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

INDI 4.0

LEARNING APPROACH & METHODOLOGY

O2

CENFIM

Project No. 2019-1-DE02-KA202-006099

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

1. INTRODUCTION

A phone

100 years ago

A car

100 years ago

A classroom

100 years ago!

Training/teaching continues to work within a very orthodox framework, with great resistance to change and increasingly moving away from the demands of today's society. It's urgent to bring training and teaching into the 21st century!

As long as we do not transform learning into a space of pleasure instead of an effort and a sacrifice, we are not providing an appropriate service to present society qualification in general.

This implies more modern instruments, tools and features, based on the current capabilities of the digital world and in a didactic based on full flexibility for learning that allows everyone to make their availability, both personally and professionally, compatible with investment in its own qualification pathway.

Flexibility, efficiency and a more attractive and productive (learning) environment are, after all, what industry 4.0 is based on, which is born within a new technological society, more digitalized, more demanding and more self-aware of its time management. Let's call it society 4.0 too.

And why not, in this proposal that contributes to this project, we can therefore call it: education 4.0. It's in this sense, not taking the easy path of simple digitization, but using its abilities to change the teaching paradigm, that these contents, included in the scope of the INDI 4.0 project, aim to contribute and inspire.

2. UNIT OF LEARNING OUTCOMES

Unit of Learning Outcomes: Elaborating manufacturing programs in CNC milling machines

Activity		K-S-A	
Id	*Designation*		
A1	**Plan the machining process** (Set the operating sequences taking into account the production type, raw material, part shape and requirements)	**Knowledge**	
		K1	· Drawing representation, technical terms, symbols and standards
		K2	· The fundamentals of the process planning
		K3	· The fundamental knowledge of machining operations and its features
		K4	· The fundamentals of cutting technology
		K5	· The fundamental knowledge of tool holding and work holding devices and theirs applications
		K6	· The raw materials and their machining properties
		Skills	
		S1	· Interpret mechanical drawing projections, cross-sections, dimensions and their related tolerances and surface markings
		S2	· Create the sequence of operations (in order to gather and to organize the necessary data for programming, set-up and machining phases)
A2	**Execute the manufacturing programs** (for workpieces to be obtained from a solid block, pre-machined part, casting or forgings with simple or complex geometry)	**Knowledge**	
		K1	· Drawing representation, technical terms, symbols and standards
		K2	·The fundamentals of the process planning
		K3	· The fundamental knowledge of machining operations and its features
		K4	· The fundamentals of cutting technology
		K5	· The fundamentals of a CNC machine (machine system, coordinate systems, references points)
		K6	· The fundamental knowledge of methods and techniques to generate a programme
		K7	· Program structure, preparatory function and auxiliary function (G-codes and/or similar programming codes)
		Skills	
		S1	· Interpret mechanical drawing projections, cross-sections, dimensions and their related tolerances and surface markings
		S2	· Interpret the work plan sheet, tooling sheet, tool data sheet applying the different data in the programme
		S3	· Apply the techniques of manual programming
		S4	· Apply the techniques of automatic programming
		S5	· Apply the techniques of parametric programming

Attitudes
Proactivity/Initiative
Responsability
Healty & Safety
Autonomous and self-orientated

Key Competencies
Critical thinking and problems solving
Working with others and in teams
Manage Information (Collecting, analysing and organising information)
Planning & Organising activities

This training module is common to all CNC-related training units and is framed in the respective LO unit as shown on the left side (in this called “Elaborating manufacturing programs in CNC Milling Machines”.

Throughout the module, trainees acquire part of the knowledge and skills mainly related to the fundamentals of process planning; machining features; cutting technology; workholding devices.

As represented, the Unit of Learning Outcomes lists the main activities that the trainee has to undertake as well as the knowledge, skills and attitudes needed to be acquired and demonstrated, all framed on three different criteria of assessment:

Level 1 Satisfactory (initial)	**Level 2** Good (intermediate)	**Level 3** Excellent (advanced)
From level 1 to level 3, the depth of knowledge increases		
From level 1 to level 3, the number, the complexity and the inter-relations between tasks increases		
With supervision	With supervision in complex and unpredictable situations	Autonomy in problem-solving and in task resolution. With supervision in unpredictable situations

3. CASE STUDY BASED LEARNING APPROACH

For success in the learning process, it is essential to apply approaches that are clear and effective for those who are learning. So, we should look at the training program from the point of view of the customer. The customer (trainee or company) wants to know what the learning activities mean in relation to a real working area. Is the trainee able to solve problems independently or does he need to follow someone's instructions to be able to lead with a specific technical issue?

In this sense, a project and/or case study-based learning approach becomes the key to a successful learning. This module has five case studies following, in general, the structure:

. **CASE STUDY** – FRAMEWORK
Scenario description

. LEARNING CONTENTS & PRACTICAL ACTIVITIES
Getting the knowlegde and skills to solve the case study challenges

. **CASE STUDY** - VALIDATION

4. METHODOLOGY & LEARNING RESOURCES

The module was developed in a way that can be applied in different scenarios and training approaches such as online training, class face-to-face training and individualized face-to-face training.

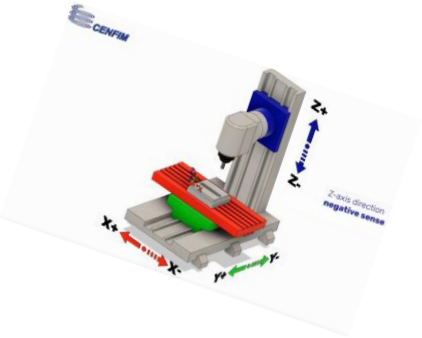
To make this possible, is it quite important to develop the learning resources and activities in a way that allows the maximization of student learning, knowing that each individual has a different learning pace and different learning style.

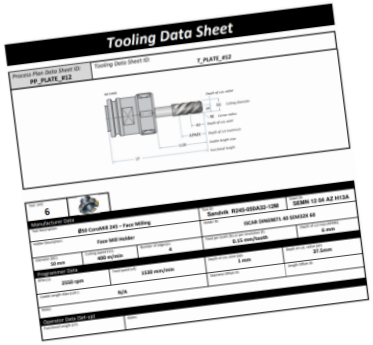
In this sense, different types of learning resources and formative assessment instruments were developed to keep the student motivated and involved in the learning activities.

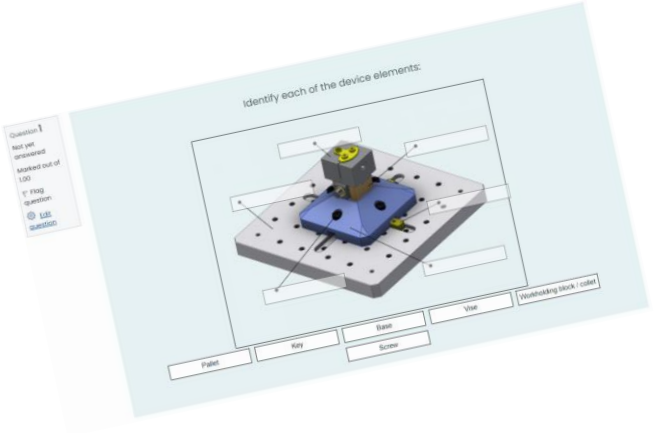
Since it is a very autonomous learning process, activities with direct feedback play a crucial role to regulate and consolidate learning. The student must feel comfortable with the way of learning and support provided by the trainer/facilitator, thus the learning activities must be diversified and dynamic.

Different didactic materials are applied such as:

. Dynamic learning contents
. Quizzes
. Practical cases
. Practical videos (Youtube channel)
. Work Plan data Sheet
. Tool Data Sheet
. etc







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

5. THE CASE STUDIES

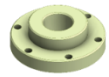
The module has 5 case studies to be performed in sequence. Each means a practical scenario (challenge) through which the trainee acquires a specific set of knowledge and skills about:

1 CNC TECHNOLOGY

In this case study, the trainee will be asked to help a company select a new CNC equipment. Through its development the trainee will acquire a set of fundamental knowledge about:

. The evolution and framing of CNC technology in the production system
. Constitution and functioning of a CNC machine
. Types of CNC machines and their application

2 PROCESS PLANNING



In this case study, the trainee will be asked to help a company find the reason for a premature wear of the roughing tool. It is suspected that one or more operations are not in the proper sequence. Through its development, the trainee will acquire a set of fundamental knowledge and skills related to:

. Fundamentals of manufacturing processes
. Fundamentals of milling machining operations
. Fundamentals of process planning applied to CNC
. Sequencing machining operations on simple 2 1/2D geometry parts

3 TOOLS & CUTTING DATA

In this case study, the trainee will be asked to help the machine operator to consult the catalogs to determine the cutting parameters for three tools that he intends to test before making deciding to purchase or not. Through its development, the trainee will acquire a set of fundamental knowledge and skills related to:

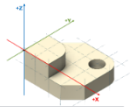
. Fundamentals of cutting tools and their application
. Fundamentals of Cutting technology
. Read and Interpret the Tool Data Sheet
. Read and interpret tool catalog in paper or digital format
. Calculate cutting parameters

4 WORKHOLDING DEVICES

In this case study, the trainee will be asked to help the company validate the project of a new workholding device that was subcontracted to GABY20, a company specialized in the development of workholding devices for the metalworking industry. Through its development, the trainee will acquire a set of fundamental knowledge related to:

. Functions of a clamping device
. Typologies: standard, modular, dedicated
. Support, positioning and clamping elements

5 AXES SYSTEM & DATUM



In this case study, the trainee will be asked to assist the programmer that is facing some challenges in the elaboration of the CNC programme . Through its development, the trainee will acquire a set of fundamental knowledge and skills related to:

. Fundamentals on axes system applied to a CNC machine
. Fundamentals of machine and part reference points
. Calculate coordinates in cartesian space
. Determine part reference points based on the engineering drawing and part geometry

Project No. 2019-1-DE02-KA202-006099