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Guidelines for the implementation of the model

Project: **“Learning e-Mobility plus”**

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0.1 BASIC DATA

Proprietà intellettuale del documento	
Name and address of the Company	PIA SOCIETA' SAN GAETANO
Telephone / Fax	+39 0444933112 / +39 0444933115
E-Mail	segreteria@sangaetano.org
Internet	www.sangaetano.org

Proprietà intellettuale del documento	
Name and address of the Company	CONFARTIGIANATO VICENZA
Telephone / Fax	+39 0444392300 / +39 0444961003
E-Mail	info@confartigianatovicenza.it
Internet	www.confartigianatovicenza.it

Proprietà intellettuale del documento	
Name and address of the Company	EUROCULTURA
Telephone / Fax	+39 0444964770/ +39 0444189012
E-Mail	info@eurocultura.it
Internet	www.eurocultura.it

0.2 VERSIONE

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0.3 AIM AND APPLICATION FIELD

This document is aimed at teachers, vocational training centers and other subjects interested in the educational process realized in the frame of the project “learning e-mobility-plus” by the Italian consortium composed of Pià Società San Gaetano, Eurocultura. Confartigianato Vicenza. This document should be used along the “Guidelines for the portability of the model” where the problems found, some practical advice and the main working stages have been described.
Specific sections have been conceived for practice exercises (useful to evaluate the skills developed) and possible further developments (useful to adapt the model to new environments and deepen the beneficiaries' knowledge)

1. INSTRUCTIONS FOR THE REALIZATION OF THE LEARNING PROCESS

1.1 BENEFICIARIES AND INVOLVEMENT OF DIFFERENT PARTNERS

The formative process on e-mobility is aimed at 2nd and 3rd year vocational' students (or comparable) of the automotive sector. 1st year theoretical and practical prerequisites are necessary to take part into the project. The number of students can vary according to the requirements of the leading partner and the characteristics of the educational paths.

For the theoretical part a group of 25 is preferred; for the practical part, on the other hand, a group of 6-8 is more advantageous.

Meetings and opportunities for exchange with companies and partners have to be foreseen to develop the following contents.

Period	Subjects involved	Contents
Before implementation	Companies-teachers	Description of the project skills to be acquired
Before implementation	Companies-teachers	Definition of roles and contributions of partners
First stage	Companies-teachers - students	Presentation of the project to the beneficiaries, partecipation of the companies and students involvement.
First stage	Companies - students	Visits of companies belonging to the sector to learn the technologies applied
After planning	Companies - students	Students' presentation of the project to the companies; evaluation; suggestions; modifications.
After planning	Companies-teachers	Sharing of materials, technologies to be used and procedure to be followed
After implementation	Companies-teachers	Presentation of the projects to the partners, diagnostics and simulation of breakdowns
After implementation	Companies - students	Students' presentation of the project, underlining the procedure, the problems and the solutions found.
Final event	Companies-teachers - students	Final meeting and delivering of certificates of attendance to the students involved

Underway meetings with the companies have to be avoided since they could limit strategies of team working and problem solving as highlighted in the document attached ("Guidelines for the portability of the model")

Nevertheless ongoing exchange of views would be advantageous to modify potential mistakes or overcome technical difficulties. The chart above summarizes the most important phases of the process, which can be broadened and developed according to the characteristic of the final product.

1.2 INSTRUCTIONS FOR THE REALIZATION OF THE EDUCATIONAL PROCESS

1.2.1 PLANNING AND THEORETICAL COMPETENCES

Planning is the core of the model since it leads to the greatest cooperation among the partners and favours key skills such as team working and problem solving of both students and teachers.

During this phase it is necessary to involve and captivate the users on the proposed thematics, as to obtain efficient results with the next phases.

More phases are forecasted for the planning stage:

1) Selection of a group of students to realize the interventions. The model should obviously be developed at mechanics lessons, through basic competences (end of 2nd year) as for traditional vehicles.
2) Introduction of the activities to the students, preferably at the presence of companies' representatives, in order to discuss the choices involving the students inside the process.
3) Creation of material and booklets to provide the students with the theoretical contents of the model: this step is of high importance mostly because it facilitates the teachers to acquire the adequate skills to lead the course; this step also represents another moment of collaboration between teachers and companies, especially in periodically readapting the materials to the legislation and technological changes as well as indicating which are the key abilities students should obtain. If there is some ready material, a phase of review/creation/update of the didactic material used during the planning process must be considered for each model repetition.
4) Selection of the tools needed to present the theoretical contents. It is important to foresee different kind of tools in order to maintain high the attention on the speech and to improve the participation.

5) Selection and purchase of the materials: also in this phase the companies' contribution to the discussion is important, in order to analyse the typologies of the needed components and the technical aspects to consider according to a specific aim. In addition, some time to research the material -also on the web- must be scheduled, with the objective of evaluating costs and technical characteristics. If possible, let the students visit the company where the products have been purchased, preparing the visit and some questions for the technicians.

1.2.2 REALIZATION AND PRACTICAL COMPETENCES

During the execution phase, which represents the core of the educational model, it is necessary to consider three important aspects.

SAFETY

1) Before starting the work in the laboratory, verify the students' knowledge on basic notions of safety. To this extent, test or questionnaires, individual or group examinations may be used.

2) Allow the access to the laboratory only to those students who possess individual safety devices.

3) Before starting any intervention, verify that the battery is connected.

MATERIAL ACQUISITION

The task of searching for the electrical material is responsibility of the educational institution, in conformity with the didactic objectives and budget restrictions. It is useful for the purpose of the educational model also to allow the students to look for material to employ. By doing this, the users apply to the reality the competences acquired from a theoretical point of view, through defining all the necessary components, analysing the technical characteristics and determining which material is more suitable to realize the requested product.

ACTIVE PARTICIPATION IN THE REALIZATION OF THE MODEL

1) It is important that the components and the support removal are carried out by the students, to let them understand in a concrete way the starting structure of the vehicle, object of the interventions. Also, this will let them evaluate with more precision all the future modifications.

2) Define possible preliminary mechanical works on the basis of measurements and of the purchased components.

3) For the realization of the proposed model, one of the essential aspect is the possibility of using a totally electric vehicle and to transform it into a hybrid one, according to the real necessities.

In detail, the students' intervention could be summarized in the following phases:

MACROAREA	ACTIVITIES	SUBJECTS INVOLVED	PERSON IN CHARGE
PLANNING	Measuring of the dimensions of the Electrical components to Project their positioning	Students Companies	Teachers
PLANNING	Purchase of materials necessary for the development of the activities	Teachers Companies	Institution Manager
IMPLEMENTATION	Complete dismantling of the kart to obtain the plain chassis	Students	Teachers
IMPLEMENTATION	Positioning of the engine clamps behind the seat, at the centre of the chassis to obtain the adequate balance.	Students	Teachers
IMPLEMENTATION	Modification of seat supports and of steering column in order to position them at the centre of the kart.	Students	Teachers
IMPLEMENTATION	Reassembling of the chassis for a preliminary quality test of the modification done.	Students	Teachers

IMPLEMENTATION	Possible painting of some chassis parts for didactical uses or to signal fixed and movable parts for the final assemblage.	Students	Teachers
IMPLEMENTATION	Intermediate evaluation of the project and analysis of the interventions to do.	Students Teachers	Companies
IMPLEMENTATION	Positioning of SLI batteries to the kart limber to give a balanced stress to the front wheel	Students	Teachers
IMPLEMENTATION	Proceed with the wiring of the electrical components, following the electrical scheme provided with the engine and the components. Use the multimeter step by step to verify the accuracy of each connection.	Students	Teachers
IMPLEMENTATION	Completion of the electrical plant with cables, connection to the dashboard, to the general ignition and to the gas pedal in connection with the potentiometer.	Students	Teachers
TEST	Testing the karts. Comparison of the models and data collection.	Students	Teachers

1.2.3 TEST AND DIAGNOSTICS

The test activity should be seen as an opportunity to increase the students' involvement, allowing them to directly test the instrument of their interventions, by directly realising all the required measurements. In particular, the battery life should be tested, by doing a comparison on the consumption, the expenses and the emissions of the vehicle, with the purpose of highlighting the positive impacts of the new technology as well as its environmental and energetic sustainability. The test on the performances (timings and acceleration) should not represent the final objective of the intervention, but simply an instrument to evaluate eventual ameliorations and to hypothesize developing interventions.

To this extent, it is useful to create a catalogue of the tests, in order to compare the new modifications to the old ones, following the recurring changes in technology.

Diagnostics is one of the key competences of the model, this is the reason why it is important to be involved in this activity.

The explanation must be practical and should take place in the laboratory with the specific equipment (theoretical lessons seem not to be efficient with this topic). To be considered a video tutorial, which may be watched many times by the students.

1.2.4 COURSE MANAGER

1.2.4 COURSE MANAGER

To increase the activity and the use of innovative educational tools, the educational model was implemented for iTunes U. ITunes U is an Apple application through App Store that allows the access to full university and school courses, with a digital catalogue of free didactical contents, which can be consulted at any time or place directly from an iOS device.

The choice of this instrument derives also from some of the opportunities provided by this app: the possibility of developing a discussion through team working and problem solving approach.

Students can also participate from their houses and individually, giving their contribution to the already developed lessons; In every moment, questions on the course or any other related topic can be formulated and shared.

Other students can intervene in the discussion and pose their questions or answers;

Teachers and students can follow the conversation in real time, thanks to the push notifications received.

Possibility to follow the lessons on iPad and other devices

The teacher can provide the students with an outline of the course, he can publish posts, give assignments, insert the didactic material, trace the students' participation in class;

- It is possible to use the advantages of the iPad camera to easily take pictures or make videos useful for the course's assignments;
- The teachers linked to qualified institutions have the possibility to publish their lessons on the iTunes U catalogue to freely share their material with everybody.
- The iTunes U application may be directly downloaded freely from the App Store.
- It is important to notice that the internal contents may vary from one country to another.

Educational objectives

ITunes U has the objective of selecting and going in deepen of the changes in pedagogical and theoretical perspectives of the Self-paced learning. The aim of the following paragraphs is to analyse the scientific evidence, by highlighting problems and obstacles linked to a wider diffusion of mobile learning and teachers training.

Specifically, this contribution has the aim of talking about mobile learning inside the theoretical perspective of the Theory of the Activity. This model is particularly useful since it allows to consider the different characteristics of the Mobile Learning.

The proposed pedagogical perspectives are highlighted in order to understand the potential of new technologies in education, where theories in practical experience are also considered.

Introduction to the tool

During the course, it is possible to listen to a brief introduction: into specifics, “Self-paced learning” is defined.

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Mobile learning: learning is motion

Give an accurate definition to Mobile Learning is not easy, considering that some definitions mainly focused on the moving peripheral devices used, while other stress characteristics such as the possibility of omnipresent learning (Pieri & Diamantini, 2009).

How can we define Mobile Learning? What are the paths which lead to understand its potentials? To give proper answers, we will try to make some experience of this resource, through past and present projects, and, at the same time, exploring theoretical approaches of learning.

In depth analysis

In the attached resources there are two links to text documents, videos and PDF documents in English, that highlight, as examples, some Mobile learning projects.

Evaluation

During the "Self-paced learning" courses, contents are usually matched with self-evaluation instruments to better understand ones' own level of preparation and, eventually, to use again the course proposed resources in order to improve self knowledge.

For the application of the model also other types of course manager are valid, provided that they follow some basic requirements:

- Free admission: extra expenses are not forecasted both for the course institution and the students.
- Presence of easy to use on-line help that could be directly managed also by the final consumers.
- Possibility to operate through multiple level access and features (ex. designers, teachers and students)
- Possibility to integrate different teaching modalities and multimedia tools.
- Possibility of direct interaction among the different subjects involved trough tools such as forums and blogs.

1.3 POSSIBLE SUPPORT EXERCISES

After creating the model, it's possible to develop additional exercises that can enhance the learning of concepts and deepen the skills developed during the practical implementation of the instrument. Define further types of interventions to be replicated with the same users or with different groups allows to further refine the tools used by upgrading the technological components when necessary and realizing continuous action of development and performances improvement.

The most important activities to be carried out on the model are:

- Dismantling and complete reassembly to understand the characteristics of the components and of the wiring. In this phase it is also possible to experiment with alternative solutions restoring in any case at the end the model in its original form. This type of exercise is the basis to reply the model with other groups of students.
- Simulation of errors, disconnecting a component and charging the student to find the fault using the diagnostic tools and following the wiring diagrams. This allows to simulate wiring problems, and is a quick activity to realize, also for larger groups of students.
- Substitution of a working piece with a broken one. This typology of exercise allows the student to identify defective parts of the system, by strengthening his/her abilities on diagnostics.
- Execution of standard diagnostic activities with a digital multimeter on working system.
- Interpretation of data provided by the teacher to hypothesize possible breakdowns.
- Open and closed question tests on safety and technology topics.

2. POTENTIAL FUTURE DEVELOPMENT STARTING FROM THE MODEL WE MADE

Developments and innovation of the model allow to predict more areas of action for the development of issues related to electric mobility in vocational training courses.

Even repeating the same model it is still important to constantly update the expected theoretical material (technical and safety). Every repetition of the model should include a review of the material to verify the latest innovations in the field

At present we can identify four possible improvements in this field:

1 – Acquisition of an electric car to achieve the same type of exercises provided on the kart on a more advanced tool. In this way it would remain available the kart for the practical experience of dismantling and reassembling components, while the car would become the basic tool for diagnostic and fault simulation exercises.

2 – Acquisition of a hybrid car to carry out targeted exercises on this type of technology. Even in this case, the main use of the model would cover interventions of diagnosis and malfunctions recovery.

3 – Improvement of the created model working on the hybrid development in parallel analysing the software required.

4 – Improvement of the created model integrating it with an energy recovery system.

3. SUPPORT HANDBOOK

Handbook O6 – Document for transferability. This document contains the main guidelines for the realization of the model based on the gained experience, with highlighting of the problems found and changes made as compared to the initial model.

Presentation of the model on Prezi (Presentation on Results), avaiable at: https://prezi.com/px_i0owb6zkx/presentation-of-results: Presentation of the final results, especially of the mind map that describes the implementation process in all its phases and changes.

Handbook O2 (Lastenheft) and Handbook O3 (Pflichtenheft): Documents that describe the initial requirements and their interpretation during the planning phase.

4. QUALITY INDICATORS

As regards the quality of the results it is considered necessary to focus the attention on the following aspects:

1. Learning: to evaluate the acquisition of technical skills through tests and questionnaires drawn up by the teachers.

2. Realization: within the Lastenheft there is a final section where are shown the percentages of achievement compared to the original objectives for each type of requirement.

3. Performances: initially performance goals over the final product are not defined, but in progress performance targets can be inserted with a view to improving