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

EDU-VET

E-Learning, Digitisation and Units for Learning at VET schools – Creating online Learning Environments in Technical Education for European metal industry

EDU-VET Curriculum

April 2021
UPB / BKBW

Project Title:	E-Learning, Digitisation and Units for Learning at VET schools – Creating online Learning Environments in Technical Education for European metal industry
Acronym:	EDU-VET
Reference number:	**2019-1-DE02-KA202-006068**

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

Inhalt

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

1 Introduction

This paper provides you the EDU-VET Curriculum. First of all, you will get an insight into the underlying pedagogical approaches, especially the focus is on the Blended-Learning approach. Afterwards, the basic structure of the three basic modules is presented as well as the structure of the Learning Outcome Matrices. This part forms the elementary frame of reference for the definition and elaboration of the EDU-VET Learning modules.

In the following, the curricular approach is addressed. In summary, the curriculum will be structured into three fundamental pillars: Pillar 1) EDU-VET Process model; Pillar 2) EDU-VET Curriculum skill level model and Pillar 3) EDU-VET Curriculum learning unit model. In this context, the didactic concept of the modules is discussed. H5P tasks are implemented and presented at this point. Finally, the report provides an insight into the EDU-VET Moodle Learning Platform.

2 Basic approaches of the EDU-VET Curriculum

2.1 Basic competence approaches

This chapter contains the basic competence approaches of the EDU-VET Curriculum. Afterwards, the focus will be on the EDU-VET Blended-Learning approach.

Technical competence (professional competence)

This competence refers to the willingness and the ability to solve tasks and problems in a goal-oriented, appropriate, method-guided and independent manner on the basis of professional knowledge, as well as the ability to assess the results. In this context, the trainees are required to have basic knowledge in mathematics and technical aspects (cf. KMK 2002).

Action competence

Here, the focus is on decision-making and assuming responsibility with regard to the tasks. Action competence is developed within the dimensions of professional competence, personal competence and social competence (cf. IBID.).

Personal competence

This refers to the willingness and the ability of an individual to clarify, think through and assess the development opportunities, requirements and limitations in family, work and public life, to develop his or her own talents and to make and develop life plans. It includes personal qualities such as

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

independence, critical faculties, self-confidence, reliability, a sense of responsibility and duty. In particular, it also includes the development of well-thought-out values and a self-determined attachment to values (cf. IBID.).

Social competence

Social competence refers to the willingness and the ability to conduct social relationships and to shape, grasp and understand possibilities and tensions and to discuss and communicate with others in a rational and responsible manner. In particular, this includes the development of social responsibility and solidarity (cf. IBID.).

Methodological and learning competence

Knowing, analysing and applying suitable methods for the learning process is an important set of competences. These competences grow from a combination of the above-mentioned competence areas (cf. IBID.).

As well as fostering the aforementioned competences, the integration of syllabus objectives for VET learners in the metal sector is also relevant. The objectives of the syllabus for VET learners in the metal sector should be realised according to the development of the curriculum as well as through online and face-to-face learning courses. Furthermore, the partners should follow the didactic principles by creating the curricular framework.

In concrete terms, the objectives of VET require that instruction should be related to action (cf. KMK 2020). That means that young people should learn to plan, carry out and evaluate tasks independently within the framework of their occupation. Learning at vocational school occurs in relation to professional action as well as various cognitive operations (cf. IBID.).

On the basis of learning theory and didactic findings, the pragmatic approach to the design of action-oriented teaching is as follows:

- Didactic reference points are situations that are important for carrying out the profession (learning for action).
- The starting point of learning is formed by actions, if possible carried out by the learner or mentally understood (learning by doing).
- Actions must be planned and carried out by the learners as independently as possible, and have to be checked, corrected if necessary and finally evaluated.

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

- Actions should promote a holistic understanding of the professional reality; for example, technical, safety, economic, legal, ecological and social aspects must be included.
- Actions must be integrated into the learners' experiences and be relevant to their social context.

Actions should also include social processes, such as the declaration of interests or conflict resolution. Action-oriented teaching is a didactic concept which is based on intertwining subject-specific and action-systematic structures. It can be realized through different teaching methods (cf. IBID.).

2.2 The EDU-VET Blended-Learning approach

EDU-VET combines pedagogical needs and approaches with the technical environment based on the blended learning approach.

Blended learning is a mix of e-Learning and classroom instruction. Norm FRIESEN states that "´Blended learning´ designates the range of possibilities presented by combining internet and digital media with established classroom forms that require the physical co-presence of teacher and students" (FRIESEN 2012, p. 1).

The EDU-VET Blended-Learning approach offers new possibilities to rethink VET in the metal industry and enhances the access of the learners to training and qualifications. This is the reason why in the context of EDU-VET VET schools and enterprises cooperate to meet the economic needs of practice and the world of work. It is crucial to have a strong and relevant curriculum as a basis for EDU-VET which ensures quality and provides both structure and learning tips for VET teachers, VET educators and learners.

With reference to KERRES, the Blended-Learning approach is defined as "[…] a combination of media-supported learning with face-to-face elements in learning arrangements" (KERRES 2018, p. 23). KERRES & DE WITT provide a more differentiated definition. They understand Blended-Learning, based on DRISCOLL, primarily:

"to combine different web-based technologies,

- to combine different pedagogical approaches,

- to combine any form of instructional technology with FTF instructor led training or / and

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

- to combine instructional technology with actual job tasks in order to improve learning transfer" (KERRES / DE WITT 2003, p. 2).

The EDU-VET Blended-Learning approach is separated into two parts: the online scenario and the classroom scenario.

The online scenario refers to the development of online courses and materials which will be provided via the online learning platform. It also includes interactive tasks and videos as well as audios, photos, images and illustrations. The use of the survey module provides a variety of tested questionnaire instruments in order to discover relevant information about the EDU-VET target group. The task creation is completed through the H5P platform.

Concerning the classroom scenario, the partners have to create courses and content for face-to-face classrooms lessons. Additionally, existing methods can be used, such as group work, discussions, creating a poster, working in the workshop and on the machine, building a model, simulations etc. The partners could also create additional didactical materials which can be used in the classroom in combination with the online platform.

The objectives for authentic learning in the EDU-VET blended learning scenario are the following:

a) EDU-VET take the learner´s/person´s qualifications and interests into account and offers learning modules and courses that fit to the needs and fit to the curricular structures of EDU-VET and the partner countries.

b) EDU-VET provides scientifically sound concepts and teaching and learning resources.

c) EDU-VET offers high quality OER.

d) EDU-VET addresses the metal industry where blended learning on the basis of learning platforms is currently not state of the art and here the project offers

e) EDU-VET offers modern learning and takes digitisation in education into account

f) EDU-VET will be sustainable. The EDU-VET approach will be completely transparent. It can be developed to further stages. EDU-VET will provide a sound basis for future work, too. The implementation of EDU-VET and the activities of the partners will ensure that the curriculum, the courses and the handbook which will be there also after the end of the project will be used in the daily work of VET teachers.

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

g) EDU-VET brings young, potentially young disadvantaged people in contact with interesting knowledge which fit to the needs of economy in the metal sector.

h) EDU-VET can grow and diversify. In contrast to currently available eLearning approaches, EDUVET offers the advantage that traditional modules and foci can be integrated easily also after the end of the project duration.

i) EDU-VET integrates the idea of authentic learning.

The EDU-VET blended learning approach is shown below:

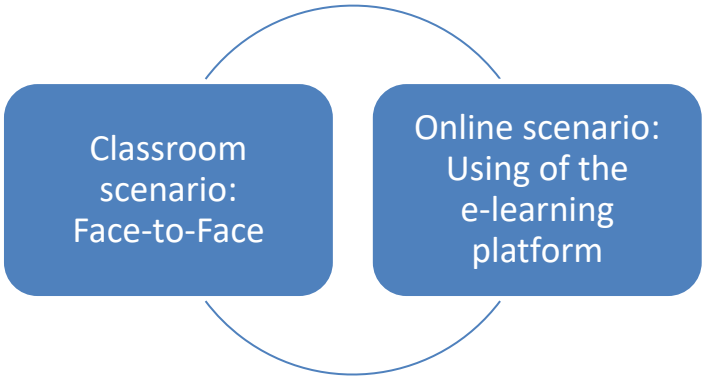


Figure 1: The EDU-VET Blended-Learning Approach

3 Modular structure of the EDU-VET Learning Modules

Following chapter contains the modular structure of the EDU-VET Learning Modules. Firstly, the basic modular structure as reference framework for the EDU-VET Learning Modules will be provided. Afterwards, specific approaches of the modular structure will be presented.

3.1 Basic modular structure of EDU-VET Learning Modules

A modular VET curriculum for the metal industry will be developed as a basis for the online courses and learning modules on the learning platform to be developed. The idea is to support the acquisition of key high-value competences necessary for the establishing modern and innovative learning in the field with as comparable European focus. The development of this new curriculum will require an 'ab initio' approach as there is little in terms of available coherent educational resources addressing the target groups in any partner country.

The six learning outcome matrices of EDU-VET (LOM1 to LOM6) provides insights in the addressed outcomes, suggested methodological approaches and possible assessments.

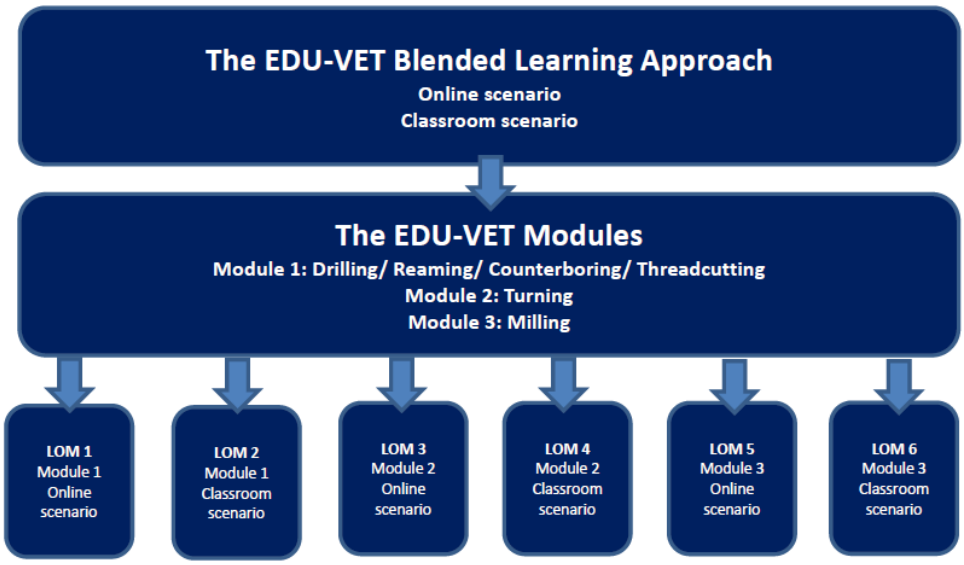


Figure 2: The EDU-VET Curricular Framework

The Learning Outcome Matrices are designed to inform about the development of the curriculum structure to integrate the results of the Summary Research Report. Focusing on a learning outcomes approach facilitates the tailoring of the pedagogic induction resources. This provides the possibility to suit specific cultural and societal values and ensures that local issues and necessary topics are addressed within the EDU-VET approach.

The EDU-VET modules for VET learners will be addressed in the EDU-VET curriculum. These modules based on the researches which are being conducted in each partner country:

EDU-VET focusses on three modules and their subareas for learners:

• ***Module 1: Drilling/ Reaming/ Counterboring/ Threadcutting***

- Fundamental definition of terms and processes
- DRCT-Part _1: small diameters/low bore depth (flat) bores of different types: blind/through bores, fitting bores, tapered bores (steps a-f)
- DRCT-Part_2: medium diameters/medium depts bores of different types: blind/through bores, threaded bores, counterbores (steps a-f)

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

• ***Module 2: Turning***

- Fundamental definition of terms and processes
- TURN-Part_1: Simple external contour (steps a-f)
- TURN-Part_2: Medium complex external contour with groove and thread (steps a-f)
- TURN-Part_3: Simple internal contour (steps a-f)
- TURN-Part_4: Medium complex internal contour with groove and thread (steps a-f)
- TURN-Part_5: Medium complex external- and internal contour with grooves and/or threads (steps af)

• ***Module 3: Milling***

- Fundamental definition of terms and processes
- MILL-Part_1: simple external contour (2 1/2D) (steps a-f)
- MILL-Part_2: medium complex external contour (2 1/2D) (steps a-f)
- MILL-Part_3: simple external contour and one or more pockets (rectangular and/or circular pockets
- with and/or without pin) (2 1/2D) (steps a-f)
- MILL-Part_4: medium complex external contour and one or more slots (linear and/or arced slots) (2
- 1/2D) (steps a-f)
- MILL-Part_5: medium complex part (3D) (steps a-f)

For all the different work piece types and all three different manufacturing methods (DRCT, Turning, Milling) the manufacturing process comprises the following six steps (a-f):

- Step a: Manufacturing planning (defining the machine(s), device(s), tool(s) and cutting technology
- Step b: NC programming (including simulation)
- Step c: Preparing the machine (including testing of NC-programme on the machine „air cutting“)
- Step d: Manufacturing the work piece (doing the real thing)
- Step e: Measuring and testing the manufactured work piece (dimensions, forms, surfaces)
- Step f: Documenting and presenting the manufacturing process (steps a-f)

Following, the modules are shown graphically once again:

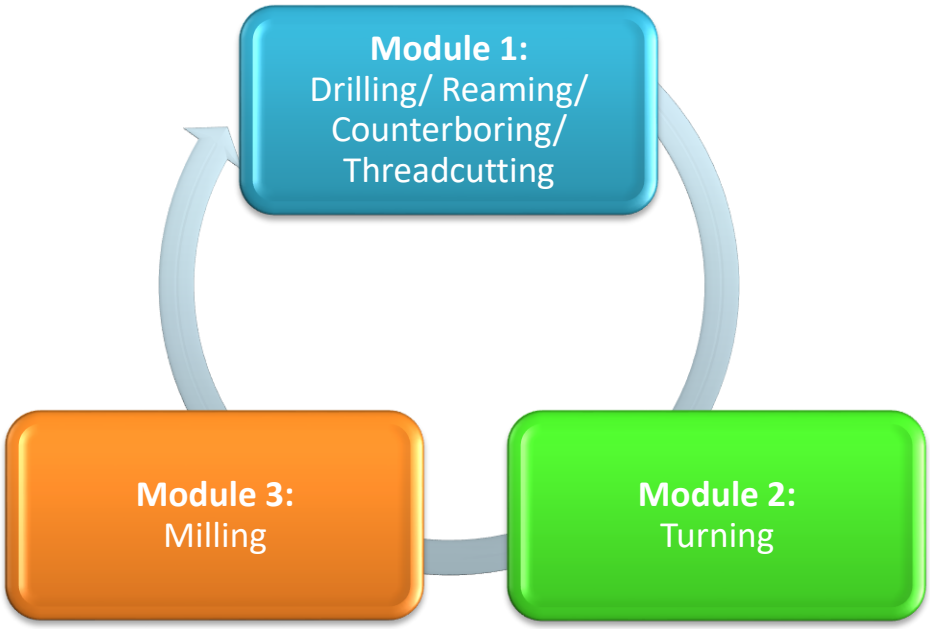


Figure 3: The EDU-VET basic modules for learners

Didactical und curricular conception of the modules and the LOMs

According to the didactical and curricular conception of courses for technical education in the metal sector, the partners should create these courses for two scenarios:

Online scenario:

Firstly, they should develop online courses and materials which will be provided via the online learning platform MOODLE. EDU-VET courses come with introductions, address concrete objectives, offer descriptions and explanations as well as rationales.

They include interactive tasks and can include videos as well as audios, photos, images and illustrations. The use of the survey module provides a variety of proven questionnaire instruments for discovering interesting information about the state of mind of the EDU-VET target group.

In EDU-VET course pages themselves are a main tool for VET teachers, allowing them to add or remove and structure activities as necessary. The use of Quizzes and Assignments help to structure the courses. At the end of a course or module as general overview is provided to the learners to let them fit to their experiences and knowledge in the wider context of the whole curricular approach behind the courses

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

and modules. Therefore, the courses and modules will be interlinked but designed in a way to fit to the needs of the leaners and their own learning path as well as their own speed.

Moreover, the partners will create these online tasks via H5P. Please have a closer look into the document "O2-P1-EDU-VET-Overview tasks H5P-EN". There, you will find all task types and examples for possible contents task designs. In total at least 80 H5P tasks should be created by the partners. Firstly, all tasks should be created in English, then follows the translation into the respective national language of the partners.

There are over 60 different types of tasks via H5P, e.g.: Multiple Choice, Advanced fill the blanks, Arithmetic Quiz, Find the words, Image Slider etc.

Furthermore, also facilitating discussions in forums, as well as asking questions, and guiding learners within the modules and courses creates a specific EDU-VET learning experience with regard to topics of the metal sector.

Classroom scenario:

The partners should also create courses and contents for face-to-face classrooms scenarios. The partners could also create additional didactical materials which can be used in the classroom in combination with the online platform.

Here, the partners can use known and existing methods of face-to-face teaching. These could be group work, discussions, creation of a poster, work in the workshop and on the machine, creation of a work piece, simulations, etc.

Integration of syllabus objectives for VET learners in the metal sector

The objectives of the syllabus for VET learners in the metal sector should also be noticed according to the development of the online and face-to-face learning courses. Furthermore, the partners should follow the didactical principles by creating the courses.

Concretely, the didactical objectives and principles[1] are as follows:

[1] Cf. KMK (2002): Rahmenlehrplan für den Ausbildungsberuf Metallbauer/Metallbauerin. On the internet: https://www.kmk.org/fileadmin/Dateien/pdf/Bildung/BeruflicheBildung/rlp/metallbauer.pdf, date: 01.04.2020.

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

The objectives of VET require that instruction should be action oriented. That means that young people should learn to plan, carry out and evaluate independently within the framework of their occupation. Learning at vocational school is basically carried out in relation to concrete professional acting as well as in various mental operations.

On the basis of learning theory and didactic findings, the pragmatic approach to the design of action-oriented teaching is following:

- Didactic reference points are situations that are important for the exercise of the profession (learning for action).
- The starting point of learning is formed by actions, if possible self-executed or mentally understood (learning by doing).
- Actions must be planned and carried out by the learners as independently as possible, are checked, corrected if necessary and finally evaluated.
- Actions should promote a holistic understanding of the professional reality, e.g. technical, safety, economic, legal, ecological, social aspects include.
- Actions must be integrated into the learners' experiences and be relevant to their social impacts are reflected.
- Actions should also include social processes, e.g. the declaration of interests or conflict resolution. Action-oriented teaching is a didactic concept that is based on subject-specific and action-systematic structures are intertwined. It can be realized by different teaching methods.

3.2 Specific modular structure of the EDU-VET Learning Modules

As the curricular framework mentioned, the curriculum will be based on the blended learning approach, which focus on the one hand online scenarios, and on the other hand classroom scenarios. Under this roof, the EDU-VET learning modules will be developed:

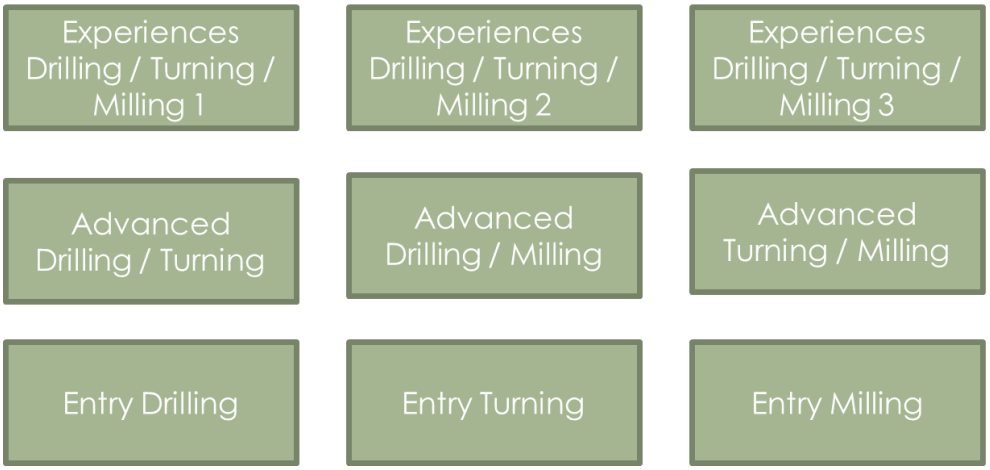


Figure 4: EDU-VET Learning modules – basic structure

As you can see in the graphic above, the nine modules focus the three manufacturing topics milling, drilling and turning. Moreover, they also consider the difficulty level. In total, we define three difficulty levels: 1) Entry level 2) Advanced level 3) Experienced level.

For all the different work piece types and all three different manufacturing methods (DRCT, Turning, Milling) the manufacturing process comprises the following six steps (a-f):

- Step a: Manufacturing planning (defining the machine(s), device(s), tool(s) and cutting technology
- Step b: NC programming (including simulation)
- Step c: Preparing the machine (including testing of NC-programme on the machine „air cutting“)
- Step d: Manufacturing the work piece (doing the real thing)
- Step e: Measuring and testing the manufactured work piece (dimensions, forms, surfaces)
- Step f: Documenting and presenting the manufacturing process (steps a-f)

In this context, the above-mentioned content focuses as well as the difficulty levels are combined, resulting in the following modular structure:

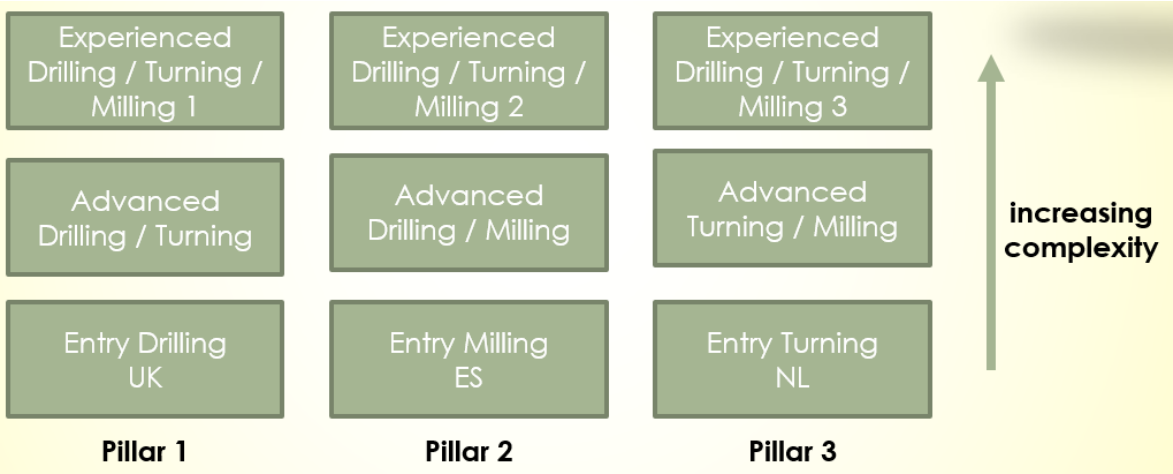


Figure 5: EDU-VET Learning modules – final structure

4 The fundamental pillars of the EDU-VET Curriculum

The EDU-VET curriculum aims to support many different users in different European countries – this shall be made possible by integrating the specifically different viewpoints of the four EDU-VET partner schools.

The following design principles should help to meet this objective:

- The curriculum is primarily structured by the process steps of the „**EDU-VET manufacturing process model**“ in the format of an event process chain. Thus, there is a first trans-national and trans-school-system applicable integration means.
- Secondarily the curriculum is structured by the skill levels of the „**EDU-VET curriculum skill level model**“. This allows the assignment of the learning units to different student groups according their state of development.
- Thirdly the EDU-VET curriculum and learning units shall be easily integrated with the user‘s local curriculum and learning units, therefore the „**EDU-VET curriculum learning unit model**“ distinguishes different ***learning unit types*** and ***learning unit variants.***

- *Finally,* the learning units of the EDU-VET curriculum are classified regarding **delivery media** and **learning activity type** in order to support the users in the process of delivery preparation and student orientation.

Summarized the curriculum will be structured with three fundamental pillars:

- Pillar 1) The EDU-VET Process model
- Pillar 2) The EDU-VET Curriculum skill level model
- Pillar 3) The EDU-VET Curriculum learning unit model.

4.1 The EDU-VET Process model

The EDU-VET Process model describes a manufacturing process. An event initiates the execution of a process step. The execution of the process steps leads to the events of step is completed and step outcomes are ready.

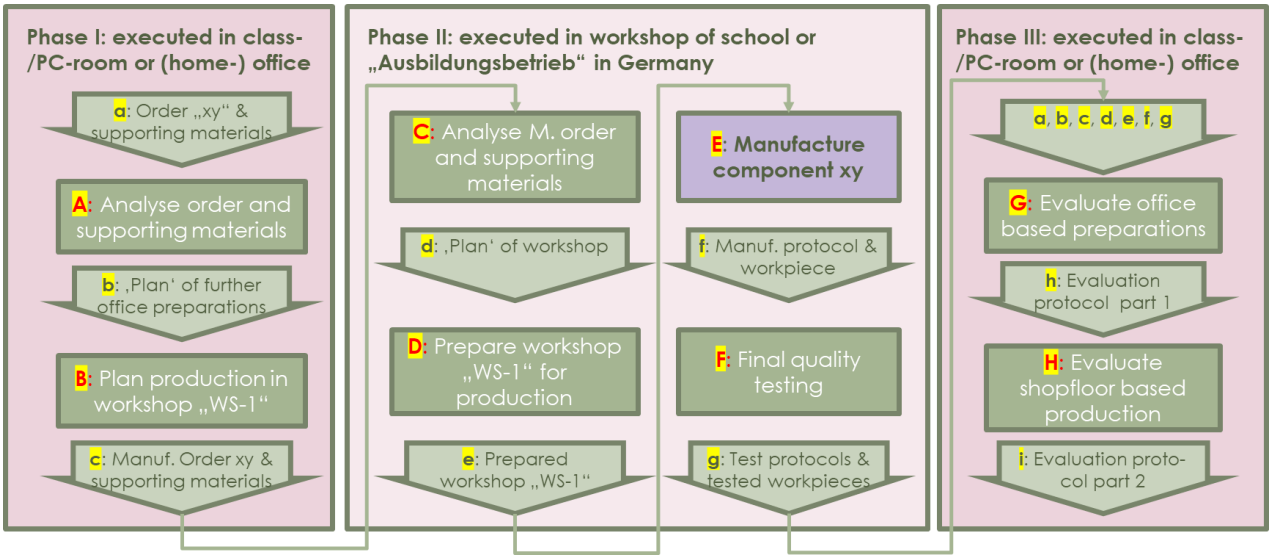


Figure 6: The EDU-VET Process Model

4.2 The EDU-VET Curriculum Skill Level Model

The EDU-VET Curriculum Skill Level Model comprises three different skill levels distinguished by the complexity level to be handled on each skill level. Four sources drive the complexity. The EDU-VET curriculum skill level model is also linked to the difficulty levels of the EDU-VET learning modules.

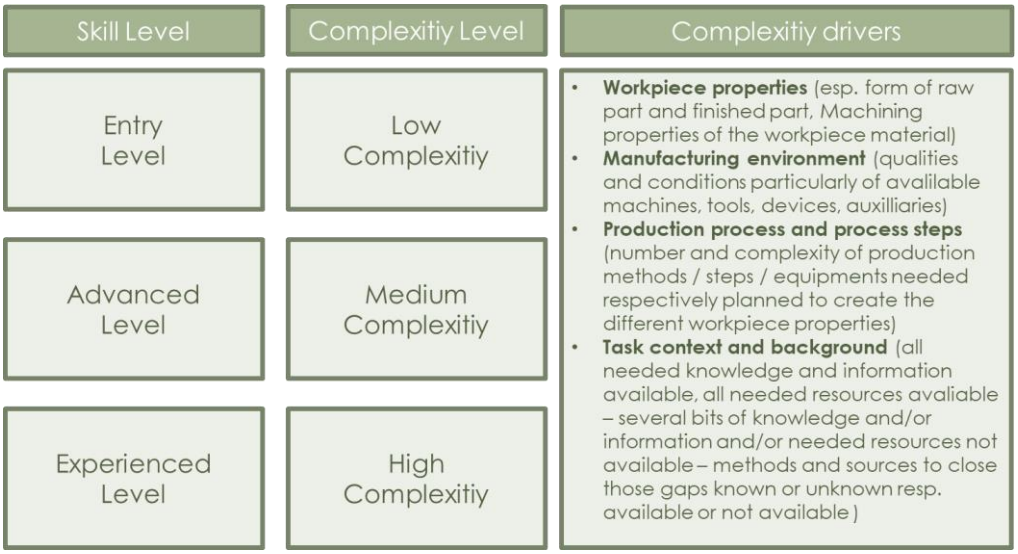


Figure 7: The EDU-VET Curriculum Skill Level Model

4.3 The EDU-VET Curriculum Learning Unit Model

The EDU-VET Curriculum Learning Unit Model comprises learning units of different types and variants and shall support several different learning unit application types and variants, too. This will be shown in the figure below:

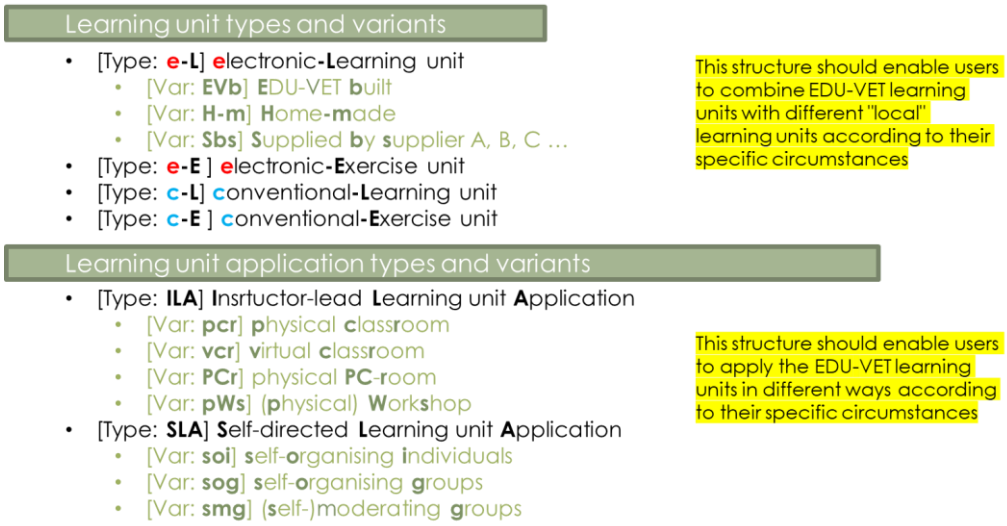


Figure 8: The EDU-VET Curriculum Learning Unit Model – 1

The EDU-VET curriculum learning units are classified regarding delivery media and regarding learning activity type, this creates four basic types: [e-L], [e-E], [c-L], and [c-E].

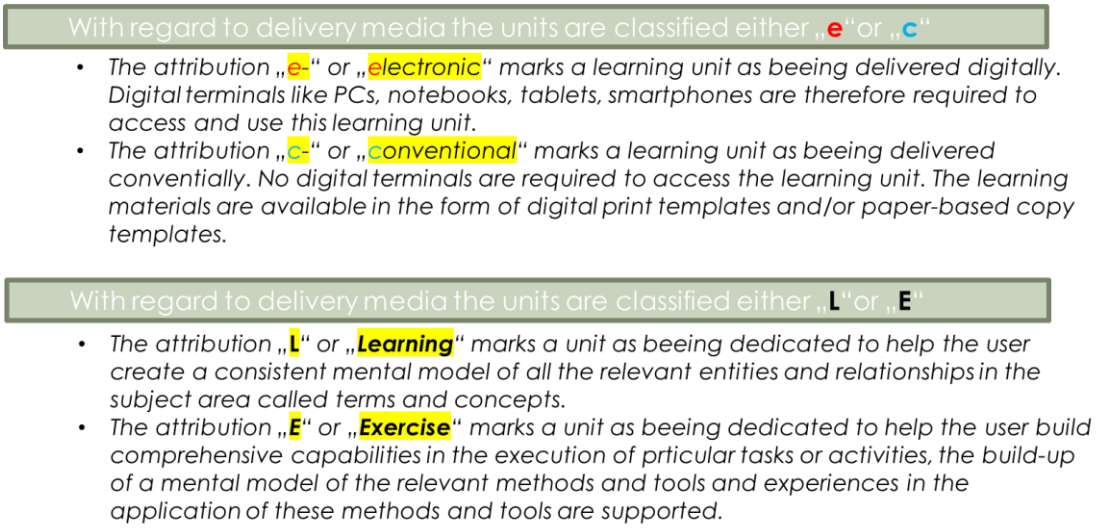


Figure 9: The EDU-VET Curriculum Learning Unit Model – 2

5 Conception of EDU-VET Learning Modules on the EDU-VET Learning Platform

With regard to the conception of the EDU-VET Learning Modules on the EDU-VET Learning Platform[2], each Learning Modules shows the same basic structure.

Each individual module is differentiated into 6 sections: 1) Welcome to Learning Module 2) Objectives and learning outcomes 3) Learning Units 4) Additional learning materials and tasks 5) Glossary - Basics terms 6) Chat.

This structure will be presented below with the example of the first Learning Module “Entry Drilling”.

1) Welcome to Learning Module

Welcome to Learning Module 1 “Entry Drilling”

The first Learning Unit serves to welcome you and to give you a first brief orientation. This Learning Unit focuses the introduction to the topic “Entry Drilling”. Concretely, this course intends to cover the basics of machinery manufacturing processes which include the manufacturing processes of drilling,

[2] http://edu-vet.eduproject.eu/

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

countersinking and reaming. To understand deeper issues concerning this topic e.g. cutting parameters or drilling tools, it is necessary to understand the basics of the machinery manufacturing processes.

This learning unit was developed within the EDU-VET project. Therefore, on this welcome page we offer a very brief orientation about the structure of this learning section. If you have further questions about the EDU-VET project or this learning unit, please do not hesitate to contact the project coordinator Prof. Dr. Marc Beutner.

We wish you much pleasure and a good learning success!

2) Objectives and learning outcomes

The objective of this course is to learn the basics of machinery manufacturing processes in order to understand the individual manufacturing processes of drilling, countersinking and reaming. Besides, the different sub processes of drilling, countersinking and reaming will be also explained. Following, you can test your knowledge by doing interactive tasks.

The learning outcomes of this Learning Module 1 are:

- An understanding of the main aspects, processes and definition of Drilling.
- An understanding of the main aspects, processes and definition of Countersinking.
- An understanding of the main aspects, processes and definition of Reaming.
- An understanding of the relationship between the machinery manufacturing processes.
- Insights into cutting parameters.
- Insights into drilling tools.

3) Learning Units

This section includes the Learning Units of the whole Learning Module 1 "Entry Drilling". These Learning Units addresses three fundamental sub topics of Drilling: Introduction to Drilling, Introduction to Countersinking and Introduction to Reaming.

Learning Unit 1: Introduction to Drilling

Firstly, you will get to know the different core elements of machinery manufacturing processes.

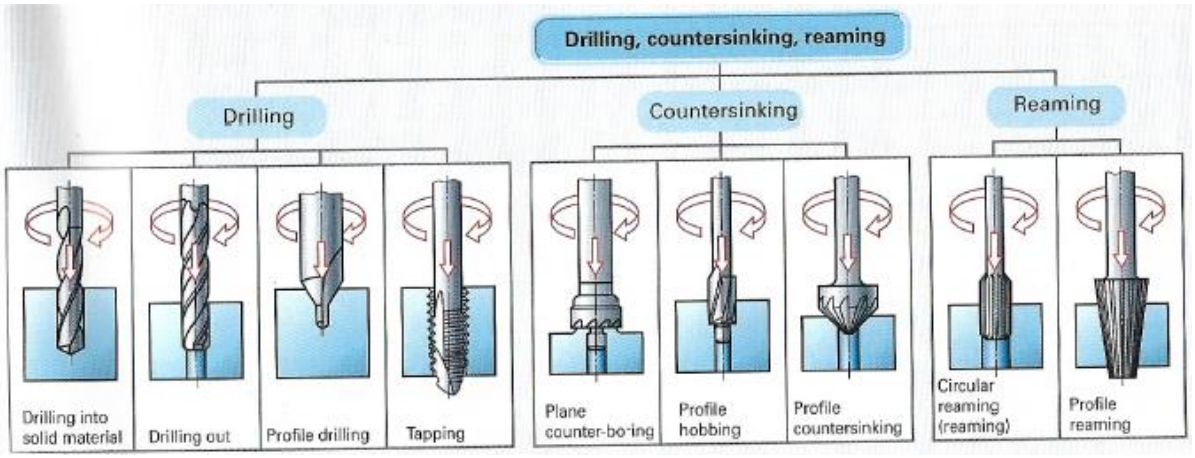


Figure 100: Drilling, countersinking, reaming manufacturing processes
Source: BARTENSCHLAGER ET AL. (2016, p. 139).

Drilling:

The first core process of machinery manufacturing is the Drilling.

"Turning is a machining process in which the cutting movement is performed by the workpiece and the auxiliary movement (feed and infeed) by the tool. Feed and infeed are generated on most lathes by longitudinal and cross slides. The tool used for turning, the turning tool, has only one main cutting edge. Simple turned parts obtain their shape by a feed movement in the direction of the axis of rotation or perpendicular to it. The associated processes are named according to the direction of the feed movement that takes place during machining (longitudinal or facing). The contour of the finished part is created by several steps. The infeed takes place before each step outside the workpiece" (FACHWISSEN TECHNIK 2020, n.p.).

The drilling process consists of the following core elements

- Drilling into solid material
- Drilling Out
- Profile Drilling
- Tapping

(cf. BARTENSCHLAGER ET AL. 2016, p. 139).

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

Countersinking:

Another basic process of machinery manufacturing is the Countersinking.

“Countersinking is used to produce profiled or conical surfaces perpendicular to the axis of rotation. As well as drilling, it is based on rough machining. The countersink - a multi-blade tool - produces shaped partial surfaces. In contrast to drilling, however, it does not work into the solid, but into already existing holes. The tool is better guided by several cutting edges, on which the cutting and feed forces are distributed. The cutting speed must be lower, the feed rate can be selected higher than for drilling” (FACHWISSEN TECHNIK 2020, n.p.).

The countersinking process consists of the following core elements:

- Plane counter-boring
- Profile hopping
- Profile Countersinking

(cf. BARTENSCHLAGER ET AL. 2016, p. 139).

Reaming:

The third key component machinery manufacturing is reaming.

“Reaming is a reaming process with low chip thickness to produce precisely fitting bores with high surface quality. The cutting work is mainly performed by the first cut of the reamer. The circular grinding chamfers smooth the bore surfaces and are of great importance for the surface quality, dimensional and shape accuracy. The reaming allowance depends on the bore diameter and the type of reamer, e.g. straight or twist fluted reamer 0.1 mm to 0.5 mm, skiving reamer up to 0.8 mm. The cutting speed is considerably lower than when drilling. The feed rate depends on the material, the bore diameter and the required surface quality” (FACHWISSEN TECHNIK 2020, n.p).

According to countersinking process the following core elements can be listed:

- Circular reaming (reaming)
- Profile reaming

(cf. BARTENSCHLAGER ET AL. 2016, p. 139).

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

Cutting parameters:

In the last sections, you learned the basics of the different procedures of manufacturing processes. Furthermore, this following section will have a closer look into the very extensive drilling process. Therefore, the cutting parameters will be focus.

"During Drilling, the tool primarily carries out a circular cutting movement while the feed movement takes place in a straight line along the rotational axis. The toll cutters penetrate the material due to the feed force. The circular cutting movement creates the cutting force" (BARTENSCHLAGER ET AL. 2016, p. 139). The following figure also illustrates forces and movements during the drilling process:

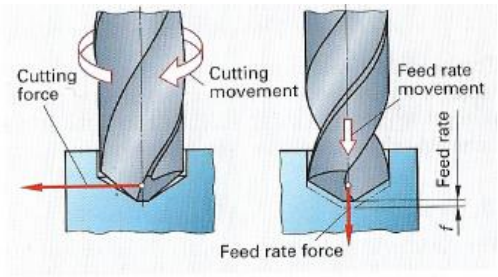


Figure 11: Forces and movements during drilling
Source: BARTENSCHLAGER ET AL. (2016, p. 139).

For calculating the forces and movements during drilling, you have to use the cutting speed rate, which depends on the one hand on the drill type or drill process and on the other hand on the material and the required work quality.

"The speed n can be read off from speed diagrams or calculated from the cutting speed Vc and the drill diameter d" (BARTENSCHLAGER ET AL. 2016, p. 139). The speed rate can be calculating with the followed formula:

Speed: $n = \frac{Vc}{\pi * d}$

In addition, you have to calculate the feed rate f.

"The feed rate f in mm per rotation primarily depends on the material, the cutting material and the diameter of the drill, on the drill process and the drilling depth. It influences the chip formation and the power requirement. The feed speed vf in mm/min is calculated from the rotational speed n and the feed rate f" (BARTENSCHLAGER ET AL. 2016, p. 139):

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

Feed speed: $vf = n * f$

In summary, you have to consider:

"The rotation speed results from the selected cutting speed and the drill diameter, and the feed speed results from the rotational speed and the feed rate" (BARTENSCHLAGER ET AL. 2016, p. 140).

Drilling Tools:

In addition, in this learning section you will learn more about other drilling processes and drilling tools which include profile drilling, system tools and boring. Its basics and fundamentals will be presented step by step.

Profile Drilling:

"Centre drills produce locating holes for milling and grinding between points. NC spot drills are used for precisely-positioned spot drilling into full bodies and for centring on NC machines. They are manufactured with a point angle of 90° or 120°, and can simultaneously produce the countersink for subsequent screw thread tapping at the same time as the centring" (BARTENSCHLAGER ET AL. 2016, p. 144).

Figures 12 and 13 show you the centring drill hole with centring drill as well as a NC spot drill.

Figure 12: Centring drill hole with centring drill
Source: BARTENSCHLAGER ET AL. (2016, p. 144).

Figure 13: NC spot drill
Source: BARTENSCHLAGER ET AL. (2016, p. 144).

System Tools:

System tools are also a key component of other drilling processes and drilling tools. With reference to BARTENSCHLAGER ET AL., it is declared as follows:

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

"Modern system tools can be used to produce high-precision drill holes and profile drill holes, for example in pump housings, using solely one tool. Multi-step drill bits or system drills are available comprising a carrier, adjustable guide rails and a cutting part with adjustable and replaceable cutters. It is often possible to do without post-processing such as reaming and countersinking. System tools are often used in drill bit systems. The base carriers forms the interface between the drilling tool and the drilling machine. No spinning and no longitudinal displacement in the clamping equipment must occur so that the torque and feed force are transferred without problem. Concentricity errors and lack of stiffness are frequent causes of drilling problems" (BARTENSCHLAGER ET AL. 2016, p. 144).

Additionally, please have a closer look into the two figures, which present the multi-step drilling machine and the drilling tool system:

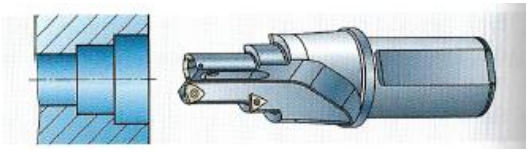


Figure 14: Multi-step drilling machine
Source: BARTENSCHLAGER ET AL. (2016, p. 144).

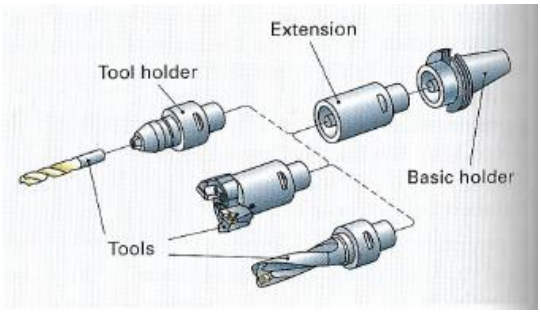


Figure 15: Drilling tool system
Source: BARTENSCHLAGER ET AL. (2016, p. 144).

Boring:

The last procedure of other drilling processes and drilling tools is the boring.

Boring can be defined as "drilling to increase the size of pre-drilled, pre-cast or pre-punched holes, or is used to connect two offset drill holes" (BARTENSCHLAGER ET AL. 2016, p. 144).

On the one hand, the boring tools include rebore drills which "are tools with 1 to 4 blades. The chamfer diameter of drill tip is such that the prepared hole diameter must be at least 70 % of the boring

diameter. The cut speed and feed rate is selected as for drilling with HSS drills" (BARTENSCHLAGER ET AL. 2016, p. 144).

On the other hand there are boring/ cutting out tools with CC inserts. These tools "are used for boring larger diameters. Fine-boring heads enable adjustment of the drill hole diameter in the µm range using a Vernier scale" (BARTENSCHLAGER ET AL. 2016, p. 144)

Let´s have a closer look into the figures 16, 17 and 18.

Figure 16: Rebore drill (spiral countersink)
Source: BARTENSCHLAGER ET AL. (2016, p. 144).

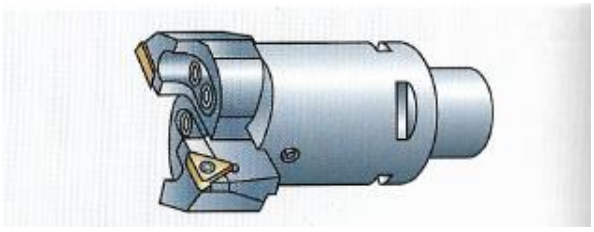


Figure 17: Dual-cutter boring tool
Source: BARTENSCHLAGER ET AL. (2016, p. 144).

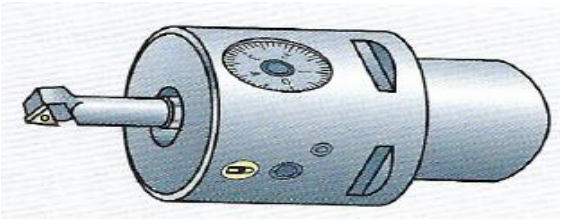
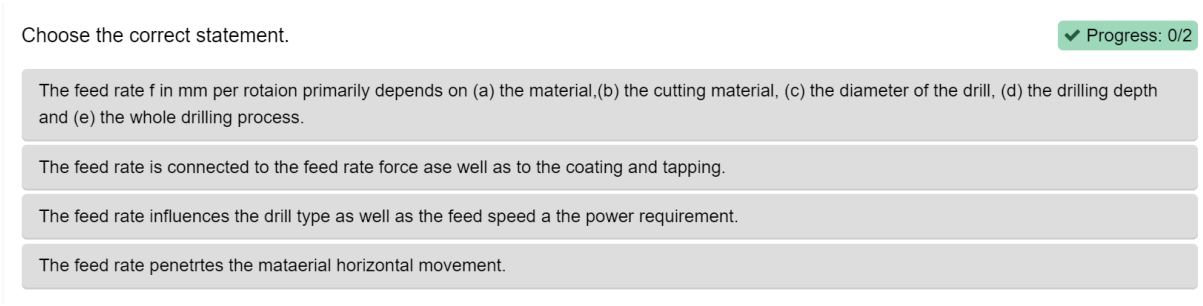


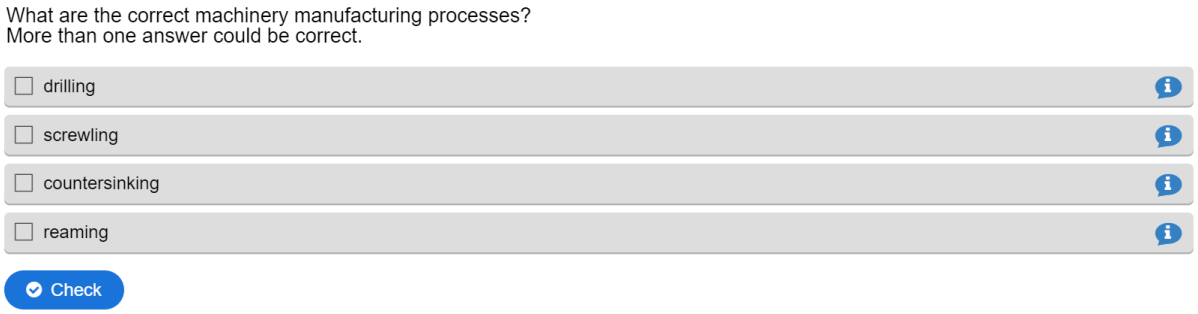
Figure 18: Incision fine-boring head
Source: BARTENSCHLAGER ET AL. (2016, p. 144).

After the theoretical input, now you can test your learned knowledge by doing following interactive tasks.

Task 1) Please choose the right statement:



Task 2) What are the correct machinery manufacturing processes? More than one answer could be correct.



Task 3) Here, you can deepen your knowledge. Unfold the tabs so that you can have a closer look at the summarised definitions.

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

4) Additional learning materials and tasks

In this section you will find additional learning materials and taks to practise the knowledge you have learned. These tasks integrate all topics of the three Learning Units above.
A total of 10 additional task will be provided in this context.

5) Glossary - Basics

Basic Terms and its explainations of "Entry Drilling" Glossary
In this section you will get an overview about all fundamental explainations and descriptions of basic terms concerning the topic "Entry Drilling".

Example:

Countersinking

Another basic process of machinery manufacturing is the Countersinking.

“Countersinking is used to produce profiled or conical surfaces perpendicular to the axis of rotation. As well as drilling, it is based on rough machining. The countersink - a multi-blade tool - produces shaped partial surfaces. In contrast to drilling, however, it does not work into the solid, but into already existing holes. The tool is better guided by several cutting edges, on which the cutting and feed forces are distributed. The cutting speed must be lower, the feed rate can be selected higher than for drilling” (FACHWISSEN TECHNIK 2020, n.p.).

The countersinking process consists of the following core elements:

- Plane counter-boring
- Profile hopping
- Profile Countersinking (cf. BARTENSCHLAGER ET AL. 2016, p. 139).

6) Chat

In this chat you can directly ask questions concerning the topic "Learning Module 1: Entry Drilling" and share your ideas with other learners or teachers. The chat also provides you a place to discuss specific questions or topics.
For learners, the chat is available at any time. Once a week, a teacher will be also available to answer and explain questions. Regarding these specific chat times, please note the announcements in the general forum above.

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

6 Relevance of the development of interactive tasks

Based on the key approaches of EDU-VET Curriculum the didactical conception of innovative and modern learning resources for each of the nine EDU-VET Learning Modules plays a very relevant role. Therefore, EDU-VET intends to develop interactive tasks, especially via H5P, and integrate it into the EDU-VET Learning Platform.

In EDU-VET the course pages provide a core tool for VET teachers and learners which allow them to add, remove and structure activities flexibly. Quizzes and assignments help to structure the courses. At the end of a course or module a general overview is provided to the learners which allows for self-reflection and offers them the opportunity to evaluate their knowledge in the wider context of the whole curriculum. Therefore, the courses and modules are interlinked but designed to fit the needs of the leaners and their own learning paths as well as their learning pace.

Moreover, the partners will create these online tasks via the H5P platform. In total the partners will create at least 80 H5P tasks. Initially, all these tasks will be created in English, and they will then be translated into the languages of the partner institutions (cf. H5P 2020).

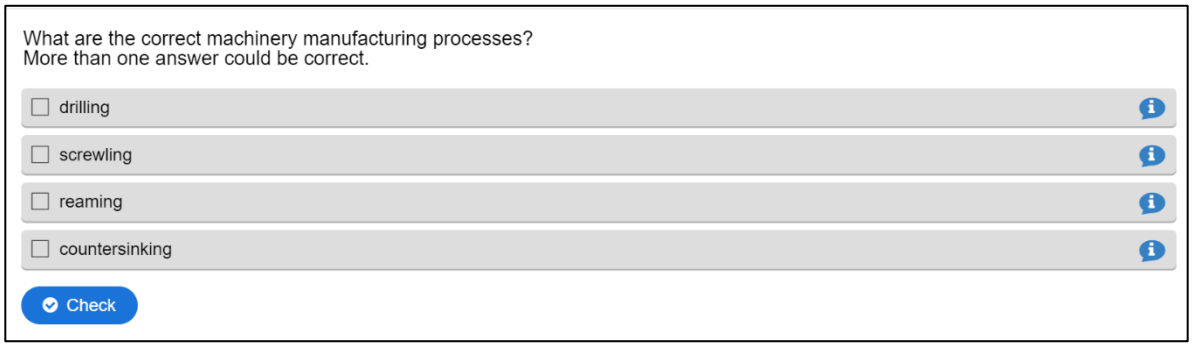
The objective of H5P is the creation of new types of digital learning and teaching material. The following section will give an insight into selected task formats. The platform offers approximately 40 different interactive task types, such as multiple-choice questions, gap filling tasks, arithmetic quizzes, word quizzes, image sliders, and so on (cf. IBID.).

Below, four task types are explained in detail. These tasks have already been created within project activities.

Multiple Choice

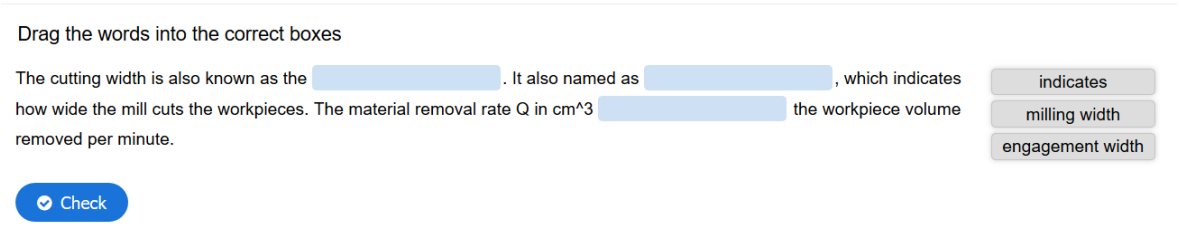
Regarding Module 1, basic and theoretical knowledge can be tested through multiple choice questions. The image below shows an example in which the learners have to name the correct elements of a machinery manufacturing process. There are four response options. The difficulty is that one or more answers might be correct. After selecting possible answers, the learners can check their knowledge by clicking on the “Check” button. They receive feedback immediately and can see the correct answers.

All H5P tasks can be repeated indefinitely depending on the learner's needs. The following H5P tasks is carried out within the Learning Module 1 – Entry Milling.



Gap filling

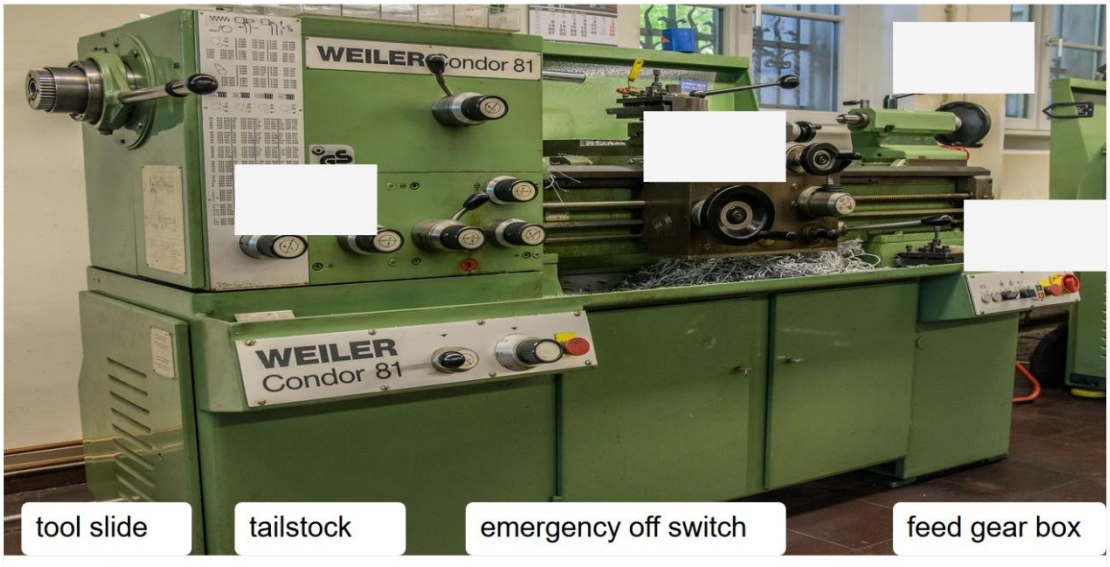
As well as multiple choice questions, the interactive task "Gap filling" is also a suitable task for testing basic and theoretical knowledge. Figure 6 gives a first impression of the possibility to check the knowledge taught in module 3, the milling process. The answer options highlighted with a grey box have to be dragged into the blue boxes. One advantage of this task type is that the degree of difficulty can be very easily adapted to the learners' requirements. Moreover, the scope of the task can also vary as required. The learners receive feedback and the correct answer by clicking on the "Check" button. The following H5P addresses the Learning Module 1 – Entry Drilling.



Drag and Drop

The integration of images with H5P offers a wider range of possible tasks which promote concentration and increase learning success. The task type "Drag and Drop" allows the combination of theoretical knowledge with practical examples. The following task refers to Module 2. Learners are challenged to correctly label a universal lathe. The answer options provided have to be added via drag and drop and placed in the white boxes on the image. When the learners click the "Check" button they will receive the correct answers and brief feedback. The H5P task below is designed for the entry level.

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



Course Presentation

H5P can also be used to integrate learning videos into interactive learning materials. The task type "Course Presentation" allows the embedding of videos and audios. The task below shows an example for turning (Module 2). Within the following task, the learners become familiar with the different tools of the turning processes, and especially the different types of milling cutters. Due to the transmission of knowledge via multiple senses, the video helps the learners to improve their knowledge effectively. The advantage of this task type is that they can watch it at any time, as often as they choose and can thus learn at their own pace. The following task contains the turning process at the entry level (Learning Module 3).

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

Finally, the examples of H5P tasks represent a fit-for-purpose approach to creating interactive online units for innovative learning processes. The key advantage is that H5P can be easily integrated into other systems such as Moodle or WordPress. As a result, the H5P tasks can be integrated quickly and easily into the EDU-VET platform. Furthermore, the level of difficulty of the tasks can be adjusted. Learners have the opportunity to refresh or develop their knowledge independently at any time and in any place. This provides them with the opportunity to improve their knowledge without the support of teachers or trainers, which is an additional objective of this project. The various task types, combined with immediate feedback, ensure an independent, flexible and successful learning process.

Literature

BARTENSCHLAGER, J. / DILLINGER, J. / ESCHERICH, W. / GÜNTER, W. / IGNATOWITZ, E. / OESTERLE, S. / REIßLER, L. / STEPHAN, A. / VETTER, R. 7 WIENEKE, F. (2016): Metal Engineering Textbook. Haan-Griuten: Verlag Europa.

FACHWISSEN TECHNIK (2020): Zerspanungsverfahren. Available at: https://www.fachwissen-technik.de/verfahren/drehen.html, Accessed: 07.10.2020.

FRIESEN, N. (2012): Report: Defining Blended Learning. On the internet: http://learningspaces.org/papers/Defining_Blended_Learning_NF.pdf, date: 01.04.2020.

H5P (2020): H5P software. Available at: https://h5p.org/. Accessed: 03.12.2020.

KERRES, M. (2018): Mediendidaktik. Konzeption und Entwicklung digitaler Lernangebote (5. Aufl.). Berlin: De Gruyter Oldenbourg.

KERRES, M. / DE WITT, C. (2003): A Didactical Framework for the Design of Blended Learning Arrangements. Available at: https://learninglab.uni-due.de/sites/default/files/Draft-JEM-BL_0.pdf, Accessed: 03.10.2020.

KMK (2002): Rahmenlehrplan für den Ausbildungsberuf Metallbauer/Metallbauerin (Beschluss der Kultusministerkonferenz vom 14.05.2002). Available at: https://www.kmk.org/fileadmin/Dateien/pdf/Bildung/BeruflicheBildung/rlp/metallbauer.pdf, Accessed: 03.10.2020.

KMK (2016): Bildung in der digitalen Welt. Strategie der Kultusministerkonferenz. Available at: https://www.kmk.org/fileadmin/Dateien/pdf/PresseUndAktuelles/2017/Strategie_neu_2017_datum_1.pdf, Accessed: 03.10.2020.

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

Annex

Learning Outcome Matrix – Summary

Below the merged LOMs of each project partner will be shown. Please notice that VET in each European country shows differences. For example, regarding the Spanish VET curricula the outcomes are the same for the three levels due to drilling/ reaming/ counterboring/ threadcutting belonging to basic, intermediate and advanced level.

For this reason it should be mentioned that the results of the LOMs have been generalized to have a fundamental basis for the EDU-VET Curriculum. Therefore, in the case of using the Curriculum and LOMs, it is important that the each education system of the several European countries have to be taken into account.

The LOMs can be differentiated according to the level of difficulty:

Level 1: Introductory level (Knowledge tasks)

At this level the knowledge of learners should be trained. Therefore, the tasks only intend to test the knowledge. This can be, for example, the querying of definitions, formulas, etc.

Level 2: Intermediate level (Extended tasks)

At this level the learners should apply the knowledge that they have learned at level 1. This could be, for example, the calculation of formulas.

Level 3: Advanced level (Problem-oriented tasks)

Within this level problem-oriented tasks will be focused. Existing knowledge must be used to activate new knowledge and transfer it to new contexts. For example, this can be trained by case studies or discussion groups.

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

Learning Outcome Matrix: Module 1 (Drilling/ Reaming/ Counterboring/ Threadcutting) - Online scenario (LOM1)

	Outcomes	**Teaching and Learning activities**	**Assessment**
	Having taken this induction/ course, learners will be able to:	**The learners will be taught to achieve this specific outcome through the following learning-activities:**	**The learners will be assessed on their achievement of this specific outcome through the following assessment-tasks:**
Introductory level (12-14 years)	Understand the main aspects, processes and definition of Drilling.	The learners will get informed by a ppt presentation which provides an overview concerning the topic of Drilling.	An online task via H5P and a short evaluation questionnaire are main basis of assessing the right understanding of Drilling.
	Understand the main aspects, processes and definition of Reaming.	The learners will get informed by a ppt presentation which provides an overview concerning the topic of Reaming.	An online task via H5P and a short evaluation questionnaire are main basis of assessing the right understanding of Reaming.
	Understand the main aspects, processes and definition of Counterboring.	The learners will get informed by a ppt presentation which provides an overview concerning the topic of Counterboring.	An online task via H5P and a short evaluation questionnaire are main basis of assessing the right understanding of Counterboring.
	Organise the work in the execution of drilling/reaming/counterboring/threadcutting by interpreting the information contained in the product specifications.	Learners will be informed through a ppt presentation and pdf documentation that provides an overview about drilling/reaming/counterboring/threadcutting.	Online tasks via H5P and an evaluation questionnaire will be used to assess their understanding about these issues.
	Prepare the drill and its tools, recognising its main features and applications.	Learners will be informed through a ppt presentation and pdf documentation and will have to carry out several online activities via H5PA related to calculations needed, selection of tools, etc.; concerning to drilling/reaming/counterboring/threadcutting.	Online tasks via H5P and an evaluation questionnaire will be used to assess their understanding about these issues.

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

	Understand how to use the drill and the equipment involved in drilling processes, taking into account the relationship between its operation, the process conditions and the characteristics of the final product.	Learners will be mainly informed through videos and will have to carry out several online activities via H5PA concerning to practical activities of drilling/reaming/counterboring/threadcutting.	Online tasks via H5P and an evaluation questionnaire will be used to assess their understanding about these issues.
	Recognise labour risk prevention standards by identifying the risks associated with drilling operations.	Learners will be informed through a ppt presentation and pdf documentation that provides an overview about labour risk prevention focused on drilling/reaming/counterboring/threadcutting.	Online tasks via H5P and an evaluation questionnaire will be used to assess their understanding about these issues.
	Understand the health and safety requirements for the safe operation of drilling processes.	The learners will get informed by a ppt presentation which provides an overview of key Health and safety instructions that must be followed.	An online task via H5P and a short evaluation questionnaire is main basis of assessing their understanding on safety.
	Understand the different types of drills of drills that are readily used in the industry.	The learners will get informed by a ppt presentation which provides an insight into drill selection and process.	An online task via H5P and a short evaluation questionnaire on drill selection.
	Understand the main aspects and processes and definitions of Drilling/ Reaming/ Counterboring/ Threadcutting.	The learners will get informed by a ppt presentation which provides an overview concerning the topic of Drilling.	An online task via H5P and a short evaluation questionnaire is main basis of assessing the right understanding of Drilling.
	Understand the drilling / reaming / countersinking / threading operations and be able to apply them where required in practice.	The students are informed by means of teaching material and demonstration videos that provide an overview on the topic of drilling. All this on a digital platform within Office 365.	An online task via Teams where a questionnaire (test) is available and must be completed is the most important basis for assessing the correct understanding of drilling.
	Familiar with the technical terms and concepts listed in the attached table, Cutting force during drilling, formulae, tables, diagrams, technical-	The relevant technical terms, concepts etc. are presented to the learners via "interactive H5P course presentations" using multimedia (in	The learners are given the opportunity to check their learning progress using the appropriate

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

	physical quantities and sources of information/aids listed in the attached table.	particular texts, images, audios, videos and specifically structured interaction tasks) in such a way that they can use these technical terms, concepts and etc. in a self-directed manner Learn "playful" procedures.	elements in the "interactive H5P course presentations.
	Determine main productive time when drilling. Learners are familiar with the technical terms and concepts listed in the attached table, main productive time of use when drilling, formulae, tables, diagrams, technical-physical quantities and sources of information/aids listed in the attached table.	The relevant technical terms, concepts etc. are presented to the learners via "interactive H5P course presentations" using multimedia (in particular texts, images, audios, videos and specifically structured interaction tasks) in such a way that they can use these technical terms, concepts and etc. in a self-directed manner Learn "playful" procedures.	The learners are given the opportunity to check their learning progress using the appropriate elements in the "interactive H5P course presentations".
Intermediate level (14-16 years)	Understand the drilling process.	The learners will get informed by a screencast-session, created by the teacher, which explains the several steps of the drilling process.	An online task via H5P (e. g. assignment of correct terms of drilling process) is main basis of assessing the right understanding of drilling processes.
	Understand the cutting parameters of drilling processes.	The learners will get informed by a screencast-session, created by the teacher, which explains the cutting parameters.	An online task via H5P (e. g. calculation of different cutting parameters) is main basis of assessing the right understanding of cutting parameters.
	Understand the different twist drill types.	The learners will get informed by a ppt presentation which provides an explanation concerning the different twist drill types.	An online task via H5P (e. g. Multiple Choice) and a short evaluation questionnaire are main basis of assessing the right understanding of the different twist drill types.

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

	Document the parts and components that make up a pillar drill.	Learners will be asked to split into pairs, research a pillar drill and document their findings.	Learners will be asked to present their findings in pairs to the rest of the cohort. Produce a drawing of the pillar drill with the main components highlighted.
	Understand the importance of cutting fluid in the drilling process.	The learners will be involved in a group discussion on cutting fluids and their uses. Their own individual points will be discussed.	A short presentation followed by a Q&A session.
	Reading and understanding engineering drawings.	The learners will research engineering drawings and the specific abbreviations that accompany them.	The learners will need to produce a drawing of a base plate with holes at equal measurements.
	Understand the drilling / reaming / countersinking / threading operations and being able to describe how and where to apply them in practice. Both conventional and CNC.	Describing the creation of partial products that contain the aforementioned operations. This can be manual or with machine tools.	The end product will be assessed on the basis of checklists that are completed and compared by the practical teacher and the participant.
	Apply these terms, concepts, etc. in a task- and situation-based way.	The relevant technical terms, concepts etc. are presented to the learners via "interactive H5P course presentations" using multimedia (in particular texts, images, audios, videos and specifically structured interaction tasks) in such a way that they can use these technical terms, concepts and etc. in a self-directed manner Learn "playful" procedures.	The learners are given the opportunity to reflect on their learning progress by creating standardised solution path documentation. This is achieved by using adapted forms and a comparison with experts. This comparison serves as reference solution documentation for the learners.
Advanced level (16-18	Understand the tool selection procedure.	The learners will get informed by a video with a practical example which provides an explanation concerning the tool selection procedure.	On the EDU-VET online learning platform moodle the learners will find the video and an online H5P task (e. g. allocation tasks) which are the main basis

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

			of assessing the right understanding of tool selection procedure.
	Getting to know measures for different types of drilling problems.	The learners will get informed by a ppt presentation and a checklist which provides an overview and explanation concerning the different types of drilling problems.	On the EDU-VET online learning platform moodle learners will find a video which shows different drilling problems. Learners will asked to identify these problems and find a solution. The correct answers can be determined by means of an H5P task (e. g. Multiple Choice).
	Recognise and command the deep-hole drilling and deep drilling.	The learners will get informed by a video with a practical example which provides an explanation concerning the process of deep-hole drilling and deep drilling.	The assessment will be carried out in the moodle platform of EDU-VET (online forum). There will be an easy and time-independent place to discuss, share impressions and get feedback of other learners and teachers.
	Calculate formulas when looking at cutting speeds and drill times.	The learners can achieve theoretical knowledge via self directed learning with the support of the online platform.	The assessment will be carried out on the EDU-VET online platform. The learners must have completed Interactive H5P tasks to acquire theoretical knowledge about how to calculate drill speeds.
	Demonstrate an understanding of materials that can be drilled and their advantages/disadvantages.	The learners can achieve theoretical knowledge via self-directed learning with the support of the online platform.	The assessment will be carried out on the EDU-VET online platform. The learners must have completed Interactive H5P tasks to acquire theoretical knowledge about materials used in drilling.
	Demonstrate knowledge with respects to the quality and compliance of drilling processes.	The learners can achieve knowledge of quality and compliance processes via self-directed learning with the support of the teachers and their systematic coaching.	The assessment will be carried out on the EDU-VET online platform. The learners have to done interactive H5P tasks to acquire theoretical knowledge about quality and compliance of drilling.

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

	Retrieve the correct tools and cutting data for the machining process. And translating this into CNC programs and testing them.	Creating machining sequence and CNC programs containing all machining as taught.	The participants are questioned during their assessment conversation about the knowledge they have acquired.
	Optimize the production process with this data.	The machining sequence, the CNC program are assessed on the basis of established criteria.	
	Determine cutting force drilling and document their approach to the task as well as the partial, intermediate and final results achieved in a clearly legible and easily comprehensible structured way.	The relevant technical terms, concepts etc. are presented to the learners via "interactive H5P course presentations" using multimedia (in particular texts, images, audios, videos and specifically structured interaction tasks) in such a way that they can use these technical terms, concepts and etc. in a self-directed manner Learn "playful" procedures.	Learners are given the opportunity to carry out such comparative reflections with fellow students and/or experienced practitioners/teachers. This can be done in synchronous and/or asynchronous contact situations with oral and/or written forms of communication.

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

Learning Outcome Matrix: Module 1 (Drilling/ Reaming/ Counterboring/ Threadcutting) - Classroom scenario (LOM2)

	Outcomes	**Teaching and Learning activities**	**Assessment**
	Having taken this induction/ course, learners will be able to:	**The learners will be taught to achieve this specific outcome through the following learning-activities:**	**The learners will be assessed on their achievement of this specific outcome through the following assessment-tasks:**
Introductory level (12-14 years)	Understand the main aspects, processes and definition of Drilling.	The teacher who provides an overview (Texts in textbook, worksheets) concerning the topic of Drilling will inform the learners.	The Drilling fundamental processes will be shown in the metal workshop by the teachers to assess the right understanding of Drilling.
	Understand the main aspects, processes and definition of Reaming.	The teacher who provides an overview (Texts in textbook, worksheets) concerning the topic of Reaming will inform the learners.	The Drilling fundamental processes will be shown in the metal workshop by the teachers to assess the right understanding of Reaming.
	Understand the main aspects, processes and definition of Counterboring.	The teacher who provides an overview (Texts in textbook, worksheets) concerning the topic of Counterboring will inform the learners.	The Drilling fundamental processes will be shown in the metal workshop by the teachers to assess the right understanding of Counterboring.
	Organise the work in the execution of drilling/reaming/counterboring/threadcutting by interpreting the information contained in the product specifications.	The teacher who provide a review the main topics related to drilling/reaming/counterboring/threadcutting processes using face-to-face lessons in classroom and workshop.	A task and an evaluation questionnaire will be used to assess their understanding about these issues.
	Prepare the drill and its tools, recognising its main features and applications.	Several practical tasks will be proposed to learners to be carried out in the workshop.	A task and an evaluation questionnaire will be used to assess their understanding about these issues.

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

	Carry out basic drilling/reaming/counterboring/threadcutting operations.	Several practical tasks will be proposed to learners to be carried out in the workshop.	A task and an evaluation questionnaire will be used to assess their understanding about these issues.
	Comply with labour risk prevention and environmental protection standards, identifying the risks associated with drilling/reaming/counterboring/threadcutting operations.	The teacher who provide a review the main topics related to labour risk prevention and environmental protection standards belonging to counterboring/threadcutting processes using face-to-face lessons in classroom and workshop.	A task and an evaluation questionnaire will be used to assess their understanding about these issues.
	Understand the health and safety requirements for the safe operation of drilling processes.	The teacher who provides an overview concerning the topic of Drilling will inform the learners.	The learners will be introduced into the workshop. They must provide knowledge of the mandatory PPE requirements.
	Understand the different types of drills of drills that are readily used in the industry.	Demonstration by the tutor on a range of drilling processes.	The learner will demonstrate their ability to select the correct drill and consumables for a specific work piece.
	Understand the main aspects and processes and definitions of Drilling/ Reaming/ Counterboring/ Threadcutting..	The teacher who provides an overview concerning the topic of Drilling will inform the learners.	The Drilling fundamental processes will be shown in the metal workshop by the teachers to assess the right understanding of Drilling. The learner must demonstrate a good understanding of the health and safety required in a workshop environment.
	Understand the drilling / reaming / countersinking / threading operations and be able to apply them where required in practice.	In the classroom, the theoretical teaching material will be treated by means of textbooks, videos and practical examples.	In theory, the student's knowledge is tested on paper.

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

Intermediate level (14-16 years)	Understand the drilling process.	The learners can achieve these knowledge aspects via self directed learning with the support of the trainers.	The assessment will take place in the direct communication situation and can be carried out in discussion forums as well to get direct feedback by the teacher.
	Understand the cutting parameters of drilling processes.	The learners can achieve these knowledge aspects via self directed learning with the support of the trainers. Learners can also work on tasks to calculate parameters of drilling processes.	The assessment will take place in the direct communication situation and can be carried out in discussion forums as well to get direct feedback by the teacher.
	Understand the different twist drill types.	The participants discuss a presentation about different twist drill types. They create an own working team and set roles to design a flipchart presentation themselves to highlight the key aspects.	The assessment will be via creating an own team to achieve an aim is the basis for understanding the different twist drill types.
	Prepare and tune drill, equipment, tools up involved in the drilling/reaming/counterboring/threadcutting process, applying the techniques and procedures required.	Several practical tasks will be proposed to learners to be carried out in the workshop.	A task and an evaluation questionnaire will be used to assess their understanding about these issues.
	Use the drill and the equipment involved in drilling/reaming/counterboring/threadcutting processes, taking into account the relationship between its operation, the process conditions and the characteristics of the final product.	Several practical tasks will be proposed to learners to be carried out in the workshop.	A task and an evaluation questionnaire will be used to assess their understanding about these issues.
	Comply with labour risk prevention and environmental protection standards, identifying the risks associated with	Learners will have to put into practice this knowledge when they are carrying out the practical tasks proposed in the workshop.	Learners will be assessed according to the implementation of these standards when they are

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

	drilling/reaming/counterboring/threadcutting operations.		carrying out the practical tasks proposed in the workshop.
	Understand the parts and components that make up a pedestal drill.	Locate the pillar drill in the workshop and draw a sketch of the parts of the drill – take health and safety into consideration.	After naming the parts of the drill, safely demonstrate how to complete pre start checks and ensure specific safety measures are in place.
	Understand the importance of cutting fluid in the drilling process.	Split into pairs. Locate the COSHH data sheets for the cutting fluids and discuss.	Produce a report on the cutting fluids and the safety information required. Demonstrate workshop awareness.
	Reading and understanding engineering drawings.	Learner will locate engineering drawings that are already existing in the workshop. Choose a specific drawing.	Using own engineering drawing of the base plate demonstrate the ability to produce the base plate.
	Understand the drilling / reaming / countersinking / threading operations and being able to describe how and where to apply them in practice. Both conventional and CNC.	In the classroom, the theoretical teaching material will be treated by means of textbooks, videos and practical examples. The students will apply this when making practical assignments under the supervision of a teacher	The theory is tested on paper. In practice, the assignments are assessed on the basis of measurement lists that are completed by both the student and the teacher.
Advanced level (16-18 years)	Understand the tool selection procedure.	The learners think about the tool selection procedure and take part in a discussion.	The assessment of getting to know the tool selection procedure can be carried out best in an oral way in a discussion process.
	Adopt measures for different types of drilling problems.	The adoption process will be learned in short case studies which will be analysed and combined with practical experiences. These experiences will be integrated in creating own learning contents.	The assessment of the adopting process will be done in two way, creating an own short learning content by the learners and a group discussion with feedback on these created contents.

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

	Recognise and command the deep-hole drilling and deep drilling.	The learners will go through a life demonstration. Therefore, the are forced to see and reflect the actions and also to do all actions themselves.	The assessment will take place in the direct communication situation and can be carried out in discussion forums as well to get direct feedback by teachers and other learners.
	Calculate formulas when looking at cutting speeds and drill times.	The learners can achieve theoretical knowledge via self directed learning with the support of the online platform.	Find out if the machines capability to set a Speed Rate make a note of how this is achieved. Demonstrate ability to chage the speed of the drill.
	Demonstrate an understanding of materials that can be drilled and their advantages/disadvantages.	The learners can achieve theoretical knowledge via self directed learning with the support of the online platform.	Produce a table with the recomended speeds of drilling dependant on material selection. Demonstrate drilling on a variety of materials
	Demonstrate knowledge with respects to the quality and compliance of drilling processes.	Research the types of measuring tools that are used in an engineering workshop. Highlight those specific to the drilling process and document their advantages and limitations.	The learner must demonstrate the correct use of specific measuring tools when carrying out quality checks on drilled holes – base plate can be used.
	Retrieve the correct tools and cutting data for the machining process. And to apply this in practice and on an internship by means of programming and editing on a CNC machine.	In the classroom, the theoretical material will be treated by means of textbooks, videos and practical examples. Further additional information is obtained by the student at the internship company. The theoretical knowledge will be applied at this internship company by making real pieces of work.	The theory is tested on paper. In practice, the assignments are assessed on the basis of measurement lists that are completed by both the student and the teacher. The student makes a portfolio of his work. This is discussed at the end of the training during the assessment interview.

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

Learning Outcome Matrix: Module 2 (Turning) - Online scenario (LOM3)

	Outcomes	**Teaching and Learning activities**	**Assessment**
	Having taken this induction/ course, learners will be able to:	**The learners will be taught to achieve this specific outcome through the following learning-activities:**	**The learners will be assessed on their achievement of this specific outcome through the following assessment-tasks:**
Introductory level (12-14 years)	Understand the main aspects and definition of Turning.	The learners will get informed by a ppt presentation which provides an overview concerning the topic of Turning.	An online task via H5P and a short evaluation questionnaire are main basis of assessing the right understanding of Turning.
	Know about the differentiation between three chip types (rupture chips, shearing chips, continuous chips).	The learners will get informed pdf work sheets/ online materials (e. g. texts from Online textbook) which provides an overview concerning the topic of chip types.	An online task via H5P (e. g. allocation tasks) and a short evaluation questionnaire are main basis of assessing the right understanding of different chip types.
	Know about the differentiation between chip forms.	The learners will get informed by a ppt presentation which provides an overview concerning the topic of chip forms.	An online task via H5P (e. g. drawings – allocation of terms) and a short evaluation questionnaire (e. g. Multiple Choice) are main basis of assessing the right understanding of chip forms.
	Organise the work in the execution of basic turning processes by interpreting the information contained in the product specifications.	Learners will be informed through a ppt presentation and pdf documentation that provides an overview about basic turning processes.	Online tasks via H5P and an evaluation questionnaire will be used to assess their understanding about these issues.
	Do a basic preparation of the lathe and its tools, recognising its features and applications.	Learners will be informed through a ppt presentation and pdf documentation and will have to carry out several online activities via H5PA related to calculations needed, selection of tools, etc.; concerning to turning.	Online tasks via H5P and an evaluation questionnaire will be used to assess their understanding about these issues.

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

	Understand how to carry out basic turning operations.	Learners will be mainly informed through videos and will have to carry out several online activities via H5PA concerning to practical activities of turning.	Online tasks via H5P and an evaluation questionnaire will be used to assess their understanding about these issues.
	Recognise labour risk prevention standards by identifying the risks associated with turning operations.	Learners will be informed through a ppt presentation and pdf documentation that provides an overview about labour risk prevention focused on turning.	Online tasks via H5P and an evaluation questionnaire will be used to assess their understanding about these issues.
	Understand the health and safety requirements for the safe operation of turning processes.	The learners will get informed by a ppt presentation which provides an overview concerning the topic of turning.	An online task via H5P and a short evaluation questionnaire is main basis of assessing the learners understanding of Health and safety in turning.
	Understand the different types of lathes that are readily used in the industry.	The learners will get informed by a ppt presentation which provides an overview concerning the topic of turning.	An online task via H5P and a short evaluation questionnaire is main basis of ensuring lathe selection is correct.
	Understand the main aspects and processes and definitions of turning.	The learners will get informed by a ppt presentation which provides an overview concerning the topic of turning.	An online task via H5P and a short evaluation questionnaire is main basis of assessing the right understanding of turning.
	Understand the drilling / reaming / countersinking / threading operations and be able to apply them where required in practice.	The students are informed by means of teaching material and demonstration videos that provide an overview on the topic of drilling. All this on a digital platform within Office 365.	An online task via Teams where a questionnaire (test) is available and must be completed is the most important basis for assessing the correct understanding of drilling.
Inter media te	Understand the different types and its characteristics of a turning process.	The learners will go through a life demonstration. The learners will get informed by a video with practical examples which provides explanations	The assessment will be carried out on the EDU-VET online platform. The learners have to done interactive H5P tasks to acquire theoretical

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

		concerning the different types and its characteristics of a turning process.	knowledge about the characteristics of the different types of a turning process.
	Know about characteristics and applications of different cutting-edge designs.	The learners can achieve theoretical knowledge via self directed learning with the support of the online platform.	The assessment will be carried out on the EDU-VET online platform. The learners have to done interactive H5P tasks to acquire theoretical knowledge about characteristics and applications of different cutting-edge designs.
	Recognise cutting-edge angles for various machining types.	The learners will go through a life demonstration. Therefore, the are forced to see and reflect the cutting-edge angles for various machining types the actions and also to use it themselves.	The assessment will be carried out on the EDU-VET online platform. The learners have to watch online learning videos to have insights in practical examples and also acquire theoretical knowledge about cutting-edge angles for various machining types.
	Organise the work in the execution of turning processes, analysing the process sheet and the product specifications, preparing the documentation required.	Learners will be informed through a ppt presentation and pdf documentation that provides an overview about turning processes.	Online tasks via H5P and an evaluation questionnaire will be used to assess their understanding about these issues.
	Prepare the lathe, choosing the tools and applying the required techniques and procedures.	Learners will be informed through a ppt presentation and pdf documentation and will have to carry out several online activities via H5PA related to calculations needed, selection of tools, etc.; concerning to turning.	Online tasks via H5P and an evaluation questionnaire will be used to assess their understanding about these issues.
	Understand how to use the lathe and the equipment involved in turning processes, taking into account the relationship between its	Learners will be mainly informed through videos and will have to carry out several online activities	Online tasks via H5P and an evaluation questionnaire will be used to assess their understanding about these issues.

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

	operation, process conditions and features of the final product.	via H5PA concerning to practical activities of turning.	
	Document the parts and components that make up a conventional lathe.	Learners will be asked to split into pairs, research a lathe and document their findings.	Learners will be asked to present their findings in pairs to the rest of the cohort. Produce a drawing of the pillar drill with the main components highlighted.
	Understand the importance of cutting fluid in the turning process.	The learners will be involved in a group discussion on cutting fluids and their uses. Their own individual points will be discussed.	A short presentation followed by a Q&A session.
	Reading and understanding engineering drawings.	The learners will research engineering drawings and the specific abbreviations that accompany them – related to turning operations.	The learners will need to produce a drawing of a base plate with holes at equal measurements.
	Understand the drilling / reaming / countersinking / threading operations and being able to describe how and where to apply them in practice. Both conventional and CNC.	Describing the creation of partial products that contain the aforementioned operations. This can be manual or with machine tools.	The end product will be assessed on the basis of checklists that are completed and compared by the practical teacher and the participant.
Advanced level (16-18 years)	Know about the theory and facilitating of the preparation process of a machine (including testing of NC-programme).	The learners can achieve theoretical knowledge via self directed learning with the support of the online platform.	The assessment will be carried out on the EDU-VET online platform. The learners have to done interactive H5P tasks to acquire theoretical knowledge about the preparation of a machine.
	Calculate the theoretical surface roughness.	The leaners have to do online work sheets and have to do different tasks to apply the formula of the theoretical surface roughness.	Online tasks via H5P (e. g. application of formulas) and a short evaluation questionnaire (e. g. Multiple Choice) are main basis of assessing the right understanding and calculating the theoretical surface roughness.

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

	Discuss about possibilities which are available for producing short broken chips.	The learners discuss in an online session the possibilities which are available for producing short broken chips.	The assessment can be carried out best in an oral way in a discussion process via online discussion forums on the EDU-VET online learning platform. Learners will asked to identify these possibilities and find a solution. The correct answers can be determined by means of an H5P task (e. g. Multiple Choice).
	Organise the work in the execution of CNC turning processes, analysing the process sheet and preparing the documentation required.	Learners will be informed through a ppt presentation and pdf documentation that provides an overview about CNC turning processes.	Online tasks via H5P and an evaluation questionnaire will be used to assess their understanding about these issues.
	Prepare the CNC lathe, choosing the tools and applying the required techniques and procedures.	Learners will be informed through a ppt presentation and pdf documentation and will have to carry out several online activities via H5PA related to calculations needed, selection of tools, etc.; concerning to turning. They will also program the CNC lathe and use simulators to check the results with regard to the specifications.	Online tasks via H5P and an evaluation questionnaire will be used to assess their understanding about these issues.
	Understand how to use the CNC lathe and the equipment involved in CNC turning processes, taking into account the relationship between its operation, process conditions and features of the final product.	Learners will be mainly informed through videos and will have to carry out several online activities via H5PA concerning to practical activities of turning.	Online tasks via H5P and an evaluation questionnaire will be used to assess their understanding about these issues.
	Know about the theory and facilitating of the preparation process of a machine (including testing of NC-programme).	The learners can achieve theoretical knowledge via self directed learning with the support of the online platform.	The assessment will be carried out on the EDU-VET online platform. The learners have to done interactive H5P tasks to acquire theoretical knowledge about the preparation of a machine.

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

	Calculate formulas when looking at cutting speeds and feeds times.	The learners can achieve theoretical knowledge via self directed learning with the support of the online platform.	The assessment will be carried out on the EDU-VET online platform. The learners have to done interactive H5P tasks to acquire theoretical knowledge about the preparation of a machine.
	Demonstrate knowledge with respects to the quality and compliance of turning processes.	The learners can achieve theoretical knowledge via self directed learning with the support of the online platform.	The assessment will be carried out on the EDU-VET online platform. The learners have to done interactive H5P tasks to acquire theoretical knowledge about the preparation of a machine.
	Retrieve the correct tools and cutting data for the machining process. And translating this into CNC programs and testing them.	Creating machining sequence and CNC programs containing all machining as taught.	The participants are questioned during their assessment conversation about the knowledge they have acquired.
	Optimize the production process with this data.	The machining sequence, the CNC program are assessed on the basis of established criteria.	

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

Learning Outcome Matrix: Module 2 (Turning) - Classroom scenario (LOM4)

	Outcomes	**Teaching and Learning activities**	**Assessment**
	Having taken this induction/ course, learners will be able to:	**The learners will be taught to achieve this specific outcome through the following learning-activities:**	**The learners will be assessed on their achievement of this specific outcome through the following assessment-tasks:**
Introductory level (12-14 years)	Understand the main aspects and definition of Turning.	The teacher who provides an overview (Texts in textbook, worksheets, figures) concerning the topic of Turning will inform the learners.	The Turning fundamental processes will be shown in the metal workshop by the teachers to assess the right understanding of Turning. In the classroom the teacher shows work pieces to explain the Turning.
	Know about the differentiation between three chip types (rupture chips, shearing chips, continuous chips).	The teacher who provides an overview (Texts in textbook, worksheets, figures) concerning the topic of the differentiation between three chip types will inform the learners.	The assessment will take place in the direct communication situation in the classroom. There will be feedback sessions and oral support by the teacher.
	Know about the differentiation between chip forms.	The teacher who provides an overview (Texts in textbook, worksheets, figures) concerning the topic of differentiation between chip forms will inform the learners.	The assessment will take place in the direct communication situation in the classroom. There will be feedback sessions and oral support by the teacher.
	Organise the work in the execution of basic turning processes by interpreting the information contained in the product specifications.	The teacher who provide a review the main topics related to turning processes using face-to-face lessons in classroom and workshop.	A task and an evaluation questionnaire will be used to assess their understanding about these issues.
	Do a basic preparation of the lathe and its tools, recognising its features and applications.	Several practical tasks will be proposed to learners to be carried out in the workshop.	A task and an evaluation questionnaire will be used to assess their understanding about these issues.

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

	Carry out basic turning operations.	Several practical tasks will be proposed to learners to be carried out in the workshop.	A task and an evaluation questionnaire will be used to assess their understanding about these issues.
	Comply labour risk prevention standards by identifying the risks associated with turning operations.	The teacher who provide a review the main topics related to labour risk prevention and environmental protection standards belonging to turning processes using face-to-face lessons in classroom and workshop.	A task and an evaluation questionnaire will be used to assess their understanding about these issues.
	Understand the health and safety requirements for the safe operation of turning processes.	The teacher provides a demonstration on safe operations concerning the topic of turning and will inform the learners.	The learners will be introduced into the workshop. They must provide knowledge of the mandatory PPE requirements.
	Understand the different types of lathes that are readily used in the industry.	Demonstration by the tutor on a range of drilling processes.	The learner will demonstrate their ability to select the correct lathe and consumables for a specific work piece.
	Understand the main aspects and processes and definitions of turning.	The teacher who provides an overview concerning the topic of turning will inform the learners.	The turning fundamental processes will be shown in the metal workshop by the teachers to assess the right understanding of lathes. The learner must demonstrate a good understanding of the health and safety required in a workshop environment.
	Understand the operations and be able to apply them where required in practice.	In the classroom, the theoretical material will be treated by means of textbooks, videos and practical examples.	In theory, the student's knowledge is tested on paper.
Intermediate level (14-16	Understand the different types and its characteristics of a turning process.	The learners discuss a presentation about different types and its characteristics of a turning process and its characteristics. They create an own working team and set roles to design a flipchart	The assessment will be via creating working groups to achieve an understanding of the different types and its characteristics of a turning process with the

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

		presentation themselves to highlight the key characteristics of a turning process.	aim to present and discuss their results in the whole class.
	Know about characteristics and applications of different cutting-edge designs.	The learners go through different characteristics and applications of different cutting-edge designs and create own poster overviews.	Direct communicative feedback by teacher/ other learners and short overview descriptions allow to assess the characteristics and applications of different cutting-edge designs.
	Recognise cutting-edge angles for various machining types.	The learners discuss these points in a discussion group.	Direct communicative feedback processes allow to recognize cutting-edge angles for various machining types.
	Prepare and tune lathe, equipment, tools up involved in the turning process, applying the techniques and procedures required.	Several practical tasks will be proposed to learners to be carried out in the workshop.	A task and an evaluation questionnaire will be used to assess their understanding about these issues.
	Use the lathe and the equipment involved in turning processes, taking into account the relationship between its operation, process conditions and features of the final product.	Several practical tasks will be proposed to learners to be carried out in the workshop.	A task and an evaluation questionnaire will be used to assess their understanding about these issues.
	Comply with labour risk prevention and environmental protection standards, identifying the risks associated with turning processes.	Learners will have to put into practice this knowledge when they are carrying out the practical tasks proposed in the workshop.	Learners will be assessed according to the implementation of these standards when they are carrying out the practical tasks proposed in the workshop.
	Document the parts and components that make up a conventional lathe.	Locate the pillar drill in the workshop and draw a sketch of the parts of the drill – take health and safety into consideration.	After naming the parts of the lathe, safely demonstrate how to complete pre start checks and ensure specific safety measures are in place.

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

	Understand the importance of cutting fluid in the turning process.	Split into pairs. Locate the COSHH data sheets for the cutting fluids and discuss.	Produce a report on the cutting fluids and the safety information required. Demonstrate workshop awareness.
	Reading and understanding engineering drawings.	Learner will locate engineering drawings that are already existing in the workshop. Choose a specific drawing	Using own engineering drawing of the base plate demonstrate the ability to produce the base plate
	Understand the operations and describe how and where to apply them in practice. Both conventional and CNC.	In the classroom, the theoretical material will be treated by means of textbooks, videos and practical examples. The students will apply this when making practical assignments under the supervision of a teacher.	The theory is tested on paper. In practice, the assignments are assessed on the basis of measurement lists that are completed by both the student and the teacher.
Advanced level (16-18 years)	Know about the theory and facilitating of the preparation process of a machine (including testing of NC-programme).	The learners can achieve this knowledge via self directed learning with the support of the teachers and their systematic coaching.	The assessment will take place in the direct communication situation and directly on the machine.
	Calculate the theoretical surface roughness.	The learners go through different tasks and practice to calculate the theoretical surface roughness.	The assessment will take place in the classroom. The learners work on the assignments on their own and can ask the teacher if they have any questions.
	Discuss about possibilities which are available for producing short broken chips.	The learners discuss these points in a discussion group.	The assessment will take place in the direct communication situation. Direct communicative feedback processes allow to assess possibilities which are available for producing short broken chips.
	Prepare the CNC lathe, choosing the tools and applying the required techniques and procedures.	Several practical tasks will be proposed to learners to be carried out in the workshop.	A task and an evaluation questionnaire will be used to assess their understanding about these issues.

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

	Use the CNC lathe and the equipment involved in CNC turning processes, taking into account the relationship between its operation, process conditions and features of the final product.	Several practical tasks will be proposed to learners to be carried out in the workshop.	A task and an evaluation questionnaire will be used to assess their understanding about these issues.
	Comply with labour risk prevention and environmental protection standards, identifying the risks associated with turning processes.	Learners will have to put into practice this knowledge when they are carrying out the practical tasks proposed in the workshop.	Learners will be assessed according to the implementation of these standards when they are carrying out the practical tasks proposed in the workshop.
	Preparing the machine (including testing of NC-programme).	The learners can achieve these knowledge via self directed learning with the support of the teachers and their systematic coaching.	The assessment will take place in the direct communication situation and directly on the machine.
	Calculate formulas when looking at cutting speeds and feeds times.	The learners can achieve these knowledge via self directed learning with the support of the teachers and their systematic coaching.	The assessment will take place in the direct communication situation and directly on the machine.
	Demonstrate knowledge with respects to the quality and compliance of turning processes.	The learners can achieve these knowledge via self directed learning with the support of the teachers and their systematic coaching.	The assessment will take place in the direct communication situation and directly on the machine.
	Retrieve the correct tools and cutting data for the machining process. And to apply this in practice and on an internship by means of programming and editing on a CNC machine.	In the classroom, the theoretical material will be treated by means of textbooks, videos and practical examples. Further additional information is obtained by the student at the internship company. The theoretical knowledge will be applied at this internship company by making real pieces of work.	The theory is tested on paper. In practice, the assignments are assessed on the basis of measurement lists that are completed by both the student and the teacher. The student makes a portfolio of his work. This is discussed at the end of the training during the assessment interview.

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

Learning Outcome Matrix: Module 3 (Milling) - Online scenario (LOM5)

	Outcomes	**Teaching and Learning activities**	**Assessment**
	Having taken this induction/ course, learners will be able to:	**The learners will be taught to achieve this specific outcome through the following learning-activities:**	**The learners will be assessed on their achievement of this specific outcome through the following assessment-tasks:**
Introductory level (12-14 years)	Know about the safety when grinding.	The learners will get informed by a ppt presentation and by online guidelines which provides an overview concerning the safety when grinding.	An online task via H5P (e. g. Multiple Choice) and a short evaluation questionnaire are main basis of assessing the right understanding of safety when grinding.
	Know about the advantages of grinding.	The learners will get informed by an online video which will be provided on the EDU-VET online learning platform to get an overview about the advantages of grinding.	An online video and a short evaluation questionnaire are main basis of assessing the right understanding of the advantages of grinding.
	Know about different types of abrasive tools.	The learners will get informed by a ppt presentation and by online work sheets which provides an overview concerning the different types of abrasive tools.	An online task via H5P (e. g. Multiple Choice, allocation tasks) and a short evaluation questionnaire are main basis of assessing the right understanding of different types of abrasive tools.
	Organise the work in the execution of basic milling processes by interpreting the information contained in the product specifications.	Learners will be informed through a ppt presentation and pdf documentation that provides an overview about basic milling processes.	Online tasks via H5P and an evaluation questionnaire will be used to assess their understanding about these issues.
	Do a basic preparation of the milling machine and its tools, recognising its features and applications.	Learners will be informed through a ppt presentation and pdf documentation and will have to carry out several online activities via H5PA	Online tasks via H5P and an evaluation questionnaire will be used to assess their understanding about these issues.

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

		related to calculations needed, selection of tools, etc.; concerning to milling.	
	Understand how to carry out basic milling operations.	Learners will be mainly informed through videos and will have to carry out several online activities via H5PA concerning to practical activities of milling.	Online tasks via H5P and an evaluation questionnaire will be used to assess their understanding about these issues.
	Recognise labour risk prevention standards by identifying the risks associated with milling operations.	Learners will be informed through a ppt presentation and pdf documentation that provides an overview about labour risk prevention focused on milling.	Online tasks via H5P and an evaluation questionnaire will be used to assess their understanding about these issues.
	Understand the health and safety requirements for the safe operation of milling processes.	The learners will get informed by a ppt presentation which provides an overview concerning the topic of Drilling.	An online task via H5P and a short evaluation questionnaire is main basis of assessing the right understanding health and safety in respect of milling.
	Understand the different types of milling machines that are readily used in the industry.	The learners will get informed by a ppt presentation which provides an overview concerning the topic of Drilling.	An online task via H5P and a short evaluation questionnaire is main basis of assessing the right understanding of milling.
	Understand the main aspects and processes and definitions of milling.	The learners will get informed by a ppt presentation which provides an overview concerning the topic of Drilling.	An online task via H5P and a short evaluation questionnaire is main basis of assessing the right understanding of milling.
	Understand the milling operations and be able to apply them where required in practice.	The students are informed by means of teaching material and demonstration videos that provide an overview on the topic of drilling. All this on a digital platform within Office 365.	An online task via Teams where a questionnaire (test) is available and must be completed is the most important basis for assessing the correct understanding of drilling.

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

Intermediate level (14-16 years)	Know about the characteristics and differentiations of universal milling machines.	The learners go through the EDU-VET online observatory and watch life demonstration of Best-Practices. Therefore, they are forced to see and reflect the characteristics of universal milling machines.	Based on life demonstrations of Best-Practices the learners compare the characteristics and differentiations of universal milling machines provided by the EDU-VET Online Observatory with own experiences and rate the situations.
	Use measures concerning the safety when grinding.	The learners discuss these points in the Online discussion forum of the EDU-VET learning platform and create poster in online break-out sessions in working groups.	Direct communicative feedback and presentation of posters allow to assess the measures concerning the safety when grinding.
	Know and use the safety rules when grinding.	The learners create explanations videos in working groups and upload them on EDU-VET online learning platform.	Creation of explanation videos allow to understand and use the safety rules when grinding. The learners work on the assignments in a working group and allow to reflect the results.
	Organise the work in the execution of milling processes, analysing the process sheet and the product specifications, preparing the documentation required.	Learners will be informed through a ppt presentation and pdf documentation that provides an overview about milling processes.	Online tasks via H5P and an evaluation questionnaire will be used to assess their understanding about these issues.
	Prepare the milling machine, choosing the tools and applying the required techniques and procedures.	Learners will be informed through a ppt presentation and pdf documentation and will have to carry out several online activities via H5PA related to calculations needed, selection of tools, etc.; concerning to milling.	Online tasks via H5P and an evaluation questionnaire will be used to assess their understanding about these issues.
	Understand how to use the milling machine and the equipment involved in milling processes, taking into account the relationship between its operation,	Learners will be mainly informed through videos and will have to carry out several online activities	Online tasks via H5P and an evaluation questionnaire will be used to assess their understanding about these issues.

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

	process conditions and features of the final product.	via H5PA concerning to practical activities of milling.	
	Document the parts and components that make up a conventional lathe.	Learners will be asked to split into pairs, research a milling machine and document their findings.	Learners will be asked to present their findings in pairs to the rest of the cohort. Produce a drawing of the milling machine with the main components highlighted.
	Understand the importance of cutting fluid in the turning process.	The learners will be involved in a group discussion on cutting fluids and their uses. Their own individual points will be discussed.	short presentation followed by a Q&A session.
	Reading and understanding engineering drawings.	The learners will research engineering drawings and the specific abbreviations that accompany them – related to milling operations.	The learners will need to produce a drawing of a base plate with holes at equal measurements.
	Understand the machining operations and describe how and where to apply them in practice. Both conventional and CNC.	Describing the creation of partial products that contain the aforementioned operations. This can be manual or with machine tools.	The end product will be assessed on the basis of checklists that are completed and compared by the practical teacher and the participant.
Advanced level (16-18 years)	Understand the fundamental and theoretical basis of NC programming.	The learners go through the EDU-VET online platform and edit online tasks.	The assessment will take place on the EDU-VET online platform to do H5P self-testing online tasks.
	Recognize the effect of high grinding heat on a workpiece.	The effect of high grinding heat on a workpiece will be learned in short online case studies. Best-practices on the EDU-VET Online Observatory will be the basis for analysing and combining the effect and also creating the online case study.	The assessment will be done in two ways, creating an own short learning content and the reflection of the Best-Practices which will be provided on the EDU-VET Online Observatory.

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

	Create a work plan for cylindrical grinding.	The procedure concerning the cylindrical grinding will be learned by creating a MOOC in working groups.	The assessment will take place in the direct online communication situation and can be carried out in online discussion forums (break-out sessions) as well to get direct feedback.
	Organise the work in the execution of CNC milling processes, analysing the process sheet and preparing the documentation required.	Learners will be informed through a ppt presentation and pdf documentation that provides an overview about CNC milling processes.	Online tasks via H5P and an evaluation questionnaire will be used to assess their understanding about these issues.
	Prepare the CNC milling machine, choosing the tools and applying the required techniques and procedures.	Learners will be informed through a ppt presentation and pdf documentation and will have to carry out several online activities via H5PA related to calculations needed, selection of tools, etc.; concerning to turning. They will also program the CNC milling machine and use simulators to check the results with regard to the specifications.	Online tasks via H5P and an evaluation questionnaire will be used to assess their understanding about these issues.
	Understand how to use the CNC milling machine and the equipment involved in CNC milling processes, taking into account the relationship between its operation, process conditions and features of the final product.	Learners will be mainly informed through videos and will have to carry out several online activities via H5PA concerning to practical activities of milling.	Online tasks via H5P and an evaluation questionnaire will be used to assess their understanding about these issues.
	Understand the fundamental and theoretical basis of NC programming.	The learners go through the EDU-VET online platform and edit online tasks.	The assessment will take place on the EDU-VET online platform to do H5P self-testing online tasks.
	Calculate formulas when looking at cutting speeds and feeds times.	The learners go through the EDU-VET online platform and edit online tasks.	The assessment will take place on the EDU-VET online platform to do H5P self-testing online tasks.
	Demonstrate knowledge with respects to the quality and compliance of turning processes.	The learners go through the EDU-VET online platform and edit online tasks.	The assessment will take place on the EDU-VET online platform to do H5P self-testing online tasks.

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

	Retrieve the correct tools and cutting data for the machining process. And translating this into CNC programs and testing them.	Creating machining sequence and CNC programs containing all machining as taught.	The participants are questioned during their assessment conversation about the knowledge they have acquired.
	Optimize the production process with this data.	The machining sequence, the CNC program are assessed on the basis of established criteria.	

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

Learning Outcome Matrix: Module 3 (Milling) - Classroom scenario (LOM6)

	Outcomes	**Teaching and Learning activities**	**Assessment**
	Having taken this induction/ course, learners will be able to:	**The learners will be taught to achieve this specific outcome through the following learning-activities:**	**The learners will be assessed on their achievement of this specific outcome through the following assessment-tasks:**
Introductory level (12-14 years)	Know about the safety when grinding.	The participants discuss a presentation about safety aspects when grinding. They create an own working groups and set roles to design a flipchart presentation themselves to highlight the key aspects of safety guidelines.	The assessment will be via creating a flipchart in an own group to discuss the main aspects of safety when grinding.
	Know the advantages of grinding.	The learners are discuss different points of view and take part in a pro-contra discussion.	The assessment of getting to know the advantages of grinding can be carried out best in an oral way in a discussion process.
	Know about different types of abrasive tools.	The teacher who provides an overview (Texts in textbook, worksheets, figures) concerning the topic of the different types of abrasive tools will inform the learners.	The assessment will take place in the direct communication situation in the classroom. There will be feedback sessions and oral support by the teacher.
	Organise the work in the execution of basic milling processes by interpreting the information contained in the product specifications.	The teacher who provide a review the main topics related to milling processes using face-to-face lessons in classroom and workshop.	A task and an evaluation questionnaire will be used to assess their understanding about these issues.
	Do a basic preparation of the milling machine and its tools, recognising its features and applications.	Several practical tasks will be proposed to learners to be carried out in the workshop.	A task and an evaluation questionnaire will be used to assess their understanding about these issues.

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

	Carry out basic milling operations.	Several practical tasks will be proposed to learners to be carried out in the workshop.	A task and an evaluation questionnaire will be used to assess their understanding about these issues.
	Comply labour risk prevention standards by identifying the risks associated with milling operations.	The teacher who provide a review the main topics related to labour risk prevention and environmental protection standards belonging to milling processes using face-to-face lessons in classroom and workshop.	A task and an evaluation questionnaire will be used to assess their understanding about these issues.
	Understand the health and safety requirements for the safe operation of milling processes.	The learners will get informed by a ppt presentation which provides an overview concerning the topic of milling.	An online task via H5P and a short evaluation questionnaire is main basis of assessing the right understanding of milling.
	Understand the different types of milling machines that are readily used in the industry.	The learners will get informed by a ppt presentation which provides an overview concerning the topic of milling.	An online task via H5P and a short evaluation questionnaire is main basis of assessing the right understanding of milling.
	Understand the main aspects and processes and definitions of milling.	The learners will get informed by a ppt presentation which provides an overview concerning the topic of milling.	An online task via H5P and a short evaluation questionnaire is main basis of assessing the right understanding of milling.
	Understand the milling operations and be able to apply them where required in practice.	In the classroom, the theoretical material will be treated by means of textbooks, videos and practical examples.	In theory, the student's knowledge is tested on paper.
Intermediate level (14-16	Documenting and presenting the manufacturing process.	The learners discuss different points of view and take part in a pro-contra discussion.	The assessment of getting to know their own ways of presenting and documenting manufacturing processes can be carried out in an oral way in a discussion process.

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

	Use measures concerning the safety when grinding.	The leaners discuss these points in a discussion group and create posters in working groups.	Direct communicative feedback and short overview descriptions via posters allow to assess measures concerning the safety when grinding.
	Know and use the safety rules when grinding.	The learners will create a handbook with safety guidelines when grinding via self directed learning with the support of the teacher.	The assessment will take place in the direct communication situation and can be carried out in the classroom as well to get direct feedback by the teacher and other learners.
	Prepare and tune milling machine, equipment, tools up involved in the milling process, applying the techniques and procedures required.	Several practical tasks will be proposed to learners to be carried out in the workshop.	A task and an evaluation questionnaire will be used to assess their understanding about these issues.
	Use the milling machine and the equipment involved in milling processes, taking into account the relationship between its operation, process conditions and features of the final product.	Several practical tasks will be proposed to learners to be carried out in the workshop.	A task and an evaluation questionnaire will be used to assess their understanding about these issues.
	Comply with labour risk prevention and environmental protection standards, identifying the risks associated with milling processes.	Learners will have to put into practice this knowledge when they are carrying out the practical tasks proposed in the workshop.	Learners will be assessed according to the implementation of these standards when they are carrying out the practical tasks proposed in the workshop.
	Documenting and presenting the manufacturing process.	The learners discuss different points of view and take part in a pro-contra discussion.	The assessment of getting to know their own ways of presenting and documenting manufacturing processes can be carried out in an oral way in a discussion process.
	Understand the importance of cutting fluid in the turning process.	Split into pairs. Locate the COSHH data sheets for the cutting fluids and discuss .	Produce a report on the cutting fluids and the safety information required. Demonstrate workshop awareness.

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

	Reading and understanding engineering drawings.	Learner will locate engineering drawings that are already existing in the workshop. Choose a specific drawing.	The learners will need to produce a drawing of a base plate with holes at equal measurements.
	Understand the machining operations and describe how and where to apply them in practice. Both conventional and CNC.	In the classroom, the theoretical material will be treated by means of textbooks, videos and practical examples. The students will apply this when making practical assignments under the supervision of a teacher.	The theory is tested on paper. In practice, the assignments are assessed on the basis of measurement lists that are completed by both the student and the teacher.
Advanced level (16-18 years)	Understand the fundamental and theoretical basis of NC programming.	The teacher who provides an overview (videos, texts in textbook, worksheets, figures) concerning the theoretical basis of NC programming will inform the learners. Additionally the teacher shows NC programming directly on the machine to train the practical knowledge of NC programming.	The assessment will be trained in two ways. The fundamental and theoretical basis of NC programming will be shown in the classroom via didactical learning materials (video, work sheets). The practical basis of NC programming will be shown in the metal workshop by the teachers to assess the right understanding of it.
	Recognize and adopt the effect of high grinding heat on a workpiece.	The adoption process will be learned in short case studies which will be analysed and combined with practical experiences. These experiences will be integrated in practical adoption.	The assessment of the adopting process will be done in two ways, creating a short case study and the integration and combination, based on practical experiences, of practical adoption. Moreover the assessment can be carried out in a group discussion as well to get direct feedback.
	Create a work plan for cylindrical grinding.	The participants go through different approaches and create own work plans.	Direct communicative feedback and creation of work plans allow to assess preparation process for cylindrical grinding.

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

	Prepare the CNC milling machine, choosing the tools and applying the required techniques and procedures.	Several practical tasks will be proposed to learners to be carried out in the workshop.	A task and an evaluation questionnaire will be used to assess their understanding about these issues.
	Use the CNC milling machine and the equipment involved in CNC milling processes, taking into account the relationship between its operation, process conditions and features of the final product.	Several practical tasks will be proposed to learners to be carried out in the workshop.	A task and an evaluation questionnaire will be used to assess their understanding about these issues.
	Comply with labour risk prevention and environmental protection standards, identifying the risks associated with milling processes.	Learners will have to put into practice this knowledge when they are carrying out the practical tasks proposed in the workshop.	Learners will be assessed according to the implementation of these standards when they are carrying out the practical tasks proposed in the workshop.
	Understand the fundamental and theoretical basis of NC programming.	The learners can achieve these knowledge via self directed learning with the support of the teachers and their systematic coaching.	The assessment will take place in the direct communication situation and directly on the machine.
	Calculate formulas when looking at cutting speeds and feeds times.	The learners can achieve these knowledge via self directed learning with the support of the teachers and their systematic coaching.	The assessment will take place in the direct communication situation and directly on the machine.
	Demonstrate knowledge with respects to the quality and compliance of turning processes.	The learners can achieve these knowledge via self directed learning with the support of the teachers and their systematic coaching.	The assessment will take place in the direct communication situation and directly on the machine.

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

	Retrieve the correct tools and cutting data for the machining process. And to apply this in practice and on an internship by means of programming and editing on a CNC machine.	In the classroom, the theoretical teaching material will be treated by means of textbooks, videos and practical examples. Further additional information is obtained by the student at the internship company. The theoretical knowledge will be applied to this internship company by making real pieces of work.	The theory is tested on paper. In practice, the assignments are assessed on the basis of measurement lists that are completed by both the student and the teacher. The student makes a portfolio of his work. This is discussed at the end of the training during the assessment interview.