D.E.L.T.A.

Drones:

Experiential Learning and new Training Assets

Intellectual Output 5

SCIENTIFIC PROGRAMME

DELTA DRONES

Experiential Learning and new Training Assets

Date of release of the final version: July 19th 2019

The project is funded by ERASMUS+ Programme of the European Union through INAPP Italian National Agency. The content of this material does not reflect the official opinion of the European Union, the European Commission and National Agencies. Responsibility for the information and views expressed in this material lies entirely with the author(s). Project number: 2016-1-IT01-KA202-005374

Index

Partners' List

NO.	PARTNER	SHORT NAME	COUNTRY
P1 - COORDINATORE	**CISITA PARMA Scarl**	CISITA	Italy
P2	Aerodron Srl	Aerodron	Italy
P3	IIS "A. Ferrari"	Ferrari	Italy
P4	IISS "A. Berenini"	Berenini	Italy
P5	IISS "C.E. Gadda"	Gadda	Italy
P6 **LEADER DI OUTPUT**	**Centro Público Integrado de Formación Profesional Corona de Aragón**	Corona de Aragon	Spain
P7	Fundación AITIIP	AITIIP	Spain
P8	Liceul Teoretic de Informatica "Grigore Moisil"	LIIS	Romania
P9	SC Ludor Engineering Srl	LUDOR	Romania
P10	Universidade Portucalense Infante D. Henrique – Cooperativa de Ensino Superior Crl	UPT	Portugal

Introduction: why Drones

At the threshold of 2020, the EU scenario in terms of education and vocational training shows a gap: on the one hand, the strong pressure of the labor market which is the constant and growing search for profiles with strong STEM skills (mathematics, science, techniques and engineering); on the other hand, there is an inadequate level of STEM skills in the secondary cycle student population, in which about 22% is below the average of skills and knowledge with respect to their European peers, with peaks of 36% in the case of a partner disadvantage -cheap. A gap that widens further if we consider the gender gap, due to the fact that a still insufficient number of girls approach the technical-scientific culture.

As a result, while 90% of jobs in the next 10 years will require STEM skills, with over 7 million jobs available or being created in this area, it is estimated that the disalignment between education and the labor market costs to the EU the lack of 825,000 skilled workers.[1]

To tackle these critical issues, the EU 2020 strategy, already expressed in the "Joint Report of the Council of the ET 2020 - New priorities for European Cooperation in Education and Training (2015) focuses on a innovative concept of education and training:

- hoping for an educational process more focused on the learner and personalized, also with a view to overcoming the gender disparity in access to the fields of knowledge STEM
- betting on technology as a tool able to connect theory and practice, STEM subjects and concrete objects in the physical space, as well as the training path and the career path
- rehabilitating and enhance non-formal and informal learning paths, to complement traditional theoretical and frontal learning
- Work-based learning is promoted in the form of self-managed project work by learners, as a tool to recover and reinforce the motivation of disadvantaged students or students with low academic performance
- A new role is proposed for VET teachers, who become facilitators and mediators of the learning process, rather than knowledge providers, also thanks to the updating of teaching and pedagogical methods

[1] Sources: Eurydice report “Sviluppo delle competenze chiave a scuola e in Europa: sfide e opportunità delle politiche educative”; Eurydice Europe Report “Structural Indicators for monitoring education and training systems in Europe – 2016”, cft Eurostat, section “Education & Training”, “Europe 2020 indicators”.

From these assumptions the idea of the DELTA project was born, which aims to make an innovation contribution to technical and professional training courses at European level, promoting the learning of the STEM curricular disciplines through the work based learning methodology, through the use of harmless drones as a technology in use.

It should be pointed out right away that drones are not the end of learning, but the means that allows secondary school students to deal with mathematical-scientific disciplines, often perceived as difficult and discouraging, through a technology applicable to concrete aspects of everyday life , transferable to a context of participatory and collaborative learning, in which students are placed in a community of practices in which they take personal responsibility for and personalize their study path.

According to MIT Technology Review of 2014 (10 Breakthrough technologies) the drones would have become one of the 10 technological innovations with the greatest impact on the world economy, and the forecasts were not slow to come true. Drones are proving to be strategic for many harmless and civil purposes: rescue missions after catastrophic events, such as earthquakes and the transport of life-saving drugs; mapping of buildings to identify risks related to asbestos; environmental monitoring to avoid deforestation and hydrogeological risks; security control in high-traffic public places such as stations, airports, events; border control; urban and interurban traffic monitoring; video footage for film and documentary activities; precision agriculture; transport and delivery of light goods.

The idea behind the project is the adoption of inoffensive drone technology as a means to improve STEM skills in VET students and to develop technical and professional skills that prepare them to enter the labor market more easily by strengthening their employability. The technology of drones is combined with many aspects present in the European STEM curriculum, easily exploitable and transferable in terms of construction of teacher-led educational programs, invested with a new role of facilitator of learning, bringing theory to laboratory practice. The application of STEM theory to a real object will help teachers to involve and motivate students, especially those with low profit and / or special needs and learning difficulties. In fact, it is believed that VET students are more inclined to learn theoretical concepts through practical activities than through traditional teaching methods in which the teacher only explains concepts and assigns tasks and exercises.

On the basis of STEM educational programs developed by the teaching staff in a teacher-led perspective, the students cooperated in a community of practices inserted in a situated learning context that simulates the work-place, to study, disassemble and build inoffensive drones or parts of they, according to a logic of work-based learning.

This was possible thanks to the strategic cooperation implemented within the partnership, established on the basis of the following criteria:

a) By type of partner

Education side

- Coordinator Cisita Parma, training institution with skills in planning training and learning paths
-5 VET schools selected from 3 EU countries (Italy, Romania, Spain), equipped with technical, professional IT, electronic, mechanical-engineering, scientific curriculum
-1 University (Universidade Portucalense, Portugal) equipped with Department of Computer Science and researchers in the field of digital technologies for situated learning

Business side

-1 company expert in the development of digital applications for the use of drones in civil and industrial (Italy)
- 1 engineering firm expert in automotive solutions, as well as development of engineering applications for learning purposes (Romania)
- 1 research center expert in technological applications on plastics, engineering and automotive, also in aeronautics (Spain)

b) By combination on a territorial basis and by logic of "industrial chain":

working groups have been set up at national level to facilitate collaboration thanks to regional and linguistic continuity.

In particular, the following nerve centers have been identified:

Italy

1 training institution with skills in planning training and learning (Coordinator Cisita Parma)

3 VET schools located in the Emilia Romagna region specialized in engineering and electronic disciplines

1 company expert in applications for the drone industry

Romania

1 VET school specializing in computer science and programming

1 company expert in technological, engineering and digital applications

Spain

1 VET school specializing in industrial chemistry, engineering and automotive disciplines

1 research center expert in technological applications on plastics, engineering and automotive, also in aeronautics

Chapter I. D.E.L.T.A. project: aim and structure

Based on the discussion, D.E.L.T.A. following fundamental objectives have been set:

- Tackling phenomena of school dropout and student motivation, implementing teaching strategies that favor the acquisition of STEM disciplines according to an experiential and practical approach more suited to the learning style of VET students
- Familiarize VET students with inoffensive drone technology, as a pretext for the practical application of formal mathematical-scientific languages traditionally taught with a theoretical approach
- Create learning environments in situation, thanks to the co-planning, by educational institutions and companies, of a work-based learning setting, organized according to the production / industrialization logic of a drone
- Strengthen the professional skills and employability of VET students
- Updating and strengthening the teaching skills and methods of VET teachers and trainers, through the full integration of technological tools, digital applications and their potential

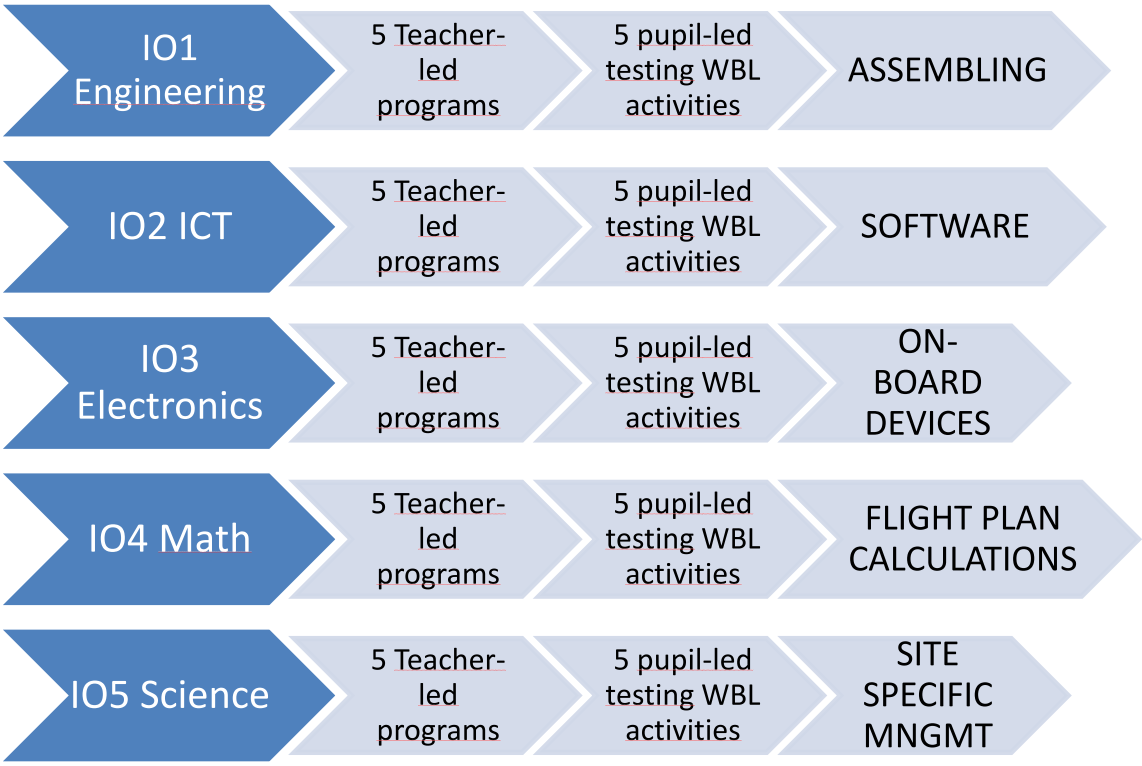


Figure 1 – General structure of D.E.L.T.A. project

The general structure of the D.E.L.T.A. project has planned to proceed according to the logic of the industrialization of a harmless drone, identified in the phase of operational co-planning thanks to the synergy between educational and training institutions on the one hand (P1 Coordinator + P10 University of Porto), and on the other the business oriented partner with special reference to P2 Aerodron by virtue of the specific skills of the sector.

In production, in fact, a harmless drone must be:

1) Designed, manufactured and assembled

2) Configured from the point of view of the software, determining the conditions for the study and processing of data on the ground

3) Configured from an electronic point of view, identifying and implementing the devices to be installed on board

4) Scheduled to follow the correct flight plan trajectory

5) Planned to carry out a mission identified according to a useful application for civil and / or industrial purposes.

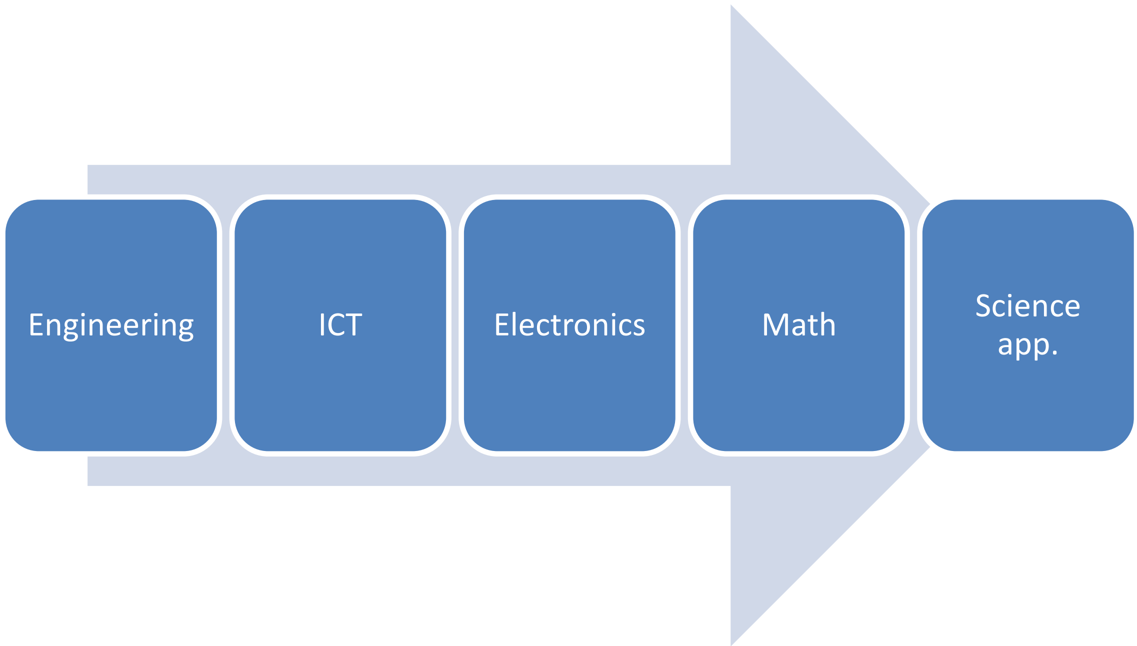


Figure 2 – the process of industrialization of an inoffensive drone

Each of these phases can be easily implemented in a context-based learning context, organized through the teaching methodology of work-based learning from a pupil-led project work perspective, based on the collective and laboratory resolution of a concrete problem.

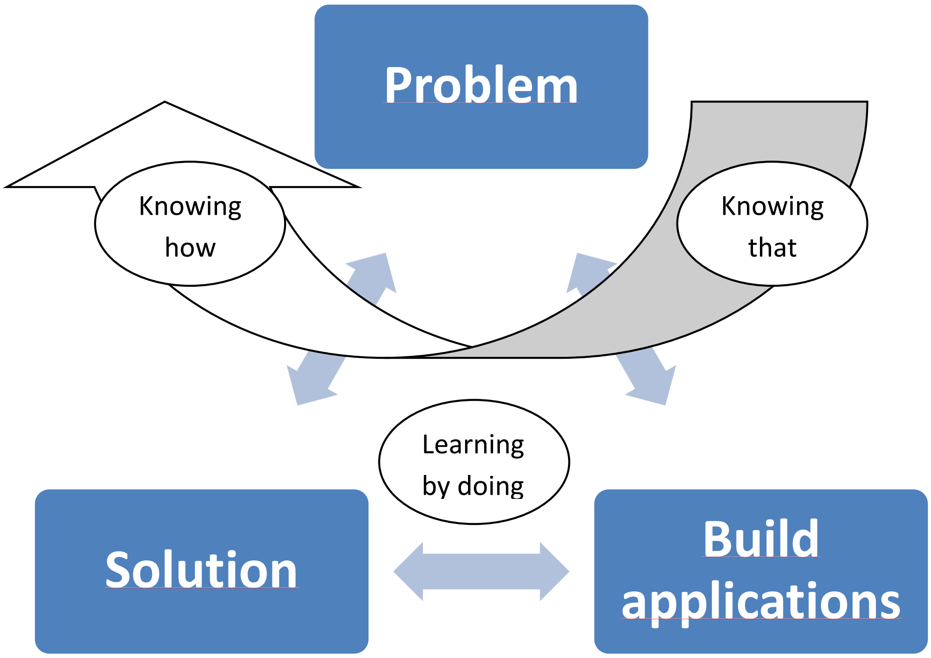


Figure 3 – Scheme of application of Work Based Learning didactic methodology

The students, organized in work groups that identify an emerging community of cognitive apprenticeship practices, are confronted with a concrete problem to be solved, linked to the construction or study of a harmless drone or its components. Immediately they must activate prior knowledge related to their informal or non-formal knowledge, as well as to formal languages learned in the institutional educational context, cooperating to identify applications, strategies and techniques to obtain the solution to the problem faced. In this way they pass from "knowing what / to" to "knowing how" a phenomenon occurs or manifests itself.

Each phase of the drone industrialization process lends itself to multiple modes of use within the VET educational curriculum, since it requires the study and mastery of formal mathematical-scientific languages, both the predisposition of a learning environment that simulates the organization socio-technical work-place.

Through the phases of the D.E.L.T.A. project, thanks to the interdisciplinary approach, the VET students were able to develop:

a) Professional skills relating to key technologies of the digital age, such as information technology for on-shore processing of data collected by the in-flight drone (IO2) and electronics for the assembly on board of aircraft of cameras, components of sensors (multi-spectrum, thermal, "sense & avoid" vision for in-flight interaction) and geolocation (IO3);

b) STEM curricular competences: engineering for the design, production and maintenance of inoffensive drones (IO1); mathematics, through trigonometry for setting the flight plan, and 3D modeling through the point cloud for volumetric calculations and remote sensing (IO4); physical and natural sciences to contextualise the problems that can be faced thanks to the technology in use - such as precision agriculture, environmental and hydrological monitoring (IO5).

Capitolo II. Intellectual Output 5 – Scientific Programme

The Output consists of a set available for reuse, released in OER (Open Educational Resource) mode, of educational experiments related to the study of the main thermal, biological and site specific management phenomena underlying the main innovative applications of drones. The possible study activities are multiple and may concern, but are not limited to: islands of heat in the atmosphere, heat dissipation from buildings or solar panels, heating of mechanical organs of plants, phytosanitary status and crop maturation, hydrogeological instability, management of water resources and use of fertilizers in precision agriculture, detection of air pollution levels and of maritime, river or lake water.

The activities of the Intellectual Output are substantiated in a teacher-led educational program, relating to the subjects of scientific area present in the training offer of each VET institute involved (chemistry, biology, natural sciences, earth sciences, physics) for the performance of the disciplinary school curriculum in work-based mode. The program prefigures the conditions for the repeatability of the experimentation and for the pedagogical organization of the work-based learning setting, so that it is as self-managed as possible by the students in project work pupil led mode. An integral part of the Output are the physical objects and the products of experimentation, documented through videos and photos of the situated learning environment.

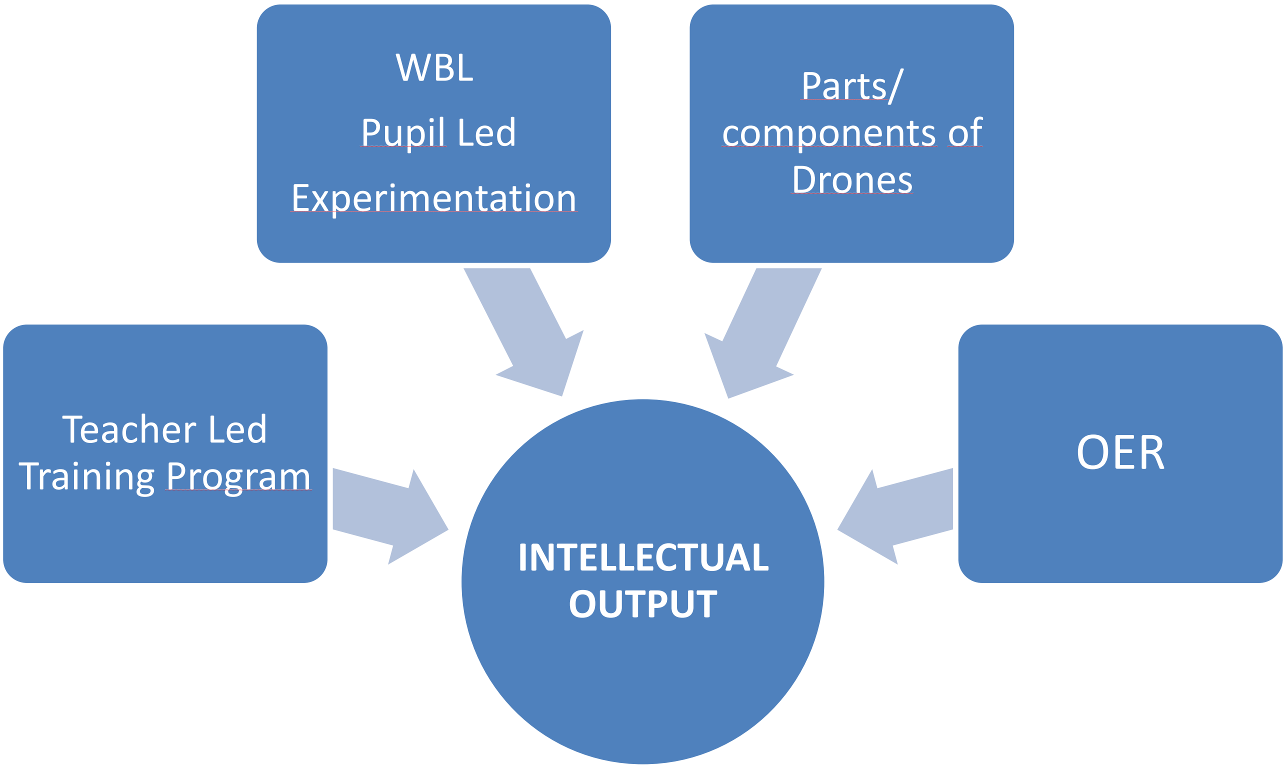


Figura 4 – Structure of the Intellectual Output

Intellectual Output 5 is composed of three distinct operational phases: Design - Test - Release, each identified on the basis of the key target groups, the organized educational and pedagogical environments, the technologies adopted and the activities actually performed. Leader of Output 5 is identified in P6 CPIFP Corona de Aragon of Zaragoza, Spain, VET institute of secondary and tertiary level, by virtue of the specialization course in Environmental Chemistry and Industrial Chemistry present within the training offer.

Phase	What	Who
Phase 1. DESIGN	1.1 Definition of the Learning Objectives 1.2 Design of the Training Programme 1.3 Didactic design of the experimentation	Leading Partner P8 together with P1 defines the guidelines for the identification of the learning objectives All schools identify Learning Objectives and plan the experimentations

		Business Partners support schools in the Design and creation of the work-based learning setting
Phase 2. TESTING	2.1 Testing 2.2 Monitoring & feedback	All schools with the support of business partners
Phase 3. RELEASE	3.1 Fine tuning of the Training programme for validation and replicability 3.2 Release in form of OER	All schools

The theoretical approach and the methodological framework that supports the educational experimentation of the Intellectual Output finds its scientific model in the theory of the Activity Sector of Yrjö Engeström (1987). According to this model, the learner in his learning path is confronted with physical objects (the drone in this case) and technologies (mechanical and engineering for IO1) that represent the tools for solving a practical problem that the field of activity proposes. The solution, the new object or the new technology in outcome represents the result of the activity itself. However in this learning process the learner is never alone, but in the field of activity he finds himself inserted in a community of practices, in which other learners live together at the same level, with which he can exchange knowledge and skills according to a peer-relationship. to-peer, as well as trainers and teachers who perform a scaffolding function supporting and facilitating the process of acquiring skills. In this community of practices there are explicit rules and tacit conventions of behavior, hierarchically or more fluidly structured relationships, based on the sharing of responsibilities, tasks and supervision of the same or different technologies. For this reason it can be stated that in the upper part of the framework of the field of activity, which represents the tangible and visible part of the practice, the so-called "hard skills" or technical skills emerge, while in the lower part, submerged and less visible but from the strong influence on all the actors involved, there are the so-called "soft skills" or relational skills.

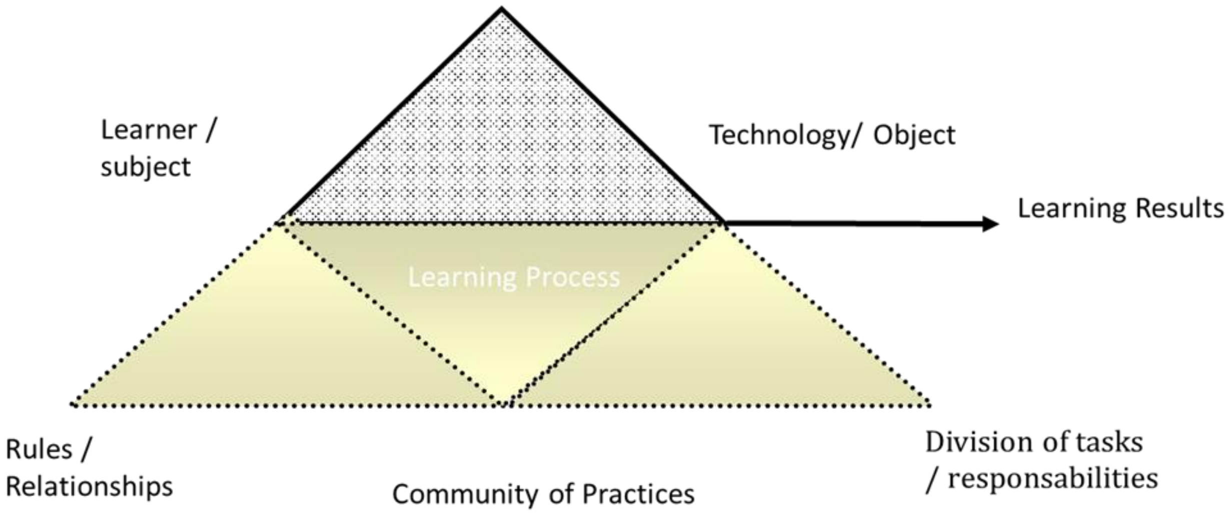


Figure 5 – Grafic representation of the activity theory by Y. Engestrom

The target groups involved in the field of activity exceed the traditional boundaries of the school class, because they involve multiple actors at various levels of responsibility and effectiveness:

- Target group 1: VET students, normally attending the upper three-year course of the secondary cycle, enrolled in mechanics, maintenance and technical assistance, electronics and automation, IT and programming courses. The involvement of an entire class group was planned for each school (around 20/30 students) or an interdisciplinary learning group was established from different classes. A significant part of the learner group was selected based on the condition of greater socio-economic disadvantage and risk of school exclusion due to low performance or motivation.
- Target group 2: VET teachers and trainers with teaching assignments for technologies and mechanical design and electronic plant engineering. Teachers responsible for planning the school curriculum were also involved, as well as those responsible for work-placement activities and curricular internships in local companies. At each VET partner school, a working group specifically dedicated to overseeing the activities of the D.E.L.T.A. project was set up within the teaching staff.
- Target group 3: entrepreneurs and technicians of partner companies, in which a working group composed of experts in applications related to drones, engineering and automotive solutions, as well as business tutors responsible for welcoming students in training during curricular internships, or those responsible for recruiting new workforce.

II.1 Implementation of the SCIENCE programme applied to drones

The activities of each of the 5 participating VET schools will be summarized below, illustrating the objectives, contents and structure of the experiments. Information will be provided on the pedagogical organization of the work-based learning environment, the target group of students involved, the duration and some indications on the curricular objectives achieved or not achieved.

OUTPUT LEADER

P6 Centro Público Integrado de Formación Professional "Corona de Aragon", Zaragoza, Spain

https://www.cpicorona.es/web/

This is a VET institute that offers a professional two-year course as the last cycle of secondary education, accessible to secondary school graduates (aged 16 and over). The institute also welcomes workers who wish to retrain professionally or add / update their technical skills, in day or evening mode. CPIFP offers, among others, the following study addresses:

- Industrial Mechatronics
- Production planning in mechanical manufacturing
- Electrotechnical and automated systems
- Civil Construction
- Environmental Chemistry
-Industrial chemistry

By virtue of the vocational training offer in environmental chemistry and industrial chemistry, both at secondary and post-secondary level, P6 has assumed the role of Output leader in order to identify and implement the possibilities of teaching use of the study of sciences applied to drones , from the point of view of concrete applications at industrial, civil and real life level.

CPIFP presented its partners three different professional areas for the possible implementation of the educational program:

Thematic Area 1: Civil Construction

The drones can be used to take photographs and shoot, whose images, suitably processed through photogrammetry programs and the use of the thermographic chamber, can provide valuable information on the dissipation of heat from buildings, with particular attention to monitoring parts such as windows, doors or energy-efficient coverage.
The technology allows accurate measurements of the surface temperature of an object without physical contact with it thanks to electromagnetic radiation within the range of the infrared spectrum reflected by it. The incorporation of a thermographic chamber among the instruments of the drone thus opens the way to the innovative field of application of aerial thermography.
The same procedure can also be applied to monitoring the heating of mechanical components of an industrial plant.

Thematic Area 2: Environmental Monitoring

It is possible to equip the drone with instruments for collecting water samples, taking it from rivers, lakes, water basins or from the sea, to subsequently conduct chemical analyzes of the level of pollution.
A similar operation can be carried out for the monitoring of air quality, through the collection and sampling of fine dust (PM 10) in the atmosphere.

Thematic area 3: Precision agriculture

Drones can also be used in agriculture to speed up and automate operations that traditionally need more time, such as fertilization or irrigation. On a more advanced level, the technology of drones allows to fly over crops, acquiring images that, once processed, can return a scan of the plots useful to identify any problems related to the state of maturation or to any phytosanitary problems of the crops themselves.

Starting from the approaches described above, due to the specialization in Environmental Chemistry present in the training offer and to the specific competences in the sector of the team of teachers involved, P6 has chosen to implement the educational program proposed by the thematic area # 2, related to monitoring environmental.

The experimentation was organized according to a theoretical-practical blended approach, structured as follows:

1a. Frontal lesson dedicated to the collection and measurement systems of chemical contaminants of water and air

1b. Instruction session dedicated to sampling tools (active, passive), to bioindicators as well as to automated collection systems and remote sensors

2a. Set-up and preparation of devices to be installed on board the drone to take the samples to be analyzed

2b. Conducting the drone's mission: flight phase management and calibration of the sampling operations

3b. In situ chemical analysis

The learning setting of work-based learning is documented with a self-produced video, publicly available on the official YouTube channel of the D.E.L.T.A. Project at the following address https://www.youtube.com/watch?v=WWvFHply13s

Students involved:

About 20 students belonging to the 1st year of the professionalization course in Environmental Chemistry. These are students who have already completed the first cycle of upper secondary education, or learners seeking professional retraining.

Duration of the design phase: approximately 10 hours

Duration of the testing phase: about 20 hours

Learning objectives

School subjects	Training programme	Learning objectives

Water purification Organization and management of environmental protection Control of atmospheric emissions [Within the post-secondary course (Upper Degree) in Environmental Chemistry]	- Training on the various equipment used to take air / water samples. - Training on the various equipment used to analyze air / water samples. - Training on the possibility of using instruments for sampling and measurement on board drones: differences, advantages and disadvantages with respect to traditional methods of collection and analysis - Training on cleaning techniques, assembly and connection of the probes and of the instrument for measuring the pH to the drone, as well as for the preparation of various liquid samples. - Instructions on driving the drone in flight and performing safe sampling and pH measurement in liquid samples and CO (ppm)	- Identify, use the tools to take and / or analyze liquid or gaseous samples from the environmental system - Conduct chemical analyzes of the collected environmental samples -Use drone technology to take liquid or gaseous samples from the environment

Organizzazione dell'ambiente di apprendimento secondo l'approccio del work-based-learning

Didactic methodologies% **Tools**	**Work – based learning setting**
Theoretical and frontal lectures 50% An in-depth explanation was provided of the various possibilities and equipment for sampling and analyzing samples using drones (dosimeters, bags, pH meters, probes, ...). Practical and group activity 50%	The experimentation took place within the modules of the course of study dedicated to Environmental Chemistry, in which students must develop skills related to the collection and analysis of samples of air, soil, waste or water: an innovative way of making such withdrawals is represented by by drone technology. - Scaffolding: school systems are based on different industrial modules provided by teachers with heterogeneous skills. CPIFP to coordinate all the training

A general explanation was provided of how a drone works, how to connect all the devices to measure different parameters and how the acquired data is processed by specific software Technologies and tools used: Drone equipped with pH meter and CO measurement probe Other measuring equipment such as humidity probe, dosimeters, bags for taking and storing air, gas syringes, filters and microbiological sampling manifold.	organizes a weekly meeting with a teacher in charge of general coordination. - Relationships: students learn and need to work in groups. Teachers support and monitor the development of skills

The scaffolding roles of situated learning:

a.scaffolding figures identified within the school staff and their professionalism:

A professor of mechanical and industrial engineering, expert coordinator of innovation projects and organization of work based learning sets, both in the upper secondary cycle and at the University of Zaragoza

2 professors expert in Industrial Chemistry and Environmental Chemistry

Certified UAV pilot for vehicles up to 5 kg

b. Scaffolding figures identified outside the school context:

1 professional of the P7 business partner AITIIP of Zaragoza, with experience in co-designing learning environments that simulate industrial design in the automotive and aeronautical fields

1 tutor of the University of Zaragoza, expert in mechanical engineering projects and industrial applications, with experience in designing learning environments according to the work-based learning de approach by virtue of the following professionalism and technical skills

P3 IIS "A. Ferrari", Maranello (Modena), Italy

https://www.ipsiaferrari.mo.it/

This is the VET institute originally founded by Enzo Ferrari as a training center for the technicians of the renowned car manufacturer, and subsequently transformed into the State Professional Institute. Currently it includes 3 professional addresses for the five-year diploma (Car-repair, Maintenance of Transportation, Maintenance and Technical Assistance) and 1 address for the technical diploma (Transport and Logistics, Articulation of Construction of the Means of transport).

As for IO5, P3 Ferrari has decided to take advantage of the strong skills in mechanical design and assembly present in its faculty and in its students, completing part of the program already started at IO1. In the phase dedicated to the Engineering program, in fact, the project team opted for the Reverse Engineering approach of a Drone model built by graduate students in the previous school years, chosen to focus the attention of teachers and learners on effective understanding of the drone design and assembly aspects. In the subsequent phases of IO2-IO3, therefore, P3 carried out educational experiments related to software programming and the sizing and testing of the electronic circuit on board the drone. Subsequently, in the context of IO4, IIS "A. Ferrari "organized a mathematical laboratory on the equations and functions of straight lines, applicable to the measurement of speed and rotation of multirotors.

By combining the learning outcomes related to IO1 (Engineering) and IO4 (Mathematics) P3 has developed its own IO5 (Science) program: using mathematical calculations and mechanical technologies to study the strength and physical properties of metals - in specific copper , brass, carbon fiber, fiberglass - to evaluate its proper use in the construction of a drone carcass. The program involved the Tecnologie Meccaniche curricular discipline preferentially with respect to the Physics and Mathematics discipline, to allow a better practical application, laboratory, experiential and pupil-led of the experimentation itself.

The program included a part of theoretical learning related to the mathematical functions related to the yield stress, the peak point and the breaking point of the materials, followed by a part of work based learning in which the students, using machines such as clamps and presses mechanical, were able to verify the resistance of the materials and the effects of the application of physical forces to each material.

The learning setting of work based learning is documented with a self-produced video, publicly available on the official YouTube channel of the D.E.L.T.A. Project at the following address https://www.youtube.com/watch?v=U4R-bPi6Yxc

Students involved:

About 30 students who have set up an interclass work group as part of the alternating school work activities, coming both from the professional addresses in "Maintenance and Technical Assistance" and "Maintenance of Transportation" and from the technical address in "Transport and Logistics - Articulation Construction of the means of transport ".

Duration of the design phase: about 10 hours

Duration of the testing phase: about 28 hours

Learning objectives

The primary learning objectives were defined based on the outgoing skills profile that graduates from the "IIS A. Ferrari" institute develop: at the end of the five-year course the students must achieve learning outcomes related to the educational, cultural and professional. Specifically, I am able to master the use of technological tools with particular attention to safety in the places of life and work, to the protection of the person, the environment and the territory; they must use result-oriented strategies, work by objectives and the need to assume responsibility in respect of ethics and professional ethics. Students are able to master the fundamental elements of the problem by making observations relevant to what is proposed using an appropriate technical language. Students must also cooperate in group work and engage constructively with teachers, peer groups and actors who participate in the learning community, while organizing their work, managing material and making judgments about their work .

Curricular learning objectives:

Curriculum subject T.M.A. (Mechanical Technologies and Applications):

Knowledge

Knowing the fundamental notions and operations related to forces and moments; Know the basic concepts of statics; Knowing the main characteristics and the use of the main materials used in the mechanical industry; Knowing how to read and correctly interpret the design of an assembly and be able to obtain the mechanical details; Knowing the parts of an electric motor; Knowing the magnetic forces that induce rotation in an electric motor; Knowing the specifications of the measuring instruments.

Capacity

Being able to apply the theoretical principles in the study of simple motor machines; Knowing how to read dimensional drawings with indications of tolerances and roughness; Knowing how to read technical manuals and find documentation from alternative sources to school ones; Knowing how to represent the mechanical organs treated during T.M.A. (Mechanical Technologies and Applications)

Curriculum subject Mathematics:

Knowledge

Connections and calculation of declarations: hypothesis and thesis; The principle of induction; Groups of real numbers; Imaginary units and complex numbers; Structures of numerical groups. Conics: geometric definitions and representation of Cartesian diagrams; Functions of two variables; Continuity and limits of a function; Periodic functions; The number π; Sinusoidal theorems and cosine; Exponential, binomial functions; Polynomial functions; Rational and irrational functions; Module function; Exponential and logarithmic functions;

Capacity

Frame problems and solve a problem; use of specific equipment; Analysis of the calculation models used; study of post-realization situations; Analysis of probable failures; Calculation of the probability of success; Analysis of the procedural systems used

Extracurricular learning objectives:

The general objective is to train students ready to take advantage of the skills acquired during the course in a professional way. The course is aimed at the acquisition of practical skills immediately applicable in the field.

Discipline T.M.A. (Mechanical Technologies and Applications):

Knowledge

Analysis of drone components and their functions; Stress analysis in the individual parts; Introduction to multirotors and their use.

Capacity

Creation of a new project through reverse engineering; Drawing (via CAD programs) the drone as a whole and draw up technical data sheets for the individual parts; Knowing how to assemble a drone; Making parts of the drone with different materials chosen from carbon fiber, copper, brass, fiberglass

Organization of the learning environment according to the work-based-learning approach

In class	Work-based learning At school
Frontal and theoretical lessons in the classroom -mechanical elements: machinery - mechanical systems - mechanical design	Premises: Laboratory of Mechanics, assisted design (CAD) Equipment: mechanical press; vice; PC, CAD drawing programs; Materials: metal samples in copper, brass, carbon fiber and glass fiber, supplied for this purpose by Metal T.I.G. of Castel San Pietro Terme, Bologna, specialized in the processing of carbon fibers, with which a partnership was activated relating to the project and other curricular stages); Conditions of logistical accessibility to the equipment:

	access to the specific equipment and materials for the project the teachers participating in the project and the students selected from the 3rd and 4th grade classes of the work group. All users have attended training courses on work safety

Scaffolding roles in the situated learning environment:

a.Scaffolding roles inside the shool staff and relevant professionalities:

In vocational education, scaffolding has always been an important teaching technique, reinforced by the role of ITPs (Technical Practical Teachers), support teachers and educators. In particular with respect to the D.E.L.T.A. project the scaffolding figures have had the purpose of:

- enhance pupils' experience and knowledge
- implement adequate interventions with regard to diversity
- to encourage exploration and discovery
- encourage collaborative learning
- promote awareness of one's own way of learning
- carry out educational activities in the form of a laboratory.

The teacher does not determine the learning mechanically. The teacher and the materials he proposes become resources within a process in which learning takes place in many complex ways.
The pedagogy of the project has turned out to be an educational practice able to involve students in working around a shared task that has its relevance, not only within the school activity, but also outside it. Working for projects leads to the knowledge of a very important work methodology on the level of action, the sensitivity towards it and the ability to use it in various contexts. The D.E.L.T.A. project, in fact, has been and can be a motivating factor, since what is learned in this context immediately takes, in the eyes of the students, the figure of tools for understanding reality and acting on it.

b. Scaffolding roles outside the school context:

1. Company Metal T.i.g. Srl of Castel San Pietro Terme (Bologna), with technical experts in the lamination and cutting of carbon fibers

2. Professionals of the P2 business partner Aerodron of Parma, by virtue of the following professionalism and technical skills

Founder & CEO of AERODRON. Electronical engineer, pilot.	Sales manager also responsible for public administration projects. Expert in technological innovation.	2 experienced UAV pilots, with a qualification recognized by ENAC. 1 pilot is also a geologist and an expert in photogrammetry and digital applications

P4 IISS "A. Berenini", Fidenza (Parma), Italy

https://www.istitutoberenini.gov.it

It is an institute with both VET study courses (Mechanical Technician, Electronic Technician / Automation, Chemical Technician) and high school (Scientific Applied Sciences option).

The project team decided to involve in the experimentation about 20/25 students of the VET address in Electronics / Automation, which also combines mechanical design skills with the knowledge of electronic circuits and systems and Arduino boards.

The course in Electronics / Automation does not require, once the two-year common area is completed, additional hours dedicated to natural sciences, physics and chemistry. However, the curricular subjects dedicated to automatic and electronic systems include aspects dedicated to the physics of materials, as well as various practical applications of chemical-physical aspects to civil and industrial circuits and automation systems. Starting from this assumption, P4 Berenini has decided to plan an educational experimentation on solar energy, including aspects of cosmology, spectroscopy and astronomical geography, applied to the use of photovoltaic panels for the production of zero-emission electrical energy for civil purposes industrial. Drones technology has played a trigger role with respect to this educational objective, through experimentation carried out in several phases:

1. Equipment of a DJI Spark drone, previously purchased, of a smartphone with a camera mounted on board
2. Exercise at school under the supervision of VET teachers: simulation of an incident with the positioning of people on the ground in a clearly life-threatening state, or an ascertained death. Assuming that the scene of the accident is inaccessible to emergency vehicles, the DJI Spark drone was guided so that it flew over the area and took some photographs.
3. Through the use of the 3DF Zephyr Software, it was possible to treat the images with photogrammetry techniques, creating navigable and measurable three-dimensional models, in order to extract information to support the decisions that hypothetically the rescue operators should take
4. Seminar meeting with the experienced pilots of the DIFLY company, based in Reggio Emilia, specialized in drone production and training on the main applications, with which a partnership

was established during the course of the project. Flight of the drone over the roof of the P4 Berenini school, in Fidenza, to take videos and images of the photovoltaic panels so far positioned
5. Image reprocessing using photogrammetric techniques learned during phase 3 (see above) for remote measurements of the width, height and depth of the different sections of the roof area. CAD design of possible integration and extension of the photovoltaic panel stock
6. Study of the conversion rate of solar energy into electricity at the current state of photovoltaic panel inclination. Study of the inclination of solar rays for the optimization of energy performance. Study of the sun, spectroscopy and nuclear reaction processes.

The learning setting of work based learning is documented with a self-produced video, publicly available on the official YouTube channel of the D.E.L.T.A. Project at the following address https://www.youtube.com/watch?v=9hZNSec0kuI

Students involved:

n 20 students of the Technical Electronic and Automation (class IV)

Duration of the design phase: approximately 8 hours

Duration of the testing phase: about 20 hours

Schools subjects	**Training programme** **Duration**	**Learning objectives**	**Didactic methodologies %** **Tools**	**Work – based learning setting**
Technologies and Design Maths Automatic systems	MODULE 1: solar radiation and its dependence on the inclination of the earth's axis, from latitude and longitude and from date and time (8 hours) MODULE 2: nuclear fusion (4 hours)	MODULE 1: evaluation of radiation on a plane MODULE 2: understanding of the physics of fusion MODULE 3:	Frontal lessons 40% Individual study 10% Study in groups 10% (students alone and in groups have studied the issues introduced at a general	The activity is carried out in the IT and electronics laboratories or outdoors Students are divided into working groups with leaders supported by the teacher Students work in a substantially autonomous way

	MODULE 3: photoelectric effect (8 hours)	understanding of the effect	level) Guided laboratory activities 20% (operational skills are introduced through simple guided experiences) Group work (pupil led) 20% Technologies and tools used: - personal computer - a DJI Spark Drone - calculation sheet to report the measurements taken on the scene of the accident and the roof of the school	between peers. The teacher intervenes only in cases of need.

The scaffolding roles of situated learning:

a.Scaffolding figures identified within the school staff and their professionalism:

2 professors of Electronics and Industrial Plant Engineering

- 1 electronic engineer

- 1 doctor in physics

With teaching skills in: Electronic and electrotechnical systems, automatic systems and industrial plant engineering

b. Scaffolding figures identified outside the school context:

- business professionals from partner P2 Aerodron di Parma, because of the following professionalities and technical competences

Founder & CEO of AERODRON. Electronical engineer, pilot	Sales manager and manager of public administration projects. Expert in technological innovation.	2 experienced UAV pilots, with a qualification recognized by ENAC. 1 pilot is also a geologist and an expert in photogrammetry and digital applications

- 1 pilot from DIFLY company (Reggio Emilia)

<u>P5 IISS "C.E. Gadda", Fornovo T. – Langhirano (Parma), Italia</u>

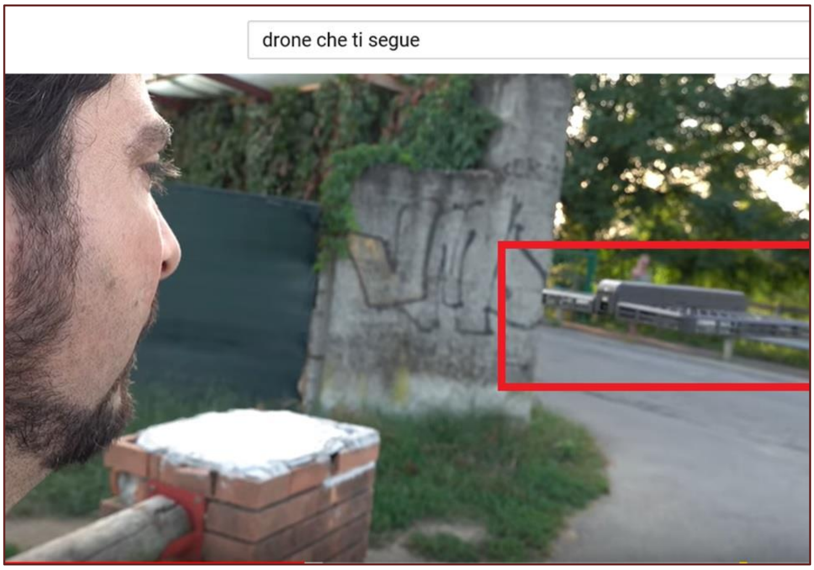
http://www.itsosgadda.it/

It is a school with two branches, with both VET (Computer Technician, Economic Technician and professional diploma in Maintenance and Technical Assistance) study addresses and high school students (Scientific Applied Sciences option, both four-year and five-year).
Both branches worked on the project, with two different approaches complementary to each other.

Fornovo Headquartes - Project Manager Prof. Luciano Amadasi

Given the vastness of approaches that the theme of science applied to drones offers, the team of teachers at the Fornovo site was inspired by a curious and widely known aspect compared to drone technology, or "the drone that follows you", to introduce the complex and multidisciplinary theme of neural networks (neural networks) and deep learning, relating to the even more vast and current topic of Artificial Intelligence.

The learning setting of the work based learning (Fornovo site) is documented with a self-produced video, publicly available on the official YouTube channel of the D.E.L.T.A. Project. to the following address https://www.youtube.com/watch?v=ap0MhU32wrE

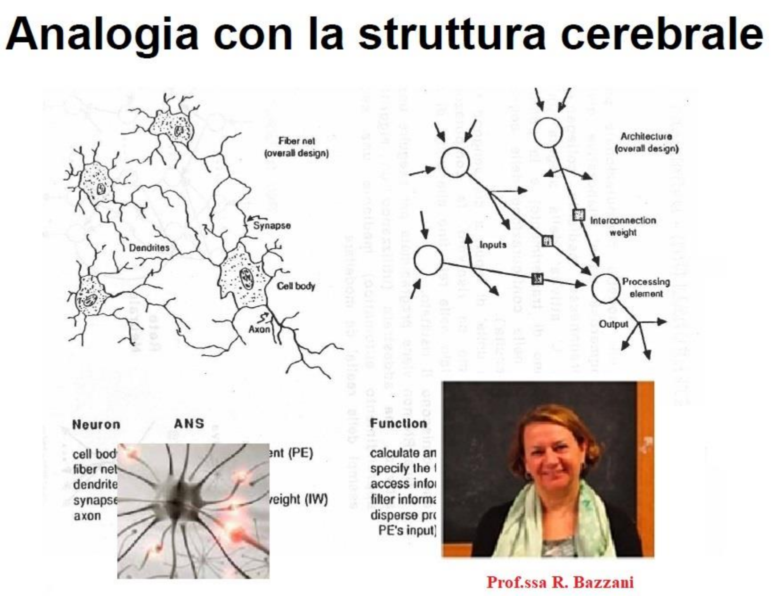


The topic of neural networks was proposed by P2 Aerodron photogrammetry experts during one of the transnational project meetings. The idea arises from the possibility of teaching the drone to recognize and pursue a moving target object thanks to a system of algorithms combined with a computer programming language (often Python), a mechanism called "neural networks".

Students involved:

about 20 students from the High School Applied Sciences Option

It is a subject that is difficult to deal with but of topical relevance. The technical aspects were carried out in a necessarily non-exhaustive manner as it was a third class of the High School Applied Sciences Option. Much importance has been given to the ethical and social aspects of the subject.

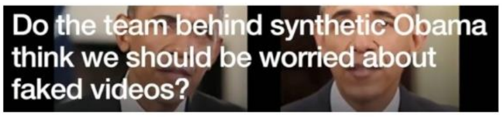


Learning Objectives and organization of the WBL setting

Curricular subject	Duration	Contents	Methodology	Learning Objectives
Extracurricular extension: Introduction to the ARTIFICIAL INTELLIGENCE theme in WBL mode *Dott. Ing. Francesca Ghidini* *Dott. Giuseppe Turchi*	4 hrs	Neural networks, deep learning, image recognition, artificial intelligence	Two meetings - conferences	Introduction of the concept of neural network both from a technical and ethical point of view. Students receive basic information for the philosophical analysis of the use of neural networks.
ICT	4 hrs	The origin of neural networks. Definitions, weak AI and strong AI. Teach. The structure of a neural network. Programming examples in	Frontal lesson in class ICT lab	Introduction to the functioning of neural networks: self-learning (feed forward, loss function, back propagation), levels, weights, biases, activation functions. Brief history of the subject (1943 Mac Culloch, and Pitt, 1950 Turing, 1956 Mac Carthy). Introduction to two applications:

		PYTHON.		YOLO V2 (image recognition) and fake news generation (Washington University).
Sciences (Chemistry & biology)	10	Biological neurons. The somatic nervous system, SNA, SNE. Propagation of the nerve impulse. The electrical and chemical synapse.	Frontal lessons, group work.	Biological neuron functioning: anatomy, synapses, action potential. Evolution of neural networks in the human brain https://www.ncbi.nlm.nih.gov/pubmed/24210963 Comparison between the functioning of an artificial neural network and a biological one.
Law	2	European Commission guidelines on the use of artificial intelligence.	Lezione frontale	European Commission guidelines on the use of artificial intelligence.
Philosophy	5	Reading of papers: ➢ *Moral dilemmas for the self-driving car* (https://ilbolive.unipd.it/it/news/). ➢ The Moral Machine Experiment (Nature, 24 ott. '18). ➢ *Norman, when artificial intelligence is psychopathic* (https://www.repubblica.it/tecnologia/). ➢ *Artificial intelligence and ethics: the problems to be addressed* (https://www.ai4business.it/intelligenza-artificiale). Framework and presentation of the standardization topic with quotations from: Tragedy "Antigone" (Sophocles). Art of the Rhetoric (Aristotle). Nomos and Physis (Protagora)	Guided discussion	Ethical-philosophical framework of the theme of artificial intelligence. Responsible use, risks of possible drifts, connected moral themes

Italian	10	Written themes, short essays and oral presentations on the topic of Artificial Intelligence	Discussione guidata, stesura di elaborati.	Personal and Group re-elaboration of all the knowledge acquired during the experimentation in the subject for the drafting of Italian papers and for oral argumentation.
English	5	A group of students produced a journalistic report in English on the work done by the class on neural networks. https://www.youtube.com/watch?v=xMTd2GDAVt0	Teamwork	Acquisition of terminology in English concerning the theme of neural networks and artificial intelligence



Prof. C. Memoli

Langhirano Heaquarters– Project Manager Prof. Francesco Bolzoni

The Langhirano site involved the students in the professional address in Maintenance and Technical Assistance and the students of the IT technical address. The students, guided by the teachers, have devised, designed and implemented a practical application tool for the use of inoffensive drones. The idea, which also led the students to plan a "mission" for the drone, consists in mounting a weather station for measuring the concentration of fine dust in the air (PM 10), to detect pollution levels at different heights from the ground.

The pupil -led project took place according to the following phases:

1. The students have programmed the control unit, rewriting the controls for the control software

2. Subsequently the programming data were saved on the SD Card, mounted on the ECU itself

3. Another group of students designed in CAD and printed in 3D, thanks to PLA filament, a box suitable for containing and protecting the control unit

4. The PLA box has been fixed on the drone and the control unit has been electronically connected to the PIXHAWK drone control system (see IO3 - electronics)

The implementation has been transformed into a business idea for the sale of pollution detection services addressed to local and European companies, and as part of the business simulation activities that fall within the Alternazione Scuola Lavoro for the 3rd class of the Scientific High School Option Applied Sciences of the same Gadda Institute. A simulated start-up called Third Air was created which won the 2018 Junior Achievement Italy competition. The Third Air guys also presented their business idea at the D.E.L.T.A. Project Final Meeting, held in Parma in May 2019.

The learning setting of the work based learning (Langhirano site) is documented with a self-produced video, publicly available on the official YouTube channel of the D.E.L.T.A. Project at the following address https://www.youtube.com/watch?v=_Gyfsb3iA5s

Students involved:

Langhirano headquarters:

n 10 students of the professional address in Maintenance and Technical Assistance n 10 students of the technical address in Computer Science and Telecommunications

Organization of the learning environment according to the work-based-learning approach

School subjects/ study courses addressed	**Didactic programme** **Duration in hrs**	**Learning objectives**	**Didactic methodology %** **Tools**	**Work – based learning setting**
Computer technology & Systems Mechanical technologies and applications Electronics	Work in business simulation: 32 hours per week, without interruption or strict distinctions between the subjects. Design phase: 6 hours	Systems: data record card design Informatics: C / Arduino programming and problem analysis Electronics: prototype construction Mechanics: CAD and 3D printing design Soft skills: I work in a multidisciplinary team with a view to project work (pupils of different fields of study) Collaboration and communication Problem Solving	Frontal lessons %5 Lab % 95 Technologies & tools Pc, Manuals and online examples, equipment for electronic prototyping (welder, tester, etc.)	- Personal Computer -Materials BME 280; PMS3003; NodeMCU v3.0; PC - Logistical accessibility conditions to the equipment: normal school hours, throughout the morning. - Scaffolding figures: laboratory teacher: supervision - Activated reports: between peers, company simulation

The scaffolding roles of situated learning:

a.Scaffolding figures identified within the school staff and their professionalism:

Electronics teacher *Engineer, STEM teacher for the class involved in the experimentation.*	Electronics lab teacher *STEM teacher for the class involved in the*	Mechanical technologies teacher *Engineer, STEM teacher for*

	experimentation.	*the class involved in the experimentation.*
Maintenance and technical assistance teacher. *Engineer, STEM teacher for the class involved in the experimentation.*	Technlogical lab teacher *STEM teacher for the class involved in the experimentation.*	Law teacher *Dealing with law and regulation about UAV's flight*
CAD Design teacher *Graphics teacher expert in CAD and 3D printing*	Maths teacher *STEM teacher for the class involved in the experimentation. Project manager*	ICT and systems & networks applications teacher *STEM teacher for the class involved in the experimentation.*

b. Scaffolding figures identified outside the school context:

- professionals of the P2 business partner Aerodron of Parma, by virtue of the following professionalism and technical skills

Founder & CEO of AERODRON. Electronical engineer, pilot	Sales manager and manager of public administration projects. Expert in technological innovation.	2 experienced UAV pilots, with a qualification recognized by ENAC. 1 pilot is also a geologist and an expert in photogrammetry and digital applications

-Ing. Francesca Ghidini, from the VISLAB laboratory, a start-up company founded as a spin-off of the University of Parma, an expert in artificial intelligence and neural networks. He took part in the "intelligent" car project, which drives itself without a human driver

-Dr. Giuseppe Turchi, Doctor of Philosophy, expert on the subject, author of publications and tutor of educational activities at the University of Parma. He assisted the P5 teachers in dealing with the ethical-philosophical implications of Artificial Intelligence

P8 Liceul Teoretic de Informatica "Grigore Moisil", Iasi, Romania

http://www.liis.ro/

It is a school of excellence in the field of technical studies in the field of information technology, systems engineering and programming. It is CISCO Academy's certified headquarters and every school year around a hundred graduates immediately enter the labor market of the Romanian Moldavian region, a constantly growing technological and IT hub.

The high school offers a solid and rigorous program of general culture, computer science and mathematics, physics, chemistry and biology faced from a purely formal and theoretical perspective.

To address the more practical, laboratory and work-based aspects of the DELTA project, the project team designed an afternoon club called "Eurodrone", which was configured as an optional extra curricular activity, which can be chosen by interested students on a voluntary basis , to which around 30 students have joined (with a fairly balanced proportion of males and females).

Learning Objectives

The activity continues the program started during IO2 and IO3, related to the construction of an app able to process and process images acquired by the drone, allowing the acquisition of environmental information (for example, a possible crack in the painting of the gym wall of the school).

During IO2 the students of P8 LIIS worked especially on the drone programming and on the construction of the database able to host images and information; in the course of IO3, on the other hand, the learners configured the drone circuit electronically.

Continuing with IO4, moreover, P8 has tackled the study of mathematics aimed at calculating and establishing the trajectory of the drone to optimize the acquisition of data (points in space related to the collection of data regarding the flight path; acquisition of images in flight) .

IO5 concludes the entire experimentation, completing all the preparatory work carried out in the previous Outputs, thanks to the 4 main activities carried out in it:

- Testing of the object detection system.

The drone must fly in automatic mode following a target within a small space

- Running of the object identification system

The drone must fly in automatic mode following targets moving within a larger space (school gym)

- Simulation on 3D Unity software platform of the drone flight path
- Image processing for the detection and measurement of physical data (detection of damp spots or cracks on walls, measurement of the size of cracks)

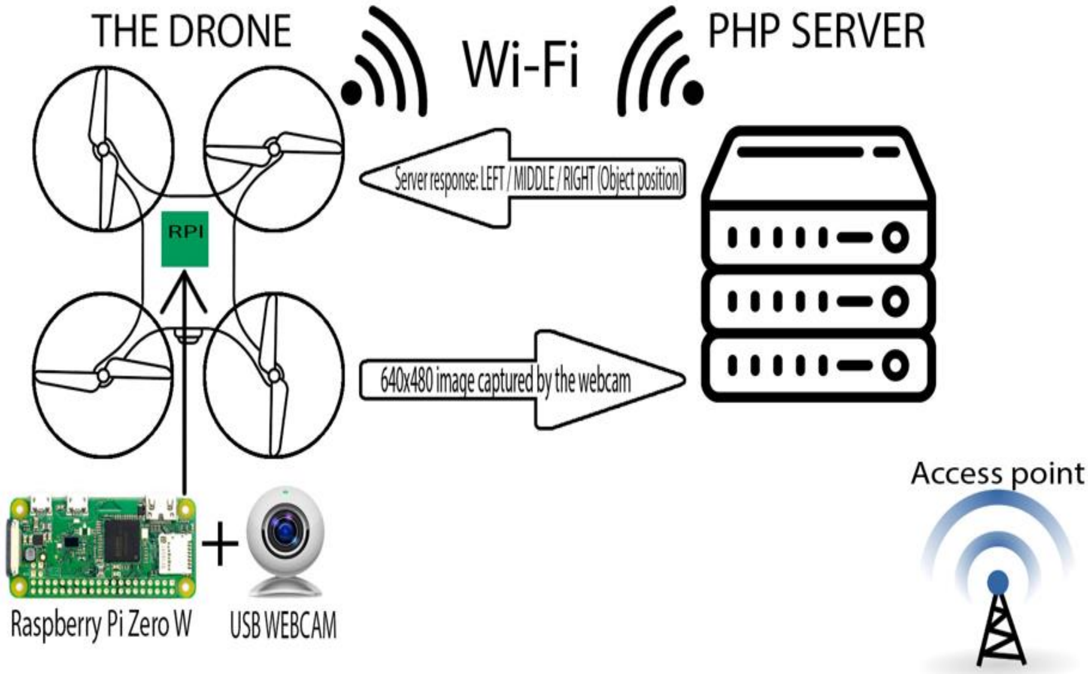


Figure 6 - The information captured by the camera on the drone is transmitted to the server, processed and again sent to the drone

Further objectives, related to the entire experimentation of the project D.E.L.T.A. as a whole they are:

Creation of a series of photos of the interior of a building (gym), images to be stored on the server, analyzed and introduced in a database to be observed in terms of possible defects or cracks in the walls.

Creation of a follow-up program and identification of the object according to a main colour or characteristic.

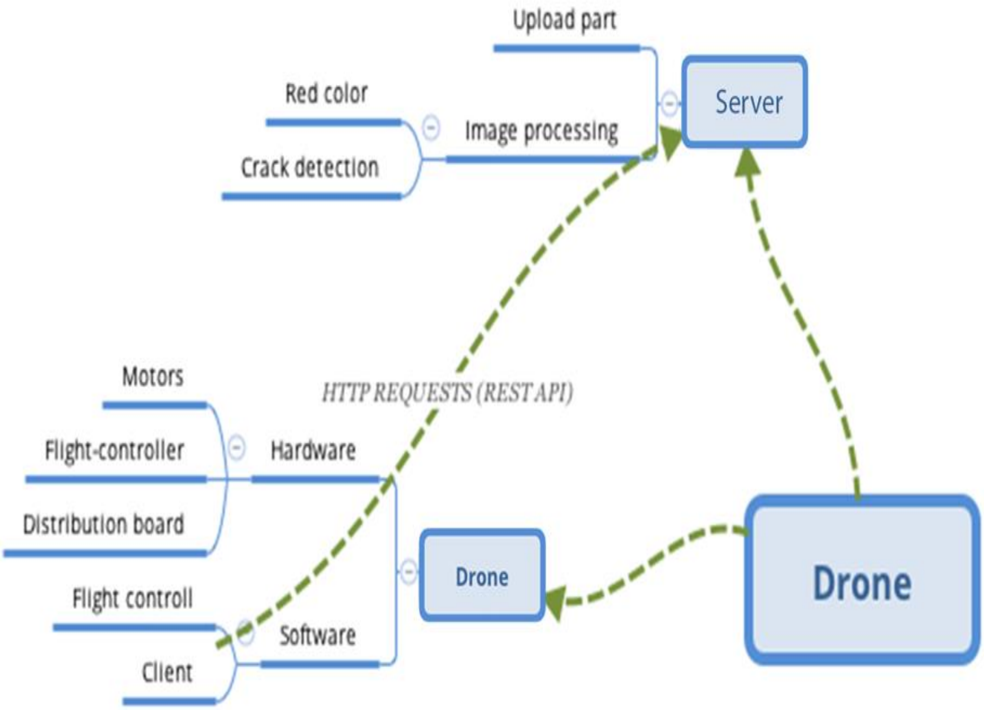


Figure 7 - Students devised brilliant and practical solutions for the use of drones in the study of cracks that can appear in the ruined parts of buildings. The students designed the flight controllers (balancing / calibration of the engine, accumulator connected to the drone and energy distribution for 4 engines (quadricopter)

Students involved:

About 30 students on a voluntary basis, generally selected among the most interested in studying in depth issues of industrial application, engineering and automotive, as well as 3D modeling

Duration of the design phase: 20h (4 weeks)

Duration of the testing phase: 30h (6 weeks)

Organization of the learning environment according to the work-based-learning approach

School subjects	Didactic programme	Learning objectives	Didactic methodologies%	Work – based learning setting

Drones' applications (18 hrs)	Formazione pratica per l'implementazione di applicazioni software per la rilevazione di imperfezioni e crepe nei muri, nonché per l'identificazione di colori e forme specifiche rispetto a un target predeterminato	Utilizzo delle applicazioni e del programma software dedicato Analisi e corretta interpretazione dei dati e delle immagini raccolte dal drone	Theoretical lessons 30% Lab 30% Team work (pupil-led) 20 % Individual study 20% Technologies and tools used: Measurement and control tools for information collected by the drone (Unity software) SERVER PHP LAPTOP DRONE Empirically collected list of possible imperfections of the walls of the	ICT lab Physics lab Scaffolder: Applied Physics teacher Network of relationships: students have the opportunity to contact the teacher in the presence or via email The horizontal network of relationships between parties within the working group allows to solve the simplest problems through self-diagnosis and search for collaborative solutions

			building to carry out the experiment (training and testing of the machine learning model)	
Use of platforms and IT infrastructures (server – drone – computer) (12 hrs)	Creation / simulation of risk situations (structural defects of the building; emergency situations in which it is necessary for the drone to follow a predetermined target, for example to identify a person to be rescued) and find solutions to solve them through the correct use of the IT infrastructure	Program the IT infrastructure necessary for the implementation of the target detection experiment: Drone / Server connection Use of Unity software to simulate the drone flight path	Theoretical lessons 30% Lab 30% Team work (pupil-led) 20 % Individual study 20%	ICT lab Physics lab Scaffolder: Applied Physics teacher Network of relationships: students have the opportunity to contact the teacher in the presence or via email The horizontal network of relationships between parties within the working group allows to solve the simplest problems through self-diagnosis and search for

				collaborative solutions

The scaffolding roles of situated learning:

a.scaffolding figures identified within the school staff and their professionalism:

1 teacher of English language, coordinator of the project and responsible for the pedagogical organization of experimentation, implementation and verification of learning objectives, as well as management of relations with the Coordinator P1 Cisita Parma for the monitoring of the project phases;

2 professors of Computer Science

1 IT lab technician

1 mathematics teacher

1 physics teacher

1 teacher of network and system engineering, CISCO / ORACLE instructor

1 professor of economics

b. Scaffolding figures identified outside the school context:

PhD Ing. Doru Cantemir, owner of P8 Ludor Engineering, expert in technological applications for educational and industrial purposes, 3D modeling, rapid prototyping and additive manufacturing.

II. 2 Physical products of the experimentation

IO5 consists of 3 distinct and complementary parts:

1) this document, which aims to provide guidelines for the replicability and transferability of the experimentation to another educational and training context, of any level, order and level

2) 6 videos documenting the work-based setting of the experimentation (2 videos for P5 Gadda and 1 video for each of the 4 VET school P3 Ferrari, P4 Berenini, P6 CPIFP and P8 LIIS), publicly available on the YouTube channel of the D.E.L.T.A. Project https://www.youtube.com/channel/UCoLeV-LZzAYRj7pr1wckprA

3) teaching materials useful for the replicability of experimentation such as presentations with technical specifications relating to the technologies adopted in IO5. The materials are publicly available at the shared link https://drive.google.com/open?id=1XeLrlmzIxC2uzl7vclCn77cr3jhwkqVo

In the folder called IO5 - Science it is possible to find:
a. The proposal of P6 CPIFP for the identification of didactic approaches for the application of drones to the study of Sciences
b. A P6 CPIFP document with details of atmospheric contaminants and the use of drones for their measurement
c. A presentation curated by P2 Aerodron for the didactic application of neural networks studied using drone technology
d. The path followed by P5 Gadda - Fornovo for the educational exploitation of drone technology, including the theme of neural networks
is. The presentation of the students who created the simulated start-up Third Air, an entrepreneurial idea that allows the use of drones to measure air pollution levels
f. The presentation of P3 Ferrari on the possible further use of drones for civil and industrial purposes

Final note

The Intellectual Outputs and the results of the project are released according to the international license Creative Commons Share Alike 4.0. The products are available for reuse, transfer and modification through adaptation, in the form of an Open Teaching Resource (OER - Open Educational Resources): any user interested in OER can download, modify and disseminate the Intellectual Output for non-commercial purposes, provided that credit is given to the author Cisita Parma scarl and provided that the new OER is shared according to the same license terms.

The project resources can be consulted and downloaded free of charge at the following channels:

Official multilingual website of D.E.L.T.A. project:
www.deltaproject.net
(Resources available in Italian, English, Spanish, Romanian and Portuguese)

Official YouTube Channel of Delta Project, where it is possible to view 30 videos dedicated to the work-based learning setting: each of the 5 partner schools has self-produced a video documenting the laboratory and experiential environment in which the students have materially produced or designed and studied drone components , for each of the 5 Intellectual Outputs envisaged (P5 Gadda produced 2 videos * Output, for each of its two Fornovo and Langhirano locations.

Shared folder on su Google Drive belonging to D.E.L.T.A. project account deltaeuproject@gmail.com , from which it is possible to download the didactic materials for each Intellectual Output, designed for replicability and transferability, at the address https://drive.google.com/open?id=1XeLrlmzIxC2uzl7vclCn77cr3jhwkqVo

Institutional website of Cisita Parma scarl, Coordinator of D.E.L.T.A. project
https://www.cisita.parma.it/cisita/progetti-internazionali/progetto-eramus-ka2-delta/
(Resources available in Italian, English, Spanish, Romanian and Portuguese)

National and international public repositories for OER – Open Educational Resources sharing:

OER Commons, digital library in English dedicated specifically to Open Educational Resources https://www.oercommons.org/

TES, British portal for free sharing of multidisciplinary teaching material, https://www.tes.com/

Alexandrianet, italiano portal for free sharing of multidisciplinary teaching material, http://www.alexandrianet.it/htdocs/

Further social updates are published onto:

Official D.E.L.T.A. project Facebook page @deltaeuproject https://www.facebook.com/deltaeuproject/

Institutional digital channels of the Coordinatore Cisita Parma scarl:

Facebook https://www.facebook.com/CisitaPr/

Twitter https://twitter.com/CisitaPr

LinkedIn https://www.linkedin.com/company/cisita-parma-srl/