

RESULT NO. 16

Training method diffusion:

Šolski center Nova Gorica:

PROCESSING EDUCATIONAL WORK AND METHODS OF TEACHING ON THE BASIS OF EXPERIENCES IN THE PROJECT

Teaching methods in educational programmes Car servicing (4 year and 3+2 years), Electrician (3 year and 3+2 years) stem from practical experiences gained at professional work and guided work with pupils in MESA project. These methods will be implemented after in teaching process at several professional levels. In the project we will transform vehicle with internal combustion engine into vehicle on electric power. Second important activity is to establish charging unit with photovoltaic panels to recharge vehicle batteries or charging unit connected to electricity networks.

Theme of the project offers possibility of excellent cooperation between theoretical and practical performance of classes in single technical module at all educational programmes mentioned above. We get the same possibility with wider interdisciplinary cooperation. Possibilities for this kind of cooperation will be introduced in in the making handbook. Because of complexity of technical contents and developing professional field there is possibility of permanent revision of handbook and performing teaching technics. This represent excellent basis for good final result.

Teaching methods are determined with teaching (project) content, aims of teaching, project aims and with pupils and teachers themselves. Appropriate or suitable teaching methods must provide achieving of determined teaching aims, representing help and easing problems at learning and must provide approaching of subject and challenges of professional sphere to pupils.

There are more teaching methods concerning entire subject matter and are constantly changing mostly because complexity and multidisciplinary of professional sphere. Mostly used methods are:

- Method of lesson, lecture

- Class discussion, working in groups
- Laboratory work at theoretical and practical classes
- Workshops, working in workshops, observation, sampling
- Research paper, reporting, debate
- Lessons, individual work of teacher or pupil with other pupil
- Project work in big or small groups, duration depends on task and aim, reporting
- Self-teaching of pupil
- when material will be gathered and/or made programmed learning will be enabled
- Playing a role, developing critical thinking, speaking skills, learning of defence of own point of view
- Demonstration; of processes, demanding work
- Analysis of media news, discussion, pros and cons
- Panel discussion, discussion on certain theme, debate, developing critical thinking
- Reporting, present at many other used learning methods
- Getting to know of professional contents at field trip, pupils attending working camps, exchange of pupils.

With help of reasonably used above mentioned methods we will achieve learning to be more prosperous, easier and more interesting. Professional subject matter and teaching contents provide tractability and control over happening in teaching process. Pupils aren't "lost" and they feel safer and oriented in "work space" of teaching contents. There is no accumulation of single concepts at several classes with little meaning but only connection of concepts with use of wider conscription of teaching methods could lead to achieving teaching aims. Teachers play important role and also their cooperation in the meaning of progressing of work, methods, and study material.

Simon Kragelj, MESA group, ŠCNG, 2011-2013

ITI Cardano:

The working method used in the process of development of the electric car was as follows.

We have observed on the market which models of electric vehicles could resemble ours and we read and studied the technical characteristics.

We discussed the idea of the project with our students and interesting ideas emerged.

In the activities with the students we have always tried to place before anything else the concept of work in safety, in compliance with all the relevant rules regarding this topic.

We then started with the mechanical and physical data of the vehicle that have been provided.

We measured and weighed the vehicle, we eliminated all the devices that concerned the endothermic engine (engine, fuel tank, fuel pump and injectors and fuel pipelines).

We then verified analytically the electric power needed to move our vehicle.

When Slovenians delivered the engine, we verified that it was compatible with our needs for traction.

We then designed and built the cradle of the electric motor housing. This activity required the use of special machine tools and the use of software tools for CAD-CAM and solid modelling.

We have also tried all the electrical circuit of the motor on the test bench before mounting them on the car.

In the embodiment of the mounting system of the solar panels we have carried out the design of the frames, taking into account all the environmental factors that affect this type of installations.

As a final remark, it is interesting to state that throughout this project we tried a new way of teaching/training approach. Students are directly involved in the organization of the project itself, they are the protagonists of its success. Educational techniques are based on peer/group work, peer teaching, peer tutoring. They learn by doing and they learn study and work together. Maybe this is the best aspect of the project.

TS Pula:

- A group of students from the fourth class of mechatronics technician and electrician vocation who will take part in making an electric car on voluntary basis was formed
- The students got the topics for the final exam connected with making of an electric car
 - speed regulation: induction motors ,DC motors, BLDC motors, efficiency
 - inverters DC-AC,12V/230 V
 - charging regulators with PV panels 24/12, 24/72 V
 - batteries-various types
 - electric cars-comparison with the cars with the internal combustion engine
 - hybrid vehicles
 - electric cars-electric buggy-our make
 - electric vehicles-bikes, scooters, boats, ships
 - battery charger AC/DC, 230VAC/72VDC, 230VAC/12VDC
 - electric vehicle transmission-differential, gearbox, gear chain, chain, electric motor on each wheel – comparison
 - PV panels
 - LED lighting, LED reflectors, LED lightening control by PLC or microcomputers
- Students and teachers included in a project were studying available literature and information regarding electric car on the internet
- They were looking for the information about
 - electric cars
 - modification of cars with the internal combustion engine into electric cars
 - different types of electric motors and controllers for speed regulation and control
 - batteries for electric cars
 - different types of electric motors and controllers for speed regulation and control
 - photovoltaic systems
 - battery chargers
 - microcontrollers for system control
 - mechanical systems for mechanical power transmission
- The gathered data were used for lectures in the following school subjects:
 - electrical machines and devices
 - renewable energy sources
 - electronic circuits
 - power electronics
 - automation by computer
 - automation process control
 - electrical installations
 - microcomputer
 - regulation and control

- Even the teachers who are not closely linked to the project got involved in procurement of the car buggy meant for modification into electric car
- Together with the purchase of single parts for installation into a car the parts became the practical teaching material at the same time:
 - electric motor BLDC 5000 W 72 V Golden Motor
 - controller for Golden Motor
 - PV panels
 - Lead acid battery
 - Golden Motor controller adjustment programme
 - smart chargers 7 A 12 V CTEK
 - gears(the students calculated the tooth number on motor and gear box
 - contactor-relay
- Local artisans also helped in car making, the students gave their contribution in workshops
- A group of students included in the process has meetings on regular basis and with a mentors help they work on assembly of electric motor parts:
 - motor holders
 - battery holders
 - PV panel holders
 - wiring
 - charger junction
 - manufacture of control for the car (microcontroller)
 - system for charging and supervising battery pack
- During parts installation the measurements and tests were done using the standard electric measuring instruments
- During making the material for future exercises was prepared

Le Vele:

Fondazione Le Vele investigated the training method to be used in the process of implementation of the car and considered that a new module will be integrated in the existing curriculum.

Consequently Fondazione Le Vele analysed the elements needed for adaptation of the training method for the standard existing curriculum:

- for Photovoltaic panels installer
- Expert in energy saving (energy manager)

In relation with integration of the needs of the realization of electric car and the optimum utilization of solar panels that will be used to recharge the vehicle batteries.

The specific elements related to the design, construction, installation and maintenance of solar panels with automatic orientation of the solar panels toward the perpendicular to the sun at different times of the day, will be included in the adapted curriculum as a specific module of the standard course.

In addition the curriculum provide a service in the automotive technical training to improve skills and theoretical and practical knowledge on issues related to electric powered cars. The following subjects are considered:

- Basic principles on issues relating to electric cars.
- Electrical parameters and electrical measurements-Instrumentation required
- Functions and Limitations of the main components used in the car.
- Battery Life and methodologies related to the charge-Checking battery state of health
- Converter DC/DC system and auxiliary services.
- Testing and electromagnetic testing.
- Procedures for monitoring and verifying the status of the vehicle.
- Dismantling of mechanical units of the internal combustion engine.

The new training method integrating the new up-dated curricula will be presented and discussed with the Regione Lombardia new decision makers (just elected) in view of the future standardization of specific courses for electric motion specialist.