Higher education institutions are increasingly using online teaching/learning as a way to modernise their work and develop new channels for students to better their creative, entrepreneurial, and critical thinking skills. The remaining difficulties are around determining the most effective and efficient methods of delivering this type of teaching (Bateman & Davies, 2014). The focus of the FIELDS project is mostly on Higher Vocational students and farmers. Partially online learning and effective skill training benefit both target groups.

2.1 Active and Passive Learning

Active learning is anything course-related that all students in a class session are called upon to do other than simply watching, listening and taking notes. When students are focused on doing, with course content and activities designed to develop and enhance their comprehension of a topic, they are said to be engaged in active learning. Online discussions/debates, group projects, idea mapping, role-playing, content-related games, and problem-solving are some examples of activities that promote active learning. Active learning entails actions that promote the application, comprehension, and discovery of new information. This could be in the form of solving an engineering challenge or designing a system in the case of engineering.

Social activities are particularly suited for active learning. Students criticise, contribute, and build a deep grasp of the material they have learned. In this situation, the instructor's responsibility is to direct and support the students.

Passive learning occurs when students are engaged solely in taking in information. Examples of this include: reading materials, listening to a lecture, watching a video, and looking at the photos, diagrams or PowerPoints. Passive learning is primarily an individual activity in which students learn by assimilating the information presented.

3 Learning objectives classification - bloom's taxonomy

To promote higher forms of thinking in education a taxonomy was created (Bloom, *et al.*, 1956) in three domains of educational activity. Over time, Bloom's cognitive taxonomy was revised into its current form (Anderson *et al.*, 2001):

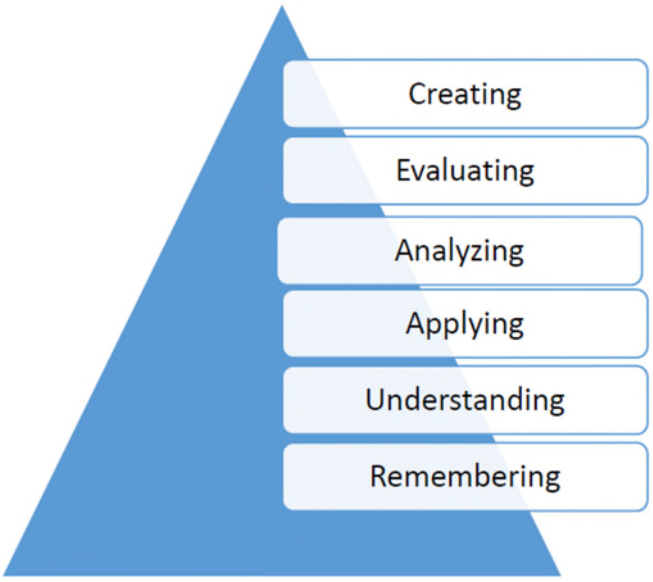

Figure 1: Revised Bloom's Taxonomy in the Cognitive domain

A description of each level of the taxonomy and examples of related behaviour follows below.

Remembering: Recall or retrieve previous learned information. (The student defines, describes, identifies, knows, labels, lists, matches, names, outlines, recalls, recognizes, reproduces, selects, states).

Understanding: Comprehending the meaning, translation, interpolation, and interpretation of instructions and problems. State a problem in one's own words. (The student comprehends, converts, defends, distinguishes, estimates, explains, extends, generalises, gives an example, infers, interprets, paraphrases, predicts, rewrites, summarises, translates).

Applying: Use a concept in a new situation or unprompted use of an abstraction. Applies what was learned in the classroom into novel situations in the workplace. (The student applies, changes, computes, constructs, demonstrates, discovers, manipulates, modifies, operates, predicts, prepares, produces, relates, shows, solves, uses).

Analysing: Separates material or concepts into component parts so that its organisational structure may be understood. Distinguishes between facts and inferences. (The student analyzes, breaks down, compares, contrasts, diagrams, deconstructs, differentiates, discriminates, distinguishes, identifies, illustrates, infers, outlines, relates, selects, separates).

Evaluating: Make judgments about the value of ideas or materials. (The student appraises, compares, concludes, contrasts, criticises, critiques, defends, describes, discriminates, evaluates, explains, interprets, justifies, relates, summarises, supports).

Creating: Builds a structure or pattern from diverse elements. Put parts together to form a whole, with emphasis on creating a new meaning or structure. (The student categorises, combines, compiles, composes, creates, devises, designs, explains, generates, modifies, organises, plans, rearranges, reconstructs, relates, reorganises, revises, rewrites, summarises, tells, writes).

Bloom's Taxonomy also added the concept of a knowledge matrix to add a cognitive dimension (Table 1):

Table 1. Cognitive Processes and Knowledge Level Matrix (examples)

	Levels of Knowledge					
Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Facts	*List*					
Concepts		*Explain*				
Processes			*Solve*			
Procedures						*Develop*
Principles				*Rank*	*Justify*	
Metacognitive			*Use*			*Create*

Where:

Facts: A specific and unique data or instance.

Concepts: A class of items, words, or ideas that are known by a common name, includes multiple specific examples, shares common features. There are two types of concepts: concrete and abstract. It includes knowledge of terminology and of specific details and elements.

Processes: A flow of events or activities that describe how things work rather than how to do things. There are normally two types: business processes that describe workflows and technical processes that describe how things work in equipment or nature. They may be thought of as the big picture, of how something works. It includes knowledge of classifications and categories, principles and generalisations, theories, models and structures.

Procedures: A series of step-by-step actions and decisions that result in the achievement of a task. There are two types of actions: linear and branched. It includes knowledge of subject-specific skills and algorithms, techniques and methods, and the criteria for determining when to use appropriate procedures.

Principles: Guidelines, rules, and parameters that govern. It includes not only what should be done, but also what should not be done. Principles allow one to make predictions and draw implications. Given an effect, one can infer the cause of a phenomena. Principles are the basic building blocks of causal models or theoretical models (theories).

Metacognition: Includes strategic knowledge, knowledge about cognitive tasks including appropriate contextual and conditional knowledge, self-knowledge.

3.1 Learning Theory

The purpose of this report is not to review learning theory. It is necessary, however, for the practitioner to have a fundamental comprehension of it. Behaviourism, cognitivism, and constructionism are the three most popular learning theories.

Behaviourism is a world-view that operates on a principle of "stimulus-response". It assumes that a learner is essentially passive and responds to external stimuli. The learner starts as a "tabula rasa" and behaviour is shaped through positive or negative reinforcement. Learning is defined as a change of behaviour in the learner.

Cognitivism is a paradigm where the learner is viewed as an information processor. Knowledge is seen as a schema, or symbolic mental construction. Learning is a change in a learner's schemata. Cognitivism responds to behaviourism by recognizing that people require active participation in order to learn and changes in behaviour are an indication of what occurs within the learner's brain.

Constructivism postulates that learning is an active and constructive process in which the learner is the information constructor. (An individual constructs his/her own subjective reality linked to prior knowledge). It views learning as an active and contextualised process in which knowledge is constructed (as opposed to acquired). This construction is based on the learner's personal experience and hypothesis about the environment, bringing past experiences and cultural factors into a learning situation.

In terms of pedagogy in engineering, the conclusion from these learning theories is that behaviourism aids in understanding and communicating learning expectations in terms of conduct. Constructivism, on the other hand, helps people comprehend how social engagement can lead to higher levels of learning.

3.2 Pedagogical and Andragogical learning

It should be noted that learning theory can be tailored based on the approaches of both Pedagogical and/or Andragogical learning, which is important when considering the types of learners you are dealing with.

Considering the engagement and practice of learning/teaching of adult learners, we consider a variety of methods, taking into consideration the individual learning styles of learners.

There are a number of different theories and frameworks with regards to learning styles, David Kolb's Experiential Learning Cycle (1984), which is based on four modes of learning, namely, Concrete Experience, Reflective Observation, Abstract Conceptualisation and Active Experimentation. Peter Honey and Alan Mumford (1986), identified four distinct ways in which people learn, these are Activists, Theorists, Reflectors and Pragmatists and Fleming & Mills (1992), whose VARK model of Learning, is based on Visual, Auditory, Read and Kinaesthetic approaches to learning. Understanding learning styles is a critical element when considering the adult learner.

Similarly, we see the emergence of models such as the 70:20:10, which suggests that people learn proportionately as follows:

- 70% on the job (job-related experiences)
- 20% through informal learning (interactions with others – learning through feedback)
- 10% through formal training events and courses.

4 Training Methodologies

4.1 In person class

Any sort of educational engagement that takes place "in person" and in real time between teachers and students, or between colleagues and peers, is referred to as in-person learning. In-person courses hold the student accountable for remaining active and alert during class time. Learners can interact face-to-face with their peers and teachers, as well as cooperate with them on a set timetable, in an in-person class.

This form of learning methodology varies based on the subject and instructor, but it often requires learners and teachers to meet twice to three times each week for a specific length of time. While each class is different, learners will often receive a participation score for this course, which will include in-class involvement and attendance. In addition, students are likely to have in-class group assignments that may or may not be graded. In-person classes allow students and teachers to form a more intimate bond.

A teacher's effectiveness in the classroom goes beyond the class they're teaching. A teacher's responsibility is to excite, encourage, and oversee their students in order to get the most out of them - the latter being particularly challenging to achieve with video conferencing software.

4.2 Online learning

Online learning (also known as remote learning, distance learning or e-learning) means the use of multimedia and Internet technologies to improve the quality of learning by facilitating access to resources and services, as well as remote exchanges and remote collaboration.

The goal of e-learning is a continuing education process that involves the use of network technologies to design, deliver, select, manage and extend learning. The main elements in the design of content that can be delivered via the network, which make distance learning no longer comparable to traditional monolithic courses to be distributed indiscriminately to all students, are fourfold:

- interactivity, i.e. the need to involve the learner, generally making use of learning by doing;
- dynamism, or the learner's need to acquire new targeted skills just in time;
- modularity, i.e. the possibility of organising the contents of a course according to the training objectives and the needs of users;
- flexibility

Regarding this last element, each training block (called learning object) can be removed from a course and assembled with other learning blocks to form a new course: therefore the learning object can be defined as any object that becomes part of the training process and that can be (re) used in different times and places. Its size varies according to the methodology adopted by the designer. The characteristics necessary to make learning objects reusable are: easy availability and portability; the ability to manage content archives; the assignment of metadata sets to individual objects.

4.3 Microlearning

Microlearning (also called bite-sized learning) is a didactic approach focused on the minutiae of learning units (or teaching units). It is a "smart" and fast methodology, such as to be shaped according to the needs of the student – who can be of any age and every cultural level, with professional skills or not: microlearning is therefore adaptable to all areas of learning. What is paid attention to is the use of multiple types of content, called "micro-content". The basic idea is in fact that, the smaller and more detailed the teaching units, the more they remain impressed in the mind of any student, who internalises them more easily (Hug, 2010).

These are podcasts, blogs-posts, wikis, messages, photos, graphics, texts, videos, social media posts, audio and any other type of multimedia content- as long as they are short, (learning time sessions from about 5 to 10 minutes) and simple (bare concepts). In addition, micro-content must have a single focus, be self-contained (i.e., contain its own structures, sub-elements or metadata that organise them), indivisible (by breaking them down, they would lose meaning) and recoverable to a web address (they must have "addressability", that is, be indexed by a permalink associated with each of them: an example is the DOI that is used for online academic publications).

By virtue of its addressability, micro-content can be used in an "on demand" way: what makes micro-learning effective, therefore, is also the fact that the subjects can decide independently when to undertake the training process, so as not to be overwhelmed by learning, but to be able to control it. Not surprisingly, in its most recent evolution, micro-learning is widely used in e-learning and Distance Learning, in different contexts of use: from corporate training to professional updating, to the testing of skills and soft skills.

Its application in classroom teaching (but also at a distance) offers the possibility of structuring agile, innovative and multi-platform learning paths, in line with a lifelong learning perspective. In this way the canons of traditional learning – normally based on books – are overturned, which often pose long and complex contents, difficult to assimilate. Microlearning involves short-term focused strategies designed specifically for the understanding, learning and education of the learner: all based on the development of his skills and competences.

4.4 Gamification

Since 2010, gamification has become not only a word in common use, but also an educational methodology fully accepted in classrooms around the world. Gamification is understood as the use of game dynamics (e.g. points, levels, rewards) in non-game contexts, such as education, marketing, health, corporate training and politics to solicit commitment and competitiveness, to stimulate the search for solutions to a problem, etc.

Studies show that translating educational, promotional, or propaganda goals through exciting challenges, along the lines of video games, then through the awarding of progress badges and visibility of performance graphs, fulfils the need for competence and increases the perceived meaningfulness of the task (Sailer *et al.* 2017).

In the classroom, "Gamification" does not mean "making the lesson playful," rather it is applying elements specific to video games in teaching to stimulate learning in traditional subjects. Gamification allows the program to be segmented into consecutive levels and satisfies the needs for growth, activity, self-esteem, while maintaining high degrees of fulfilment and interest, thanks also to the customization of the path. This approach allows them to amplify their motivation, allowing them to store information in a meaningful and longer-term way.

There are two different sources of motivation: one based on mastery, the other on the product (and its comparison to the achievement of others). Evidence shows that learning motivated by grades alone is only effective in the short term; instead, the desire to learn broader skills ensures long-range retention of those skills. Videogames guarantee the subject wide spaces of freedom, personalization, choice, and make progress immediately visible. Error is no longer a discouraging, anxiety-inducing definition, but an impulse to try again. In place of the traditional evaluation, score-rating systems typical of video games are inserted, such as rewards that range from zero upwards, instead of the classic subtractive evaluation, calculated on the basis of errors.

In the case of gamification, the error only temporarily locks the subject to a level of the game, while the score is calculated on the actual progressions, according to one's own time. It is not important how much you make a mistake, but when the impasse is resolved, finally acquiring the competence required in the training path.

An assessment based on game scores has the advantage of giving immediate feedback on one's activities: a necessary element for maintaining high levels of "engagement". It is important to have feedback on our actions, otherwise we would not derive any satisfaction from the attempts. Trials without mistakes or successes would simply remain empty, never happened, just as an invisible basket, placed beyond a wall,

cannot be considered a goal. Learning is a continuous process of confirmations and adjustments: it is always based on the comparison between the expected output and the one actually obtained, and it is only through immediately visible feedback that the shooting parabola can be adjusted.

Gamification vs game-based learning

Whilst gamification encompasses the mechanics of games, game-based learning (aka serious games) is the conduit to implement gamification into learning. It is using full blown games to reiterate the learning objectives and to reinforce particular concepts relating to the subject materials. Because of their interactive nature, games are fundamentally more engaging than traditional learning methods. The concept of serious games is based on the principles of combining learning strategies, knowledge and structures, and game elements to teach specific skills, knowledge and attitudes and can be used to promote learning and behaviour change. There is a clear distinction between gamification, game-based learning and serious games.

4.5 Flipped classroom

Advances in technology and learning theory and practice have created new directions and opportunities for pedagogy in engineering education. A pedagogy currently receiving much attention is the flipped classroom. The flipped classroom is unique in its combination of active, problem-based learning constructive ideas and direct instruction methods based on behaviourist principles (Bishop & Verleger, 2013). This pedagogical approach is enabled by technological advances that permit the transmission and duplication of information at very low cost and various means, and the trend in education to make learning student-centred.

Consensus on a flipped classroom definition is lacking (Chen *et al.*, 2014). A simple definition of the inverted classroom is given by Lage (2000). By this definition, activities that traditionally take place in the classroom, take place outside the classroom in a flipped classroom, and vice versa. Thus, a flipped classroom is one in which learning activities not requiring human interaction take place outside the classroom (enabled by technology) and learning activities requiring human interaction take place in the classroom (virtual or physical). Figure 2 illustrates this definition of the flipped classroom. Note that by this definition of a flipped classroom activities requiring human interaction may occur face-to-face or virtually and in synchronous and asynchronous manners.

In this work, the focus of activities not requiring human interaction is for the student to understand and apply basic concepts related to the subject matter of the course in preparation for activities requiring human interaction that focus on higher levels of learning in Bloom's taxonomy (Krathwohl, 2002).

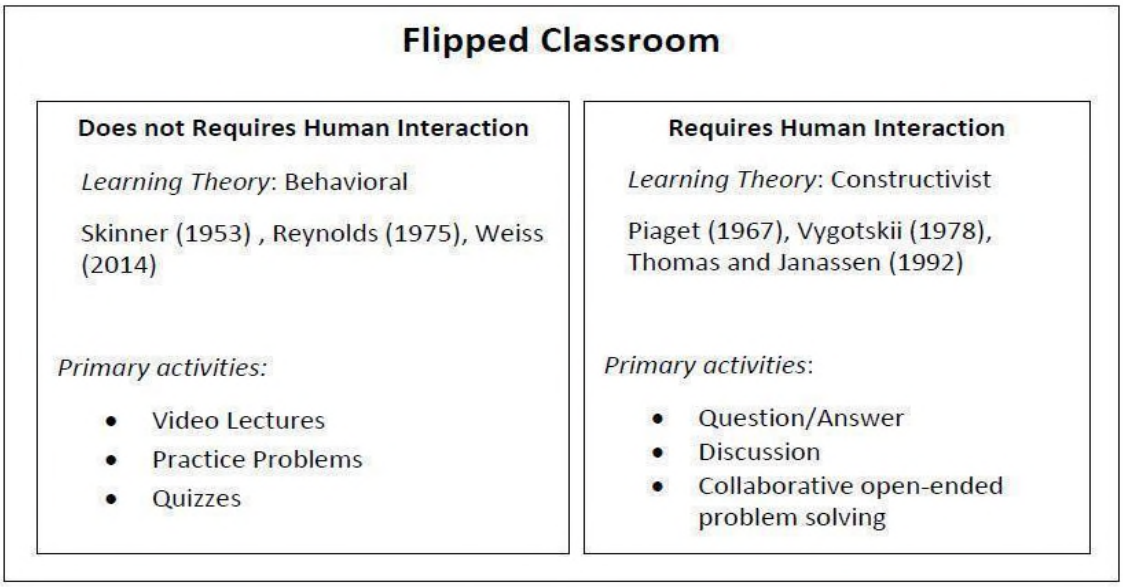

Figure 2 - Definition and theoretical framework of a flipped classroom

Some tools that do not require human interaction are video, closed-problem solving and quizzes. Early studies show that quality video lectures outperform traditional lectures (Cohen *et al.*, 1981). Also, online homework is equally effective as paper and pencil (Bonham *et al.*, 2003; Fynewever, 2008). These, coupled with quizzes for self-evaluation (Stallings & Tascoine, 1996) provide a solid basis for the student to engage in activities requiring human interaction focused on higher level skills such as communicating effectively; identify, formulate and solve engineering problems; and work in teams.

Specific activities requiring human interaction include the use of face-to-face and online discussion boards used to post and answer questions (students and faculty alike) and carefully crafted open-ended problems. This approach provides an opportunity to develop activities for active learning (Michael, 2006), cooperative learning (Foot & Howe, 1998), peer-assisted- learning (Topping & Ehly, 1998), and problem-based learning (Barrows, 1996).

It is important to note that activities are not limited to those shown in Figure 2. The number and type of activities can be diverse provided they focus on efficiently achieving a learning outcome and the learning style of the students (Zimmerman *et al.*, 2006).

4.6 Blended learning

Blended learning, also known as hybrid learning, combines and merges the innovative tools and techniques of e-learning with traditional training and the "flipped classroom" system (Graham, 2006).

The traditional teaching of the teacher who introduces a topic and then delivers individual study materials to the students is combined with the flipped classroom, where learners study and deepen the topics independently using the materials received (videos, documents, links, interactive quizzes) and then return to

confront in a synchronous manner with the teacher, who will explain any aspects that remain unclear, introduce new concepts and topics, provide new materials and so on.

Blended learning considers the fact that each person has their own pace of study and has different times - and even ways - of understanding and learning. It is made up of 3 different types of teaching, divided into stages:

- the first part is dedicated to the classroom meeting;
- the second refers to individual teaching to be carried out through digital content;
- the third, finally, concerns the creation of a community within which knowledge and know-how are shared (social learning).

The strength of such an approach lies in its ability to make all participants in the training session collaborative, improving internal communication thanks to the mix of models implemented. Blended learning is a complex system that embraces multiple levels of updating. In addition, blended learning allows faculty to offer resources a personalised path based on each individual's areas of improvement.

Some of the benefits of blended learning: empowerment of resources; involvement in the training activity thanks mainly to the formats used for the lessons; simplicity and immediacy; improved communication between employees and teachers; autonomy and collaboration of resources; takes full advantage of classroom and self-paced training (Dawley (2007).

Blended learning tools and resources include: Google Classroom, YouTube, Zoom, Microsoft Teams, Skype, Moodle, Blackboard. An example of blended learning is students doing face-to-face group work in class then returning home to analyse that work and turning in a video as an assessment form; taking an online course, then receiving face-to-face tutoring between online classes.

4.7 Peer learning

Peer Learning, or peer education, is an educational methodology that is based on a process of transmission of knowledge and experiences among members of a peer group, within a plan that includes well-structured goals, times, ways, roles and tools.

The Peer Learning method implies, somewhat similar to the Flipped Classroom, a clear change of perspective in the learning process, which will see the students, and not the teachers, at the centre of the educational system. The peer group will constitute a sort of social laboratory in which to develop awareness, test new activities, design and share together, giving students the opportunity to improve their self-esteem and social, relational and communicative skills.

According to data from a research conducted by Keith J. Topping (2005) in the area of school integration and peer learning, students who receive explanations from other students learn more than those who work alone and, even more importantly, those who take care of providing explanations to other peers assimilate even more effectively than those who receive explanations and other peers who work in a more individualistic

manner because, having to go over and explain a concept to another person allows the "student tutor" to reinforce knowledge by improving their learning strategies.

The first attempts at Peer Learning date back to the late 1800s in England when two scholars, Lancaster and Bell, attempted to remedy the problem of overcrowding in the working class and the almost total absence of professional teachers. Teaching each other allows students to increase and refine their knowledge, study methods, and problem-solving skills. It should be noted that both participants will benefit from this teaching strategy because, the "student tutor" will be valued and empowered by this role and will develop, consequently, a more proactive behaviour towards the school and the educational path; the other student will benefit from working in a protected environment with a person considered closer to him.

Given the ultimate goal of reinforcing students' self-esteem, as well as increasing their knowledge, the teacher must learn not to be the sole dispenser of knowledge for their students, standing aside and leaving space and time for the students. The teacher must accept that the type of communication that can be established between two peers can sometimes be more effective than that which can be established between a student and an adult. There is a real reorganisation of school spaces and roles, spaces that are generally set up in rigid structures. Peer Learning makes it possible to convey the teaching of life skills more effectively, those competencies necessary for each student to achieve educational success.

4.8 On-farm demonstration activities

The European Commission (2014) defines a demonstration project/activity as a: "*Practical session to illustrate a technology, the use of new or significantly improved machinery, a new crop protection method or a specific production technique. The activity can take place in a farm or in other places such as research centres, exhibition buildings, etc.*"

Various farm types, such as experimental or research farms, farms owned by trusts and charitable organisations, and commercial farms, can host demonstration activities. Farmers, commercial firms, farmers' organisations, NGOs, extension services, research institutes, and/or public institutions organise demonstration actions in a variety of alliances (Sutherland and Marchand, 2021). On-farm demonstrations range from one-time "field days" organised by input suppliers to multi-year "monitor farms", where farmers, advisors, and industry members meet at regular intervals to assess farming opportunities in situ (Prager and Creaney, 2017); and permanent research farms, where researchers test and demonstrate cutting-edge technologies and approaches. As part of their business growth initiatives, farmers are increasingly opening their farms to connect with their peers and the general public. (e.g. short food supply chains, community-supported agriculture), using traditional and new virtual 'on-line' methods. On-farm demonstration is thus one activity, – amongst many – embedded in AKIS (Agricultural Knowledge and Information Systems) and mobilised by AKIS actors to facilitate farmer learning.

By inviting farmers straight onto fields and arranging meetings between farmers where both tacit and codified (scientific) information may be transferred, AKIS players (including farmers) hope to actively mobilize this culture of 'roadside farming.' Demonstration activity has the advantage of allowing for hands-on learning and

direct dialogue between peers. Uncovering the types of learning this peer-to-peer method can offer is thus central to the conceptualisation of demonstration. Burton's research (2020) shows the history and challenges of actively striving to enable farmers to learn from scientific professionals and other farmers, highlighting design flaws that are still relevant today. Burton's paper highlighted those problems with effective demonstration that had existed for a long time.

The primary purposes of on-farm demonstration are to communicate explicit knowledge, and to make tacit knowledge more explicit. Farmers learn tacit knowledge mostly through experience: 'know how' gained through practice and experience. Tacit knowledge is not really associated with cognitive learning (Curry and Kirwan 2014). Farmers undertake a variety of assessments and tasks, ranging from spotting sick livestock to plowing fields equally, without always being able to articulate how they do so. 'Scientific information,' on the other hand, is 'codified,' meaning it can be openly recorded and documented (e.g., through scientific reports).

The influence of the demonstration activity also reflects its perceived feasibility, which is best proven on a successful commercial farm. Farmers can quickly recognize the 'excellent farmers' they want to emulate (Burton *et al.* 2020). Unfortunately, the desire to be viewed as a "good farmer" can lead to a refusal to disclose failures, and competitiveness might limit readiness to provide precise financial accounting of commercial accomplishments. Farmers, on the other hand, are motivated to engage with demonstration farms in order to stay current with new technology and techniques that can aid them in their agricultural methods by the same desire to be viewed as a good farmer. Outsiders may find it difficult to recognize these "good farmers," yet they are critical in promoting change.

For making tacit information explicit, Nonaka and Toyama (2003) suggested four steps: socialisation, externalisation, combination, and internalisation. Each of these phases builds on the previous one. The aided experience of hands-on learning known as "socialisation" occurs when a learner is purposely exposed to a setting that promotes personal experiences. When tacit information is articulated (for example, as concepts or principles), it is referred to as 'externalisation.' 'Combination' actions combine this and other people's knowledge, systematising and integrating it. The new knowledge is then internalised, integrated in agricultural techniques, when it is practically used in a new environment - such as the learning farmer's farm.

4.9 Action-based and participatory learning

Participatory Learning and Action (PLA) is a qualitative research method that can be utilised to have a comprehensive understanding of a community or issue. It is commonly used in community-based activities. PLA is a participatory methodology, which means it should always be carried out with the full and active participation of the community. PLA's major goal is to help people in communities analyse their own situations rather than relying on outsiders to provide it, and to ensure that any learning is put into action (Gosling and Edwards 2003).

PLA is located within a broader field of participatory approaches, which can be described as a “family of approaches, methods, attitudes and behaviours to enable and empower people to share, analyse and enhance their knowledge of life and conditions, and to plan, act, monitor, evaluate and reflect” (Chambers 2008)

Within the FIELDS project, participatory learning can be put into practice as follows:

4.9.1 Participatory Learning and Action

Facilitating a community (or group of trainees) to analyse their local situation or problems, find solutions together and plan and act to put the solutions into practice.

The community double-checks and validates any information obtained using the tools and processes offered by facilitators. In PLA, data analysis is done in the field by community members and facilitators in a cumulative manner. PLA does not specify any analysis methodologies, but it is critical that any analytic methods utilised be accessible to community members.

Analysis typically includes the identification of connections, relationships, gaps, contradictions and new areas of inquiry. Often this is based around:

- interpreting descriptions, stories, statements, pictures, maps, diagrams and other visual data;
- identifying themes and patterns emerging out of the data collection;
- assessing the frequency with which particular ideas or themes are mentioned;
- testing the strength of feeling about specific issues;
- identifying points of convergence or divergence between different sets of data, collected through different sources, methods and perspectives;
- identifying gaps in the data where further information needs to be collected, or where more probing of existing data is needed.

Optimal ignorance and appropriate imprecision are two key principles in PLA (Chambers 1983). This means that PLA participants should only gather and analyse information that is required, to the level of precision required to inform community decision-making and action. Many monitoring, evaluation, and research approaches, on the other hand, are intended towards establishing findings to extremely high degrees of precision in order to fulfil the needs of academic audiences. The next phase is to design a community action plan, or for the community to take particular action based on the analysis once optimal ignorance has been attained. This includes presenting work to various audiences, such as community leaders, community-based organisations, local government agencies, and other possible service providers, in a variety of ways.

Within the PLA, there is a vast variety of tools and procedures that can be used. Many of these are common data collection tools. Direct or participant observation, semi-structured interviews, focus group discussions, photography, video, case studies, and secondary data sources are some of the methods used. There is, however, a large number of tools and procedures built expressly for PLA. Many of these rely on visual aids like photographs, diagrams, charts, and maps, which are frequently created with local resources. These tools and strategies are especially useful for people who are illiterate or have never read or written before.

4.9.2 Participatory training approaches.

Participatory training is aiming at empowering people, it is especially suitable for adult education (Pretty *et al.* 1995). The important aspects of participatory training are:

- Training is based upon analysing needs and problems, mobilising knowledge and experience which is present in the community (or group of trainees) and stimulating creativity and (self)reflection.

- Training is under guidance of a facilitator who facilitates a bottom-up sharing of knowledge instead of a trainer who takes a top-down approach. Good facilitation skills are essential.

- The facilitator is responsible that a learning objective (not necessarily only cognitive knowledge) is reached and has to create a situation or prompt a reaction to ensure that a learning point is understood. The facilitator can be an expert but will always act from a point of stimulating learning, instead of from a dominating position.

- To begin the training, the goals and objectives are clarified and agreed upon with the communities or groups. If you have several or competing ambitions, then issues are resolved before proceeding.

- The aims and objectives of the training should represent both the needs of the community or group of trainees and the requirements of the outsiders. In the context of the FIELDS project “outsiders” could be for example organisations/local governments that need farmers to change to more sustainable farming methods.

- For a participatory training approach, which stresses active participation and an open dialogue, a collection of suitable tools and techniques is available. It is best to use a combination of learning methods. Examples of participatory training techniques are: Buzz-groups, brainstorming and collecting ideas, role plays, case studies. Use is made of visualisation, sharing and discussing outcomes.

Participatory learning in the field (practical activities) is close to activities described under 4.8 On-farm demonstration activities. Guided by a (expert)facilitator participants analyse certain problems, be stimulated to brainstorm and discuss solutions and even put certain solutions into practice and evaluate them together (possibly at a later time). The expert facilitator makes sure that learning objectives are met and may offer new knowledge / techniques where this serves the needs of the participants.

Peer-to-peer learning (4.7) is also a method fitting into participatory learning in the field, when the learners are equal and learn by sharing knowledge and experience and learn from each other in both ways, facilitated by an expert facilitator.

5 E-learning platform Access Modality

In spite of the requirements set in the Erasmus+ Programme Guide, practice has shown that Erasmus+ Project outputs are often made accessible under registration. This has been accepted by the European Commission under the condition that at least some basic information about the outputs is accessible publicly, without cost or registration. In other words, some elements such as the training structure, content description and video teasers should be published online without cost or registration, while the full training could be made accessible under registration.

For the project FIELDS a general description of the training content will be available on the project website and on the Moodle platform.

A registration is required to identify the trainees in order to track their knowledge growth (allocation of test results from the pre-test and final test) and to grade them. It would not work without it, and the training program's goals couldn't be measured or met without it. For the registration of the trainers there has to be a possibility for the administration by UNITO. For the registration of the learners (trainees) there has to be a possibility for the administration by the trainers and support by UNITO (if needed). This will also guarantee the needs to refine personal data management processes to be fully compliant with the General Data Protection Regulations (GDPR).

Practice has also shown that some Erasmus+ outputs are commercialised after the end of the project lifetime. This is largely because completely free outputs, even if they remain available after the project's completion, are frequently overlooked once the project consortium has ended: the outputs are not regularly updated, contain broken links, and do not provide customer support to registered users, among other things. In the case of paying outputs, however, there is a greater motivation to sustain the outputs.

We, therefore, recommend applying the CC BY-NC 4.0 Creative Commons license (Attribution-Non-commercial 4.0 International) during the project lifetime and within four years after its closure.

5.1 E-learning platform sections and user navigation

For a hands-on usability the platform needs an easy to operate structure and menu navigation. To assure this the platform has to offer simply perceivable icons (icons that visualise information what they stand for and what the user has to expect, for this reason the icons and file/video preview have to be in a noticeable size).

For these reasons, the following content icons must be present in the e-learning platform:

- Video icon or preview of the video
- documents icon
- documents with notes (for all the PowerPoint presentation with notes provided in the training course)
- external link icon

Furthermore, to handle the different content and different user options for trainers and trainees the training platform needs the possibility of two different sections with two different contents and user options.

5.2 E-learning platform languages

The project approach of FIELDS is an education programme in the languages English, Italian, French, German, Finnish, Dutch and Spanish. For this reason, the chosen training platform needs the possibility of an easy-to-use multilingual approach.

5.3 Available IT platforms and tools

To implement the training methodology a learning management system (LMS) is needed. LMS is a software environment allowing to create and deliver educational content, manage trainees, track their progress and gather statistics on their performance, provide social integration and issue certificates. Therefore it is a software application for the administration, documentation, tracking, reporting and delivery of educational courses or training programs.

LMSs could be defined as a set of software platforms, delivered to users by instructors through internet and by the use of various hardware means, having as purpose the delivery in the shortest time possible a high level of knowledge into a domain assuring at the same time a full management of the entire educational cycle, including data and information (Berking, & Gallagher, 2013).

5.4 Main categories of LMSs

According to a study of Dobre (2015), the main categories of LMSs are:

- Proprietary LMSs: These systems are called proprietary because they have been licensed by their developers under exclusivity of the legal rights belonging to the copyrights owner/s. The proprietary LMSs require the existence of a developed infrastructure (buildings fitted with labs, networks, computers etc.) and also involve the installation of the platforms on the Higher Education Institution servers and computers.

  The most known and used at present proprietary LMS is Blackboard Learn, others important to be cited are: Design2Learn, Canvas and ANGEL.

- Open-Source LMSs: These are learning management platforms which make available the source code under a public free licence, this giving to the user the rights to use, to change, to study, to create and to distribute the results, free of charge, to anyone and for any purpose.

  The most known and used at present Open-Source LMS is Moodle, others important to be cited are: Sakai, Open edX and front.

Regarding the present trends, the open-source LMSs seems to be the most used. As an example, in a study of Davis, Carmean, & Wagner (2009), 20.1 % of the High Education Institutions were using Moodle, while 13.1 % from the responders were using Blackboard LMS.

5.5 Comparison among the tools available

Learning Management Systems are systems designed to enable and facilitate education via the Internet, they are deliberately designed and network-enabled transfer applications for web-based learning. LMSs are

intended for educational institutions and corporations that train large and decentralised teams, and offer training and workshop courses, evaluation metrics, and skill gap analytics.

According to the task description the comparison will only consider platforms that could work online on smartphones, tablets and PCs.

Considering a detailed analysis of more than 70 articles and user reviews on LMS platforms on industry-leading forums like E-learning industry, Capterra, Quora, Trustradius, Class Central and others, following there is a comparison on 5 popular LMS vendors present on the market: Moodle, Sakai, Canvas, Open edX, and Blackboard.

5.6 Basic parameters for comparison

Each of these 5 LMS share the following basic parameters:

- Create Self-Registration – the automated self-registration feature is useful for targeting a large pool of learners and reduces the administrative work for the project partners (UNITO) and trainers. Otherwise, registering a small class can be done manually.
- Create a Portal for Course Materials – single location of past and current course materials makes it easier to retrieve data, reuse materials, or organise courses.
- Create a Knowledge Base or Self-Service Portal – learners and educators will need assistance to use the LMS. A self-service section should address FAQs or collate best practises and case studies.
- Assemble Course Materials by Categories –to arrange the courses by topics, subjects, authors, or curriculum order to help learners and educators sort through the materials.
- Create Groups or Teams – this feature lets you conduct group classes, which is useful for group orientations or team workshops.
- Customise Course Delivery – the ability to customise the delivery of materials based on the student's learning curve can increase completion and competency rates.
- Create a Course Funnel – to offer programs where learners can level up or down across curricula or courses.
- Create Quizzes and Tests – to assess trainees' performance or competency before, during, or after the course program.
- Export/Import – to migrate, among others, course materials, reports, and registries to popular document files like PDF, TXT, JPEG, CVS, and DOC formats.

5.7 Advanced parameters for comparison

After having considered the basic aspects, the comparison was made focusing following these advanced parameters:

- Popularity and use,

- assessments/Assignments/Grade Book availability,
- subscription and maintenance fees,
- calendar tool, discussion forum,
- multilingual capabilities,
- possibility of customization,
- ability to deliver content on mobile devices,
- synchronous and asynchronous conference tool,
- integration of applications of other companies, like MS office Package, communication tools
- data security and user privacy.

5.7.1 Moodle

Moodle is a learning platform designed to provide educators, administrators and learners with a single robust, secure and integrated system to create personalised learning environments. Powering tens of thousands of learning environments globally, Moodle is trusted by institutions and organisations large and small, including Shell, London School of Economics, State University of New York, Microsoft and the Open University. Moodle's worldwide numbers of more than 90 million users across both academic and enterprise level usage makes it the world's most widely used learning platform. With over 10 years of development guided by social constructionist pedagogy, Moodle delivers a powerful set of learner-centric tools and collaborative learning environments that empower both teaching and learning. A simple interface, drag-and-drop features, and well-documented resources along with ongoing usability improvements make Moodle easy to learn and use.

Moodle is provided freely as Open-Source software, under the GNU General Public Licence. Anyone can adapt, extend or modify Moodle for both commercial and non-commercial projects without any licensing fees and benefit from the cost-efficiencies, flexibility and other advantages of using Moodle. The Moodle project's open-source approach means that Moodle is continually being reviewed and improved on to suit the current and evolving needs of its users. Moodle's multilingual capabilities ensure there are no linguistic limitations to learning online. The Moodle community has begun translating Moodle into more than 120 languages (and counting) so users can easily localise their Moodle site, along with plenty of resources, support and community discussions available in various languages.

Moodle provides the most flexible tool-set to support both blended learning and 100% online courses. Configure Moodle by enabling or disabling core features, and easily integrate everything needed for a course using its complete range of built-in features, including external collaborative tools such as forums, wikis, chats and blogs. Because it is open-source, Moodle can be customised in any way and tailored to individual needs. Its modular set up and interoperable design allows developers to create plugins and integrate external applications to achieve specific functionalities.

Committed to safeguarding data security and user privacy, security controls are constantly being updated and implemented in Moodle development processes and software to protect against unauthorised access, data loss and misuse. Moodle can be easily deployed on a private secure cloud or server for complete control. Moodle is web-based and so can be accessed from anywhere in the world. With a default mobile-compatible interface and cross-browser compatibility, content on the Moodle platform is easily accessible and consistent across different web browsers and devices.

5.7.2 Sakai

Sakai is an open-source eLearning platform that can be used by small to medium-sized businesses or student groups. It may be widely adjusted to fulfil practically any need of both trainees and teachers by integrating with a large number of third-party modules and plugins. Some of its features, though, are cumbersome (many reviewers and commenters found its calendar a bit hard to use, work with media content rather complicated, email notifications hard to set up, etc.) Sakai may shine in the hands of a professional IT staff willing to push this LMS platform to its boundaries because it is open source.

5.7.3 Canvas

Canvas by Instructure is a LMS that prides itself on being simple, easy to use, and extremely adaptable. Canvas is a good choice for a small institution or a huge enterprise since it is mobile-friendly, allows strong student participation, and allows for easy progress tracking. However, many advanced features are only available for a fee, and you have to pay for personnel training while Canvas is being implemented; additionally, despite being declared open source, Instructure retains final control over Canvas development, so some specific modules may require in-house or third-party development.

5.7.4 Open edX

The Open edX platform is an open-source educational effort developed by organisations and educational institutions around the world, including MIT, Harvard, Berkeley, Google, and others. Open edX is fast gaining popularity thanks to its XBlock technology, which allows for easy content development and management as well as deep platform customization. The Open edX platform can be a wonderful alternative because it is easily scalable and configurable, and it is suitable for both corporate training and online learning. It comes with thousands of ready-to-use XBlocks, virtual laboratories for experimentation, and even a chatbot for better UX. For proper installation, you'll need a strong understanding of Ansible, Vagrant, and Virtualbox (either from your IT department or contractors), rather long process of setting up the Open edX Analytics system - Insights, certain inconvenience of student management, and absence of self-paced learning possibilities.

5.7.5 Blackboard

Blackboard is an online education market behemoth that has been around for 17 years and currently holds roughly 34 % of the market share. This long-standing eLearning solution includes a lot of features, a lot of support material, and clear setup directions, so it's a fantastic pick if money isn't an issue. Blackboard is a proprietary program, which entails active technical support, as well as a substantial subscription charge and the fact that platform development does not always follow the customers' expectations. Blackboard is also a conservative platform (difficulties with social integration, gamification and mobility). It's also not very configurable, but that's not something most educators and trainees want. What Blackboard is aimed at is a simple to use environment where studying and collaboration is an easy and interesting process.

6 Conclusion

In this report, several methodologies were considered: in person classes, online learning, microlearning, gamification, flipped classroom, blended learning, peer learning, on-farm demonstration activities, action-based and participatory learning. Considering the target groups and their different needs (farmers, students and farmers advisors), the types of learning (initial or continuous learning) and the topics, units and learning outcomes that will be developed in the curricula design, the involved partners preferred not to select a single methodology but a combination of those analysed here will be used, considering case by case the one that suits the needs of the moment.

Regarding investment costs, running costs and the personnel needed to run the platform the proprietary LMSs are no-longer a viable and cost-effective solution. The open-source LMSs are a better solution from financial point of view, involving less costs related to software licences and maintenance/upgrades, requiring not a well-developed infrastructure and, most important, offering the liberty to develop own LMS, based on own goals, own requirements and adapted to own necessities. Moreover, only web standard platforms (meaning technologies that don't require any special software) will be used in order to ensure the sustainability of the project.

Considering the aforementioned parameters and requirements Moodle was chosen as the LMS to be used to create the FIELDS training course, especially taking into consideration:

- Popularity and use: 90 million users across both academic and enterprise level usage makes it the world's most widely used learning platform with the most free and well-documented resources available.
- Subscription and maintenance fees: Moodle is provided freely as Open-Source software without any licensing fees.
- Multilingual capabilities: The Moodle community has begun translating Moodle into more than 120 languages (and counting) so users can easily localise their Moodle site, along with plenty of resources, support and community discussions available in various languages.
- Possibility of customization: Because it is open-source, Moodle can be customised in any way and tailored to individual needs. There are many plugins already created and ready to use to increase its capabilities
- Data security and user privacy: Committed to safeguarding data security and user privacy, security controls are constantly being updated and implemented in Moodle development processes and software to protect against unauthorised access, data loss and misuse

It should also be considered that UNITO has effectively utilised Moodle in past projects and has consequently acquired the necessary skills to properly manage the full setup of the platform and its maintenance.

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