

## EDU-VET

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

#### IO1 Summary Pedagogic Research Report

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**Project partners:**

P1	University Paderborn (UPB), DE
P2	Ingenious Knowledge GmbH (IK), DE
P3	Berufskolleg Bocholt-West (BKBW), DE
P4	Lancaster and Morecambe College (LMC), UK
P5	Centro Integrado de Formación Profesional Someso (CIFP), ES
P6	Stichting BE Oost-Gelderland (SBEOG), NL



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## 1 Executive Summary

This Summary Pedagogic Research Report focuses on the research results concerning the desk-based research and field-based research concerning the Intellectual Output 1. Moreover, this report presents findings acquired in a research process carried out between November 2019 to August 2020 by six project partners in four European countries (Germany, Spain, United Kingdom and the Netherlands) in the framework of the EDU-VET project (E-Learning, Digitisation and Units for Learning at VET schools – Creating online Learning Environments in Technical Education for European metal industry), financed by the Erasmus+ Programme of the European Commission.

The project focuses on the development of specific e-learning courses. For this reason, the partners will design a curriculum, an online teaching approach for learning technical education at vocational schools. This supports both teachers with appropriate learning resources as well as learners with innovative modern ways to deal with topics and learning activities. In summary, EDU-VET focuses on the design and development of a bespoke curriculum and corresponding e-Learning course units for VET in the metal industry. Partners will work on developing a modular curriculum to support effective and innovative learning in the field. Partners are also proposing the development of a training resource to facilitate the engagement of VET professionals with the new curriculum resources and online learning environments.

The proposed research to be conducted in each partner country will:

- identify modules to be developed in the EDU-VET curriculum;
- highlight topics to be addressed in the courses by the VET professionals;
- inform the design of the curriculum modules to ensure that high-quality standards are achieved in content production;
- get a common feedback on the use of learning units and online courses in the field of VET for metal industry.

Responses to all of the above will inform the curriculum framework and learning outcomes matrix, which will be used to guide all development actions. The curriculum framework will present content and learning outcome guidance notes on a module-by-module basis, to support the development work of partners ensuring that all the areas of required learning identified are appropriately considered and addressed. Using this learning outcomes approach as a key element of the pedagogic strategy allows individual learning content to be localised, taking into account the different cultural patterns in partner countries, without compromising the value of the learning resource.

Based on these main objectives the research was conducted in two ways. On the one hand, a desk-based research acquired through literature review. On the other hand, a field-based research acquired through a survey questionnaire and interviews with teachers and trainers in the metal sector.

The results based on the literature research and existing resources and experiences and was conducted by all partners. Part 1 presents an introduction to the report. Part 2 focuses on a text focusing on the existing resources and didactic materials at the own institution, which can be a basis for the work in the other IOs. Here learning and teaching materials will be addressed. Part 3 shows a text focusing on existing experiences with new media, e-Learning and blended learning. Part 4 highlights a text on key skill areas of a VET curriculum in the metal sector. Part 5 summarises the findings.



In Part B findings from the field-based research are shown. The research was achieved through both qualitative and quantitative parts. The general research questions of this research in EDU-VET are:

- What are the key skill areas that need to be addressed in the VET curriculum for the metal industry?
- What are the key skill levels that are appropriate for local target groups?
- What existing resources could be used or re-designed for use in the courses and the curriculum to avoid duplication?
- What are the most appropriate media formats for learning content for target groups in each partner country?
- What type of assessment framework would be most appropriate to facilitate the measurement of attainment?
- What types of pedagogic supports are needed to facilitate VET teachers and tutors into the new proposed blended learning environment?
- What are the most appropriate technology platforms to be developed as e-learning environments?

The first part of the field-based research, the interview study, from each partner consists of 4 interviews with teachers and trainers in the metal sector. The second part of the field-based research from each partner consists of a quantitative survey. Each partner should provide answers from at least 100 participants to ensure that each answer stands at least for just 1 percent and no less.

Part C presents results from the specific research performed by the project partner Ingenious Knowledge (IK) regarding the best practice e-learning environments and best practice mini-learning format resources to be used in designing the proposed curriculum.

The following part provides an overview about the Learning Outcome Matrices identified from both desk and field research, to be envisaged by the EDU-VET curriculum.

The last part of the report contains some overall statements on the current situation in participating countries regarding digitisation and learning in innovative ways in the metal sector. Finally, it provides some recommendations in the context.

## 2 Introduction

Digitisation – With more than 50,500,000 (September 2020) entries on Google, the megatrend of digitisation, caused by global change, illustrates the importance of digitisation in every organisational context. Especially in the field of education, the relevance of digital change is increasing. Nevertheless, digitisation also requires challenges in the education sector. Consequently, it is necessary to improve the education system with innovative knowledge and ways of learning and teaching to meet the challenges of digitisation. For vocational schools digitisation becomes a challenge. The learners are a new medium because they use technical devices such as smartphones and tablets in their daily lives. However, digitization is not yet a huge focus in school.

For vocational schools digitisation is becoming a challenge. Learners are used to new media because they use technical devices like smart phones and tablets in their daily life. But, at school digitisation is



not yet a huge focus. For teachers and VET-schools the changes in social life and in the economy lead to new requirements. In the future VET-schools have to provide not only Smartboards or a PC room to show they are ready for a changing situation in life but they also have to focus on providing courses online and integrate eLearning in their daily teaching activities. And this is a core anchor point for the EDU-VET project.

The Erasmus+-project EDU-VET (“E-Learning, Digitisation and Units for Learning at VET schools – Creating online Learning Environments in Technical Education for European metal industry”) addresses the challenges of the rapidly changing environment in the economy and the transfer of this into pedagogical settings.

The main objective of the EDU-VET project is to create new teaching and learning environments for VET. The project focuses on the development of e-learning courses. For this reason, the partners will design a curriculum, an online teaching approach for learning technical education at vocational schools. This supports both teachers with appropriate innovative learning resources as well as learners with innovative modern ways to deal with topics and learning activities.

### 3 Part A: Results of the literature review in partner countries

Part A presents the findings of the desk-based research of all partners. Firstly, the existing experiences with new media, e-Learning and blended learning will be shown. Therefore, the existing teaching and learning materials can be also described. Finally, it is followed by the presentation of key skill areas of a VET curriculum in the metal sector will be focused.

#### 3.1 Existing experiences with new media, e-Learning and blended learning

Based on the national research reports, there are lots of experiences from the different areas of VET because the EDU-VET project team exists of VET teachers, scientific actors and education specialists combined with technical and pedagogic expertise.

##### *The University of Paderborn (UPB), Germany*

The University of Paderborn, represented by Prof. Dr. Marc Beutner, coordinator of this project, has many years of experiences with new media, e-Learning and blended learning scenarios because the Chair professor Marc Beutner done lots of research activities in this field. His research fields are active citizenship and fostering youth in Europe, the development of new e-learning methods, innovative learning approaches, career orientation, vocational education and training (VET), didactics and evaluation. Moreover, he and his team created several e-learning tools for didactical use of e-learning in the field of higher education. Examples of successfully completed Erasmus+ projects in this field are MATH, GET-UP, Shadows, SMART, Learning Map, YES etc.

Concerning to existing learning materials, UPB developed within the Erasmus+-project MATH a handbook with several mathematical exercises. These tasks are designed to foster basic mathematical skills. They are additional didactical materials which can be used in the classroom in combination with the MATH App. The MATH App will be explained in the next chapter. These tasks cover topics such as the Pythagorean Theorem, fractional arithmetic, percentage calculations or calculations of slopes (cf. BEUTNER 2019, pp. 18ff). This math exercises are very suitable regarding the EDU-VET project because

these tasks form a fundamental basis for the training in the metal sector. Furthermore, it would be possible to give these types of tasks to trainees at the beginning of their training, so that they can refresh and develop their knowledge.

According to the MATH App, you also find the blended learning approach. Here the App can be played in a face-to-face scenario or by using the MATH App via mobile phone. Moreover, MATH provided tasks in its MATH Handbook. These tasks are created to foster basic mathematical skills. They are additional didactical materials which can be used in the classroom in combination with the App. Blended learning is a mix of e-Learning and classroom instruction (cf. FRIESEN 2012, p. 2). The following illustration shows the blended learning setting with the MATH App:

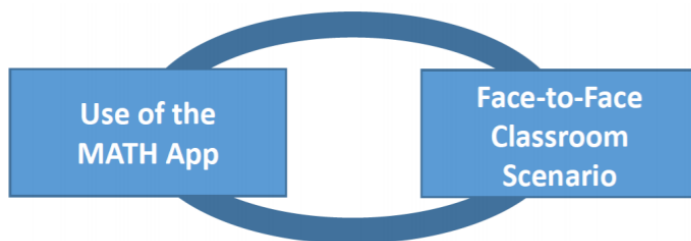


Figure 1: Blended Learning – Scenario with MATH App  
 Source: BEUTNER (2019, p. 15).

### *Ingenious Knowledge (IK), Germany*

Ingenious Knowledge consists of a combination of education specialists, game designers, graphic designers and artists, and programmers. Combining technical expertise with pedagogic expertise is a strength that sets the company apart from most other companies in this field. Ingenious Knowledge has been active in adult, youth & child education, working in various European and national projects. In recent years it has made important developments in creating a new generation of serious games in vocational education, creating authentic learning situations that can be used individually or in blended learning scenarios. An example would be the games "The Copy Job" and "The Fair Project".

### *Berufskolleg Bocholt-West (BKBW), Germany*

The Berufskolleg Bocholt-West is a vocational college/ VET school in the commercial-technical and domestic sector. At Berufskolleg Bocholt-West the following activities and experiences are available: On the one hand, there are first practical experience in the promotion and motivation of students with special need for support through the use of new teaching / learning methods (e.g. IT tools such as Moodle and Lonet). On the other hand, BKBW shows first practical experience with game-based forms of instruction through the use of resources from Erasmus + projects in the previous year, also these aids serve the motivation and promotion of low-motivated students.

Furthermore, BKBW has focused on technical education. Dual education for technical professions in particular is a large part of the school's range of courses. A crucial key for the vocational college is that the learners not only learn the theoretical framework of specialist knowledge, but can also put the learned content into practice. Accordingly, the school sees itself as a link between theory and practice.



A wide variety of utensils, resources and didactic materials are available to the students for implementing the learned content. The workshop represents an essential part of this. Here the learners learn different practices which are necessary for their later activities. The workshop is a large hall in which various tools, machines or other material stocks are stored, which can be used under the supervision of a trained teacher. In addition to the different work areas, the workshop also offers areas in which group work or individual work can take place. Presentations can also be held using active boards or multifunctional screens. A separate PC room offers learners the opportunity to plan a CNC-controlled activity or to develop further work steps. Here the trainees can use suitable software to simulate the plans and check their accuracy. Important parts of the workshop are the own workplaces, where, among other things, smaller and larger assembly and production work can take place. The students are provided with tools such as hammers and files, but also measuring utensils. The workplaces are also individually adjustable, which means that the learners can set up and adjust the workstation according to the task at hand.

Regarding experiences with E-Learning BKBW uses the learning platform Moodle to focus on learning technical terms and concepts. The curriculum is currently designed in such a way that the form of "blended learning" is used and pure electronic learning is rarely used. Although the tasks have to be processed on the computer or other digital media, the learners need additional tools and components to solve them. For example, they have to research information for the problems in their own analogue documents. Also some tasks have to be solved with teamwork, whereby the social component is promoted by the system of blended learning. However, the focus is on the new media and Moodle.

#### *Lancaster and Morecambe College (LMC), United Kingdom*

Lancaster and Morecambe College is very fortunate to have a wide range of equipment that learners can use. The College Campus itself is split into several sectors, offering a wide range of commercial courses and apprenticeships. Here students can learn and develop new skills, these courses range from engineering to sports to hair and beauty. Lancaster and Morecambe College has delivered these types of courses, in post-16 & adult education, for over 50 years. The engineering department has trade-specific workshops, with separate areas for fabrication & welding, machining and mechanical maintenance.

In the fabrication and welding department, learners can practice their welding by entering the individual welding booths, there are 12 in total, where learners will be expected to partner up. This then ensures that peer to peer marking is incorporated. Here the trainer/tutor is able to demonstrate the welding process to students (wearing industry-relevant PPE) in a real-work environment. Video aids could be used to teach online also using the same method. Here all forms of welding processes are studied and mastered, for example MIG/MAG, MMA & TIG. All machines are calibrated and fitted with the correct type of shielding gas, where necessary.

Courses and frameworks that are delivered by Lancaster and Morecambe college, are done so using a wide range of methods. Despite face to face and classroom delivery being the core method of delivery within the college, the technological advancements and development of these courses means that a blended learning approach can be evidenced throughout.





Tutors can demonstrate, practically, a wide range of skills, which learners can then replicate either as an individual or by working with one of their peers. Lesson plans are created by the tutors and these are stored electronically on a shared folder. Tutors can use video aids to assist with demonstrations and when assessing the learner's abilities, tablets and mobile phones can be used to capture both photographic and video footage and record professional discussions. Learners can describe knowledge gained throughout their journey and gain valuable experience in interview and employability skills. Learners work to and must learn to understand engineering drawings.

#### *Centro Integrado de Formación Profesional Someso (IFP), Spain*

CIFP Someso is a vocational school and is active in innovative learning and teaching. Concerning the existing resources and didactic material at the institution, they can be classified according to 3 categories: Machinery, Technical software and Digital didactic materials.

According to the first one Machinery CIFP has a large number of industrial machinery resources at the workshops belonging to the mechanical manufacturing area, for example conventional lathe, conventional milling machines, CNC lathe milling machines or an industrial welding robot etc.

Regarding the Technical software CIFP, these technical software packages are available for teachers and students. CIFP offers e.g. AUTOCAD, SOLIDWORKS, VINTECH, MICROSOFT PROJECT etc.

Moreover, CIFP Someso has a wide academic offering with different options available for students: conventional, adults, blended learning and dual-system. In order to make it easier to access didactic resources and to improve the quality of learning process, most of the teachers use multimedia technologies and Internet. In fact, some of these teachers have implanted “virtual classrooms” using a Moodle platform. The range of virtual classroom subjects is very large. Here, “Grafical interpretation”, “Manufacturing processes implementation” or “Production scheduling” can be presented as examples for virtual classroom subjects.

Against this background blended training has been developed at CIFP Someso since 2010 through 2 higher education VET diplomas. During the implementation of these diplomas under the blended learning option, the teachers in charge of the subjects had to develop part of the teaching materials because some of them hadn't been developed while others were incomplete or outdated.

#### *Stichting BVE Oost-Gelderland, Graafschap College (SBEOG), Netherlands*

Graafschap College is a Europe oriented organisation, supporting student and staff mobility and expertise exchange. Their main goals are further enhancing personal and professional development of participants, sharing expertise in the field of vocational education and concepts. The technology sector of Graafschap College consists of several departments, including the Industrial Engineering department. Within this department they have 34 different courses. These courses are within the field of Metal, Mechatronics, Precision Technique, Process Technique, Infra (high voltage and gas).

Within the teacher group of the industrial engineering department, most teachers are highly skilled. SBEOG works with e-touch screens in the classrooms of all training courses for a while now. Many of its modules that are given can also be accessed through our digital learning tools. The students have indicated that two digital platforms are used and are experienced as very pleasant. These are Office 365 (Teams, SharePoint, and OneNote) and It's Learning. Within the County College, various methods



of didactic working methods are used to ensure that the student is as closely as possible aligned with the different ways of learning.

Based on these existing experiences with e-Learning, SBEOG also follows the blended-learning approach, but the college is still in its initial phase and developing this approach in a very constantly way. Moreover, within the County College SBEOG has a special department that deals with ICT innovations within education. STRAX is the platform for educational innovation within the County College. It's sector-transcending and is always looking for the latest trends in the field of educational development with and without ICT. STRAX looks at the way education is organised in an ever-changing society. Social developments, developing students and new technologies, theories and insights demand from the education that they adapt time and time again to prepare our students optimally for an after-school life. At STRAX, these developments have a place. By working with teachers and educationalists to see what is happening in educational innovation or where energy lies to tackle something, SBEOG ensures that every educational development gets the support and attention it needs to become a key resource.

### 3.2 Key skill areas of a VET curriculum in the metal sector

#### ***Key skill areas that need to be addressed in the EDU-VET proposed curriculum in the metal sector***

Most of the key skill areas identified within the national reports are based on policies and strategies of the national ministries of education. As a result, uniform guidelines at a European level does not exist. For this reason, it is necessary to identify key skill areas for developing a VET curriculum in the metal sector within the project EDU-VET.

Digital competences, methodological and learning competences are required for mastering networked systems. These competences are necessary for developing, building and operating these systems. Moreover, there are other key skill areas of a VET curriculum in the metal sector. These also include technical competences (Professional competences), action competences, personal competences and social competences. (*Germany*)

The goal for trainees in the metal sector is "the acquisition and development of occupational and interdisciplinary competence to act", which enables pupils to act in professional, social and private situations (MINISTERIUM FÜR SCHULE UND BILDUNG DES LANDES NORDRHEIN-WESTFALEN 2019, p. 7). "By promoting the skills for lifelong learning as well as flexibility, reflection and mobility, the young people are to be prepared for a successful professional life in a changing economic and working world at national and international level" (IBID). (*Germany*)

- "It is vital that employers have the workforce they need to enable them to grow and prosper in a global economy. They need the provision to be both relevant and of high quality" (WOLF 2011). So, the need for a learner/student to embrace Digital skills is growing more important. With the technology that is becoming more available and the need to be able to operate basic systems such as Microsoft software, learners are encouraged to evidence their skills in different ways. Within the curriculum and apprenticeship standards, it is a minimum requirement that Level 1 is achieved and Level 2 attempted (Level 2 qualifications) and a minimum of Level 2 achieved for a Level 3 qualification. (*United Kingdom*)



Based on the Spanish National System for Qualifications and Vocational Education and Training (SNCFP) the following objectives have to be fundamentally intended for the EDU-VET curriculum:

- To adapt the professional training to the qualification demands of productive organizations
- To facilitate the adaptation of supply and demand on the labour market
- To extend lifelong learning beyond the traditional educational period
- To promote the freedom of movement for workers (*Spain*)

Particularly, professional and subject-related skills need to be intensified in the VET metal sector. Against this background, firstly it is necessary to teach the basic knowledge, for example: Basic metalworking (Drilling, tapping, filing, drawing, drawing reading and knowledge of materials), Basic construction (Bending, lace, welding, welding symbols, types of welding, welding stresses and the way of welding), Basic sheet metal (sides), Basic machining (conventional turning and milling and setting), Basic electrical engineering (Reading simple diagrams, making wiring, lamps, recorders, sensors, name parts), Basic mounting techniques (bolt screw joints, bearings, gears, chain wheels), Knowledge of materials and material properties, Occupational health and safety. (*The Netherlands*)

### **Key skill levels that are appropriate to local target groups**

Although the key skill levels of the target groups in partner countries vary quite a lot, a common trend on the level that should be targeted was identified and refers to Level 1 (Introductory level), Level 2 (Intermediate level) and Level 3 (Advanced level):

In *Germany*, training in the metal industry takes place in a dual system, so that the quality of training in terms of technical skills is very well developed at all three competence levels. On the other hand, there is an increased need for fostering digital competences in schools and companies. These skills are only taught in a very limited extent.

Concerning the *United Kingdom*, it is necessary to improve the education system with innovative knowledge and ways of learning and teaching to face the pitfalls of digitisation. For vocational schools digitisation becomes a challenge. The learners are a new medium because they use technical devices such as smartphones and tablets in their daily lives. The need for an online curriculum has increased due to the COVID19 situation as more companies are choosing to operate remotely.

In *Spain*, most VET schools and companies are in line with the most demanded professional profiles within the Spanish labour market through the intermediate and upper level diplomas hosted in their academic offering (technician in Machining and higher technician in Mechanical Production Scheduling), with the exception of the approach more focused on mechanical design. Its main drawback has to do with curriculum since it's necessary to update them. Thus, the updating of the VET curricula is required so as to give an appropriate and sufficient response to the changing Spanish labour market of the metal sector. It is not only a matter of enhancing the current contents but of including new ones, and fostering those which are worthy.

In *the Netherlands*, the digitisation process at schools and companies is at an appropriate level and is constantly evolving. In fact, the range of existing e-learning materials is very large, so students are quickly overwhelmed by it. Especially students at the lower levels have huge difficulties when learning



with these materials. Therefore, they need more support than students at higher levels. Thus, it is necessary to develop structured online learning material.

### ***Most appropriate media formats for learning content for target groups***

All national researches unanimously recommend, as being appropriate for the project target groups, a combination of face-to-face and online learning methods (blended-learning approach), with a focus and higher emphasis on the latter. The online environments provide easy access and distribution of the learning resources. The media formats most needed and expected to produce successfully results are: audio-video files and video clips, online platforms, slide-shows (PPTs), digital tools, webinars, MOOCs, interactive tasks (H5P), online showroom with best-practices. The Moodle platform seems to widely accommodate all learning requirements of the target groups.

### ***Type of assessment framework that would be most appropriate to facilitate the measurement of attainments***

The assessment should be built around several crucial elements: overall aim, learning outcomes, delivery methods and assessment methods. It should be also accompanied by clear and timely feedback. The research at national level revealed a common vision upon the assessment framework of the EDU-VET curriculum and E-Learning modules, achievable through a complex combination of assessment:

#### Competence level:

- Level 1: Introductory level (refers to 12-14 years)
- Level 2: Intermediate level (refers to 14-16 years)
- Level 3: Advanced level (refers to 16-18 years)

#### Methods:

Blended-Learning approach:

- Classroom scenario
- Online scenario

#### Tools:

- Classroom scenario: tests, case studies, discussions, creating posters and flipcharts, group work, exercises/worksheets, assessment using technology-based simulators in workshops, workbook, best-practices, self-directed learning, life demonstration
- Online Scenario: H5P tasks, surveys, quizzes, questionnaires, peer evaluation, group work via break-out sessions, online discussion forum, EDU-VET Online Observatory, online video, slide-show (PPTs), creation of explanation videos, online case studies.

### ***Most appropriate technology platforms to be developed as e-learning environments***

The national research reports show that different learning platforms are already being implemented in schools and integrated into teaching processes.



In *Germany* the learning platform Moodle is preferred. Moodle allows the integration of the H5P application. Moreover, there are existing learning Apps like the MATH App which focus on learning basic mathematical knowledge.

The VET schools in the *United Kingdom* use the applications of Microsoft Office 365. Platforms such as Kahoot are used to create fun online quizzes. The teachers also use a platform called ebs on-track.

In *Spain* VET studies taught through PLATEGA platform were classified as blended learning and not online. This platform is based on the Moodle tool.

In the *Netherlands*, Microsoft Office H5P office programmes are also used. Additionally, they also use the learning platform It's Learning.

Summarising, based on the reports and the previous experiences of the project partners and our technical project partner IK, the Moodle platform seems to be most suitable for delivering the EDU-VET curriculum in a blended-learning approach.

## 4 Part B: Results of the questionnaires and interviews applied in partner countries

Part B represents the results of the qualitative and quantitative research studies applied in partner countries. Firstly, the key results of the interviews will be shown. Secondly, this chapter focuses on the main results of the questionnaire survey.

### 4.1 Key results of the interviews

The following part summarises the key results of the interviews to a total of 21 persons. The interview study of each partner consists of 4 to 5 interviews with teachers and trainers from the metal sector. Due to the Corona Pandemic most interviews were conducted online or via telephone.

The questions in the qualitative interviews with teachers and trainers in the metal sector are following:

- Please, describe your position in vocational education and training (VET) in your institution.
- Are you involved in assessment of VET? And if yes, how?
- Please, describe your experiences in VET in your country?
- What is your VET target group within the metal sector?
- Are you familiar with e-learning?
- Can you explain the difference between e-learning and blended learning?
- What skills and skill levels concerning manufacturing work pieces does your target group need with regard to their work in the metal sector?
- Is the topic “Drilling/Reaming/Counter boring/Thread cutting” important for your target group? If yes: Why? - If no: Why not?
- Is the topic “Turning” important for your target group? If yes: Why? - If no: Why not?
- Is the topic “Milling” important for your target group? If yes: Why? - If no: Why not?
- What sort of didactic materials and resources do you have already which can be useful for the EUD-VET project?
- Describe your former experiences online learning units.



- What type of pedagogic supports do you need to be facilitated into online learning and proposed blended learning environments?
- Do you like to work with specific media format and especially new media formats?
- What can be the strengths of e-learning in the metal sector?
- What could be challenges of e-learning in the metal sector?
- What teacher skills do you think will be required to work with e-learning or blended learning in VET teaching in the metal sector?
- Do you have any additional comments?

The table (see Appendix, Part A) summarizes the answers obtained from all interviews and provides a more detailed overview.

In summary, the results of the qualitative study show that most of the interviewed teachers and trainers have a huge pool of experience in the metal sector. Moreover, the majority have a basic or even advanced knowledge of e-learning and digital media. So that very helpful and suitable insights for EDU-VET can be drawn.

Almost all respondents see the topics Milling, Drilling and Turning as basic knowledge in metal professions. For this reason, the modules which have to be developed within the EDU VET Curriculum will be focused on those topics.

Unfortunately, many teachers do not have didactic materials or learning resources that can be used for EDU-VET. However, some teachers offer their support within creating EDU-VET tasks by sharing their knowledge and experience with the project team.

Concerning the required pedagogic support to be facilitated into online learning and proposed blended learning environments, most of the teachers and trainers want to expand media literacy. Besides, they would like to prepare courses for the creation of online learning materials. Particularly, the trainers intend a regular exchange with learners, VET schools and companies.

Against this background, the respondents also use the following new media formats in class: internal e-learning platforms e.g. Moodle, H5P, active boards, video, audio, document camera, smartboards etc.

According to the chances or advantages of e-learning, the interviewed persons focus on following aspects:

- Independence in using (place and time)
- More flexibility
- Students can access the course anytime and anywhere
- Wide range of additional tasks
- Attractive presentation of materials
- Decoupling of communication processes (for teacher, pupils, parents and trainers etc.)
- Different ways to communicate: Chat, Videos, etc.

In contrast to the advantages, there are also disadvantages and challenges:





- Lack of IT skills
- Learners don't have access to equipment
- Students need to get practice with real machines, which goes far beyond any simulator available
- Language difficulties
- Students are distracted on-line and can no longer concentrate on their work
- Technology-led sessions can demotivate
- No action-oriented lessons possible
- Limited integration of practical experiences
- Very demanding for students regarding:
  - mental abstraction
  - organization
  - persistence
  - determination

## 4.2 Key results of the questionnaires

This part presents the key results from questionnaires applied in partner countries to a total of 531 persons. The questionnaire study was conducted online or paper based.

Ingenious Knowledge did not provide data from the field research (see Part C). The distribution of respondents per country is rendered in the table below.

	GER (UPB)	GER (BKBW)	UK	ES	NL
<b>No of Participants</b>	106	101	115	101	108
<b>Total</b>	<b>531</b>				

Table 1: Total number of respondents in the field based research

Source: Own representation.

The profile of the target groups encompasses: VET teachers, VET educators, VET providers, VET trainers, employer representatives, employee representatives, unions and chamber representatives. Their age ranges from 20 to over 60 years old. Both men and women have participated in our survey.

The applied questionnaire contained 9 multiple-choice/ matrix items and 3 open-ended items. For the multiple-choice/ matrix items the options to answer were provided on a 4-level Likert scale and 6-level Likert scale (*i.e.* 1 = Very important, 2 = Important, 3 = Less important, 4 = Unimportant). The interpretation of the results was based on number of answers per category<sup>1</sup>.

### **Environment resources and appropriate media**

Concerning the environment resources and appropriate media at the partners institutions the results show that the respondents have adequate digital competences. There is also a basic understanding of E-Learning in classroom settings. However, it is evident that E-Learning and blended learning have not yet been strongly focused in the metal sector and there is a need for development in this area.

<sup>1</sup> The exact results can be found in the appendix.



Regarding learning platforms which are appropriate for the metal sector, the answers suggested (in decreasing order) the following:

- Moodle
- ILIAS
- Blackboard
- Canvas
- Accord LMS
- Learning Space
- Schoology
- Other: It´s Learning, Office 365

Additionally, the respondents recommend the following didactic materials that are important for online teaching in the metal sector (in decreasing order):

- Best practice examples from enterprises
- Videos
- Worksheets as WORD documents or PDF
- Graphics and illustrations
- Quizzes
- Blended learning scenarios
- Interactive tasks
- Single choice or multiple choices questions
- Learning programmes / software
- OER (Open educational resources)
- Audios
- Online courses
- MOOCs (Massive open online courses)

### ***Estimations about digitisation and E-Learning/ blended learning courses***

Another question refers to the estimations about digitisation, E-Learning and blended learning courses. In the following a summary of the responses of all participants will be shown.

Concerning the estimation about digitisation it was agreed that digitisation is very important, interesting, motivating, innovative, helpful, useful and necessary. Moreover, some respondents state that it is sometimes not so easy to implement digitisation in the learning and teaching process.

Concerning the estimation of E-Learning in the metal sector the results are quite similar to the items before. However, at this point the majority expresses reservations about using E-Learning in the teaching and learning process. However, the majority of the respondents think that E-learning is also very important, interesting, motivating, innovative, helpful, useful and necessary.

Concerning the estimation about blended learning courses in the metal sector you can see that there is a very similar picture of the results as in the previous question. There are also concerns in this context in using blended learning courses in the teaching and learning process. However, the majority of the respondents express that blended learning is also very important, interesting, motivating, innovative, helpful, useful and necessary.





### ***Appropriate assessments***

This question field refers to appropriate assessments in online environments in the metal sector.

Analysis of the answers supported us to conclude that the most appropriate assessment for E-Learning or blended learning for the implementation of the EDU-VET curriculum should be: (1) Practical tasks (2) Video creation (3) Ordering tasks (4) Audio/ podcast creation (5) Mind maps/concept maps (6) Wall paper/posters (7) Formative assessments (8) Summative assessments.

Additionally, analysis of the answers supported us to conclude that other types of assessment are more appropriate for E-Learning or blended learning for the implementation of the EDU-VET curriculum should be: (1) Class test (2) Writing tasks (3) Oral assessments (4) Realistic/ authentic problem (5) Online question tests (6) Presentations (7) Interactive tasks (8) Case study (9) Diagnostic tests (10) Other: Practical examination in a workshop, Workshop audit.

### ***Opportunities and Challenges***

The last part of the questionnaire addresses opportunities and challenges of Digitisation and E-Learning. At this point it is an open response format. Following, we address the summarised results.

#### ***Opportunities of digitisation and E-Learning in the metal sector:***

- Online teaching and learning is possible
- Flexibility
- Immediate communication
- Independence of place and time
- Sustainable learning and teaching
- Consolidation of teaching and learning materials
- Easy way to learn
- Attractive and modern way for learning and teaching
- Structured teaching
- Quick communication between pupils, but also pupils and teachers e.g. via chat, forums
- Additional applications such as chat etc.
- Attractiveness of learning content
- Increase of teaching and learning motivation
- Control of own learning pace
- Individualization of the learning process

#### ***Challenges of digitisation and E-Learning in the metal sector:***

- Cost/benefit
- High training time
- Financial resources
- Observance of data protection
- Continuous training necessary
- Lack of digital skills among pupils and teachers
- High training costs
- Often no end devices for pupils
- Intensive support and supervision of pupils



## 5 Part C: Results of the specific research conducted by IK

Part C focusses the research results of the specific research conducted by IK. On the one hand IK carried out a desk-based research which addresses design opportunities and alternatives for blended-learning approaches. On the other hand IK conducted interviews with blended learning experts concerning mini-learning formats and teaching resources as well as e-Learning environments and with learners concerning acceptance of new media, e-Learning and mini-learning formats. In the following a summary of the research results will be presented.

### ***Best practices in the design and production of mini-learning-format teaching resources***

With regard to effectiveness of the design of online courses following points should be considered:

- They are grounded in an understanding of the learning process.
- They are based on the needs of adult learners.
- They link theory and practice.
- They accommodate range of learning styles.
- They are accessible.
- They are “flexibly” designed.
- They offer flexible delivery.
- They provide for flexible assessment.
- They use a variety of media.
- They are interactive. (cf. BURNS 2016, n. p.)

In this context, there are six principles of good graphic design – contrast, similarity, proximity, alignment, symmetry and repetition – that should be applied when building a course (cf. IBID.).

When designing e-Learning, repeating key points helps the learner to remember and associate these points and the new information presented together. This principle is called ‘scaffolding.’ This is also an important element of graphic design within eLearning because it allows the learner to anchor key information together (cf. COLMAN 2020, n. p.).

Concerning mini- or micro-learning format many variant will be used, e.g. short learning videos, playful elements such as a quiz (keyword: gamification), clear infographics, digital flashcards or interactive elements. These various forms are also appropriate for EDU-VET and will be also included on the EDU-VET learning platform. Moreover EDU-VET intends to combine the elements above.

The art to any effective e-Learning is to make it people-centered. In this context, we can accentuate following points regarding the development of the learning modules, which are also based on the answers of the interviewed respondents. That is also the reason why we follow the following points in the development of the learning modules within EDU-VET:

1. Enable mobile access
2. Focus on one idea per module
3. Use relevant visuals and media
4. Offer customization
5. Keep it lean

## Best practices in the design of e-Learning environments

Another research part is the research of best practices in the design of e-learning environments. Based on the literature (cf. SCHEIN 2004) and the field-based research IK proposes the following basic framework for developing e-Learning environment according to EDU-VET. The table below focusses on these research results:

<b>Instructions for Use</b>	<ul style="list-style-type: none"> <li>-Write a brief description of the topic at the beginning of a learning session</li> <li>-Clarify the learning goals/ learning outcomes</li> <li>-Mention the approximate total period of time required to complete the whole session (including reading tasks, videos, quizzes, participation, etc.)</li> <li>-Provide the students with a To-Do-Lists. This guides them to accomplish the session step by step</li> <li>-Consider Checklists at the end of each session. Checklists help students with self-evaluation and self-improvement</li> <li>-Set other rules clearly</li> <li>-Always, write instructions in an easy language</li> </ul>
<b>Content Presentation</b>	<ul style="list-style-type: none"> <li>-Identify clear learning objectives</li> <li>-Prepare consistent and structured content</li> <li>-Simplify what you explain or show</li> <li>-Use various types of learning activities and digital materials (e.g. audio, short video, slide-show, PDF, text, link to a website, etc.)</li> <li>-Employ the right material for the right context (e.g. sometimes reading a file is better than listening to an audio)</li> <li>-Make the materials accessible for online and offline uses</li> </ul>
<b>Knowledge Testing</b>	<ul style="list-style-type: none"> <li>-Create tasks for the students to assess their own learning</li> <li>-Make sure that the tasks are relevant to the content and the learning objectives</li> <li>-Provide feedback (e.g. immediate automatic feedback)</li> </ul>
<b>Engagement</b>	<ul style="list-style-type: none"> <li>-Communicate with learners more often than you do in seminars (E.g. regular emails and reminders, information in a forum)</li> </ul>

	<p>-Foster teacher-student and student-student interactions (asynchronous and synchronous communication)</p> <p>-Personalize your profile (on Moodle). Upload a profile picture and write something about yourself. Advise your students to do the same! This creates a friendly online environment.</p> <p>-Encourage students to build up virtual study groups to support each other</p> <p>-Consider feedback exchange</p>
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Table 2: Best practices in the design of e-Learning environments  
 Source: Own representation.

## 6 Insights into learning modules for the EDU VET curriculum

Based on our research findings, we would recommend that the following EDU-VET learning modules should be achieved through the EDU-VET curriculum. The modules include the contents of Drilling, Turning and Milling. Furthermore, the modules can be differentiated into three levels of difficulty (Entry level, Advanced level, Experienced level).

Module 1: Drilling/ Reaming/ Counter boring/ Thread cutting

Module 2: Turning

Module 3: Milling

In addition, the blended learning approach can be used on the basis of all the research results, so that the learning modules each represent on one hand a classroom scenario and on the other hand an online scenario. At the same time, this differentiation of the learning modules forms the structure of the Learning Outcome Matrices.

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)



## 7 Conclusions and Recommendations

E-Learning in the VET metal sector becomes more and more important. In particular, the Corona crisis has brought this issue to the forefront. As the results of the research activities show, the EDU-VET project has a high practical relevance.

Additionally, the conducted research represents a high interest in the development of new teaching and learning environments for VET. Although E-Learning offers already exist at VET schools, so far they do not relate to the metal sector. Therefore, the support for teachers and learners is still to be improved by developing an EDU-VET curriculum and a blended learning approach for learning technical education at vocational schools. Following, this supports teachers with appropriate innovative learning resources as well as learners with innovative modern ways to deal with topics and learning activities. Because of this, the curriculum and blended learning approach for VET in metal sector offered by EDU-VET is welcome.

To ensure that the EDU-VET curriculum and resources concerning the blended learning approach are relevant and useful to teachers and learners at VET schools in the metal sector, the following recommendations can be made:

- There is a need for an emphasis on the development of deal with topics and learning activities in blended learning settings in the curriculum.
- The curriculum and learning module content should be specific to teachers and learners with information and guidance to dealing with innovative learning resources at VET schools in the metal sector.
- In the curriculum and the learning modules the core competences concerning the blended learning approach should be integrated. These includes digital competences, methodological and learning competences, technical competences or professional competences, action competences, personal competences and social competences.
- In order to foster these core competences, appropriate tools should be developed. For online scenarios interactives tasks (e.g.H5P tasks), an online discussion forum, EDU-VET Online Observatory or online videos are possible. Regarding classroom scenarios case studies, discussions, creating posters and flipcharts or group work foster the intended core competences.
- The legislative framework concerning the European VET sector should be also considered in the EDU-VET curriculum.



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## Appendix

### Part A – Field based research

#### Interviews – Summary of the results

No.	Position/ Experience (in years)	Importance of basic topics	Material and available resources	Pedagogic support required	Media formats	Pros/Cons of online teaching	Teacher/ trainer skills for online courses
1	Trainer in an industrial company for the professions of process and industrial mechanics	- Drilling: Basic - Turning: Basic - Milling: Basic	-Using of e-learning to consolidate the content of VET school and the specific lessons at his company -Internal company materials and tasks	-Discussion of tasks with other trainers and teachers -Creating tasks in a team → receive comprehensive feedback and constructive comments which can be integrated into the task development	-Internal e-learning platform	+ Students can learn from home + wide range of additional exercises -expandable digital skills -no end devices are available -intensive support from teacher/trainer	-Good experience with e-learning -open-minded concerning new media formats -feels confident in using new media
2	Trainer of a worldwide operating industrial company for metal professions	- Drilling: Basic - Turning: Basic - Milling: Basic	-Using of e-learning to consolidate the content of VET school and the specific lessons at his company -Internal company materials and tasks	-Exchange with trainers as well as the vocational school teachers would be very efficient, especially to discuss the didactic preparation of the materials	-Internal e-learning platform	+Independence in using (place and time) + flexible learning - Some students need more support concerning learning with digital media - missing or expandable digital skills	- Basic understanding of using new media
3	Trainer of a worldwide operating industrial company for metal	- Drilling: Basic - Turning: Basic - Milling: Basic	-Using of e-learning to consolidate the content of VET school and	-Exchange of information with the responsible trainers from the training	-Internal e-learning platform	+ Trainees could deepen the subject matter at home or even learn it again	- Basic understanding of using new media, but expansion of digital



	professions, interns, trainees and combination students from the technical field -about 30 years		the specific lessons at his company -Internal company materials and tasks	workshop about the trainees' performance and progress -Desire for more exchange with VET teachers		and then learn at their own pace - E-learning courses can only be used to learn theoretical content. Practice cannot be replaced by e-learning courses. This must be done on site in the internal workshops	competence is necessary
4	- Training manager for commercial and technical apprenticeship s	- Drilling: Basic - Turning: Basic - Milling: Basic	-Internal company materials that are used for the internal company training or the learning management system for the trainees - Using of e- learning to consolidate the content of VET school and the specific lessons at his company	- Regular exchange with all responsible trainers. - Vocational school teachers are also invited to enter into discussion	-Internal e-learning platform -Online voting system	+Additional learning opportunity to work up or deepen their knowledge independently and at their own pace + Possibility to tailor the learning content specifically to the trainees and to encourage and challenge them according to their needs +Integration of video, audio, sequences, interactive task types or quizzes -e-learning requires high motivation and self-discipline -no direct contact with peers or even trainers or teachers →	- Open- minded regarding e- learning and new media - Good understandin g of using new media





						risk of social distancing - Equipment and network access must be available	
5	-Teacher in the internship for the subjects mechanical engineering and manufacturing technology (Upper level)	- Drilling: Basic - Turning: Basic - Milling: Basic	-No materials are yet available for the project described	-Expand media literacy -Preparation courses for the creation of online learning materials	-Active-board -black-board, -document camera -various specialist books	+The organization in the classroom can be increased with e-learning. +Editing of learning material is not tied to times. +Editable anywhere +Additional means of communication such as video conferencing +more flexibility -Develop competence to act -Distraction from the Internet -Time expenditure for the creation of learning materials -Not every student has the technical resources at home	- Basic knowledge -Basic experiences with learning Apps
6	-Teacher for mechanical engineering and automation technology -Training teacher for legal trainees in the technical	- Drilling: Basic - Turning: Basic - Milling: Basic	- Didactic materials are not yet available for the EDU-VET project	-Improve media literacy to fully exploit the potential -Instruction on how to develop and create learning materials for	-Docu-ment camera -Black board	+ Processing of tasks at any time and in any place +Different teaching paths, for example through videos	-No experiences, only some insights from other teaching colleagues.

	field (regular teaching, dual system)			blended learning		<ul style="list-style-type: none"> <li>+Language difficulties can be overcome</li> <li>-IT technology at school and at home is not at a high level</li> <li>-The high workload does not pay off</li> <li>-Students are distracted from the internet and can no longer concentrate on their work</li> <li>-Technology led too strongly</li> <li>-No action-oriented lessons possible</li> </ul>	
7	-Pre-counseling teacher at a technical vocational school (upper level, dual system)	<ul style="list-style-type: none"> <li>- Drilling: Basic</li> <li>- Turning: Basic</li> <li>- Milling: Basic</li> </ul>	<ul style="list-style-type: none"> <li>-Some learning videos</li> <li>-thematic questions about preparing for exams</li> <li>- H5P content</li> <li>-A lot of learning material that cannot yet be used for the EDU-VET project, but from which you can generate documents for the project</li> </ul>	<ul style="list-style-type: none"> <li>-Promote media literacy of the teacher</li> <li>-Preparation courses for the creation of learning materials. It is important to make the lessons differentiated so that individual support is possible.</li> </ul>	<ul style="list-style-type: none"> <li>-Moodle</li> <li>-PC</li> <li>-Smart-phones or document cameras</li> </ul>	<ul style="list-style-type: none"> <li>+individual support for learners</li> <li>+Independence of the pupils</li> <li>+transparent</li> <li>+simplified presentation of teaching material</li> <li>+strongly oriented towards practice</li> <li>+the organization of everyday school life and teaching is simplified</li> <li>+Language difficulties can be overcome</li> <li>+editable anytime and anywhere</li> <li>-IT technology in school and</li> </ul>	<ul style="list-style-type: none"> <li>-Extensive knowledge in the field of e-learning</li> <li>-Using of different online tools</li> </ul>



						at home are unsatisfactory -Competence to act is difficult to implement -no self-reflection of the pupils -high expenditure of time for the teacher to create teaching material -Learners are quickly distracted	
8	-Teacher for mechanical engineering and computer informatics in the metal sector -Head of machining mechanics (district specialist class; the students have partially long driveways) (dual system)	- Drilling: Basic - Turning: Basic - Milling: Basic	-No materials that can already be used for the EDU-VET project, but many previous experiences and materials can be used as input, from which learning materials for the EDU-VET project can be developed. → for example: Learning videos, thematic questions, start of the H5P concept, etc.	-Improve lack of media literacy -Events of online learning courses / introductory courses for the institutions -Teachers must be well pre-qualified and have a good command of modern media so that they can develop good and interesting learning materials for blended learning or e-learning	-Focus on online learning platforms -video	+-Benefits for all stakeholders: +Decoupling of communication processes → for teacher, pupils, parents and trainers +Different ways to communicate: Chat, Videos, etc. +transparent +Organization of storage and archiving of work results +Delimitation of time and space +“As a preserve on the Internet” -IT-technology in the school and at home → Frustration with the teacher and the students -Contact from person to	-Intensive experiences - 10 years of Moodle -Certificates



						person could be lost -Language difficulties can be overcome	
9	- Practical contents (Basic and upper level) - 20 years (regular teaching)	- Drilling: Basic - Turning: Basic - Milling: Basic	-Notes and tasks, which are already being used in his lessons	-Appropriated and adapted resources and activities. - Some face-to-face lectures so the students can see and work with real machines.	-Moodle -Class-room - Videos -Webex	+ Great availability. + Students can access the course anytime anywhere. - Teachers with ICTs skills. - Adapted resources/ documentation to online teaching. - Students need to get practice with real machines.	-Good knowledge of ICTs. Specific and updated knowledge of the metal industry.
10	- Practical contents (Intermediate and upper level, conventional machining) - 11 years (regular teaching)	- Drilling: It is a way to get practice planning routines. - Turning: Labour market requires it - Milling: Labour market requires it	- Tasks, which are already being used in his lessons. - Calculate variables values for proper working conditions -Planes of pieces to be machining.	Face-to-face lectures so the students can get abilities-skills working with real machines.	-Moodle -Videos	+ Availability and flexibility. + Students can access the course anytime anywhere. + They afford time and money moving. - There is a lack of good simulators of conventional machines. - Students need to get practice with real machines, which goes far beyond any simulator available.	-Good knowledge of ICTs. -Specific knowledge of the metal industry.
11	-Theoretical contents (Intermediate and upper levels) - 22 years (regular and blended)	- Drilling: Not much - Turning: Basic - Milling: Basic	-Notes and tasks that he uses in this lessons. These would need to be adapted for online	-A teacher that can solve the students' problems, doubts and curiosities.	-Moodle	+ Availability and flexibility. + Students can access the course anytime anywhere. + They afford time and	-Good knowledge of ICTs. Specific knowledge of the metal industry. And pedagogical training



	learning teaching)		teaching purposes.			money moving, and the schedules are flexible. - There is a need for more adapted contents (more interactive...). - Plus, online teaching is very time consuming for teachers and students.	related to online education.
12	- Practical contents (Upper level; CNC) - 20 years (regular Teaching)	- Drilling: Labour market requires it - Turning: Labour market - Milling: Labour market	-Notes and tasks which he uses in his lectures.	-Face-to-face lectures so the students can confront more real working conditions with real machines.	-In-different	+ There exist simulators of real machines, so the adaptation of some machining tasks is feasible. - Very demanding for students regarding: - mental abstraction - organization - persistence -determination	-Digital skills to elaborate specific contents -Be able to encourage and motivate the students
13	-Project manager in VET	- Drilling: Basic -Turning: Basic -Milling: Basic	-No available materials	- The machining profession cannot be learned online alone. You learn the trade through practical experience.	-No answer	+Attractiveness of learning for young people +Blended Learning is a good mix between theoretical and practical subjects -E-Learning in metal sector only for theoretical subjects suitable - Makes the teaching	-No answer



						package challenging so that pupils want to study the material in more depth.	
14	-Workshop manager in VET	- Drilling: Basic / core competence -Turning: Basic / core competence -Milling: Basic / core competence	-No available materials	-No answer	-No answer	-No answer	-No answer
15	-Practical trainer at VET school	- Drilling: Basic -Turning: Basic -Milling: Basic	-No ideas yet	-Clarity about logging in, time planning (how long a course takes)...	-No answer	+easy in handling -discipline is needed -Setting of deadlines are necessary	- importance of commitment, commercial skills and the ability to motivate students
16	-Project manager in VET	- Drilling: Basic -Turning: Basic -Milling: Basic	-No ideas yet	-No answer	-No answer	-No answer	-No answer
17	- Tutor in engineering	- Drilling: Basic -Turning: Basic -Milling: Basic	-3 lathes, 2 pillar drills, 1 milling / drilling machine. – Request of further tooling and equipment to full fill any other vital areas of theory	- Keep the wording here simple and easy to understand	- No answer	- limited - physical interaction with tools and equipment is a must	- a miracle method in being able to incorporate VR into a session may work
18	- I am Advanced technical team lead in Engineering	- Drilling: Basic -Turning: Basic -Milling: Basic	-No answer	- Decent computer, server network. Online learning cannot be on	-White board -Smart board	+ Interactive data bases. Interactive strength, shape calculation	- Varied software confidence to add and



				and off or only if you have enough of the newer college PC's to get it to work.		- Integration with practical experience	change content. - Good workshop skills
<b>19</b>	Lecturer in Fabrication and Welding	- Drilling: Basic -Turning: No, Turning is normally used in Engineering and not Welding -Milling: No, Milling is normally used in Engineering and not Welding	- Power points and Work Activity Sheets	-Learners need to be able to interact with the various resources	-No holistic format. Using of different media formats	+ All resources are accessible on all different platforms - Learners having the access to online resources depending on personal circumstances	- Teachers need to be familiar and up to date with all different formats of resources.
<b>20</b>	Advanced Technical Team lead in Engineering	- Drilling: Basic -Turning: Basic -Milling: Basic	-Quizzes on numerous subject. -CAD facilities -Electronic teaching materials -Video recordings	- Regular professional development for teachers -Good electronic infrastructure -development of linked software from practical machinery to CAE processes.	-White board for power outages and equations -smart boards and interactive screens	+ Industry data bases linked to teaching systems -Electronic resources in general, i.e. drawings of engineering components CAE approach used. - Integration with practical experience in a workshop -Continual computer hardware and software updating	- Varied software confidence to add and change content. -Good workshop skills.
<b>21</b>	Lecturer in Fabrication and Welding	- Drilling: Basic -Turning: Basic -Milling: No- A welder fabricator would not	- Power Points -activity sheets	- Learners need to be able to interact with the resources	-Different media formats	+ Accessibility and clarity of resources - Not all learners have access to online resources	- Teachers need to be familiar with differing formats of resources



		normally use a milling machine					
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*Table 3: Summarised interview results (field-based research)*

Source: Own representation.





## Questionnaires – Summary of the results

### General Information

#### Gender – I am ...

Female	108
Male	307
Rather not say	2
Other / Diverse	0

#### Age

Below 20	85
21-30	148
31-40	67
41-50	60
51-60	52
Over 60	5

#### Status – I am ...

a VET trainer/ VET-teacher	11
a VET educator / VET-expert	43
a VET provider	3
an employer representative	0
an employee representative	24
a union member	22
an Educational and Career Counsellor	3
a chamber representative	0
I am another type of educational expert	72
Other: Student	161

## Environment resources and appropriate media

### At our institution there are ...

	many	several	just a few	no
teachers with adequate IT skills.	97	273	26	2
teachers with knowledge how to handle e-learning.	133	229	53	5
teachers with knowledge how to handle blended learning.	85	271	56	14
teacher with organisational skills.	273	93	28	6
teachers applying theoretical knowledge in the metal sector.	320	63	1	0
teachers applying practical work in the metal sector.	348	59	6	0
facilities and technical equipment which can be used for teaching with digital media.	87	192	114	3
PCs for the learners.	92	173	120	18
Smart boards.	102	130	105	102
possibilities to use learning platforms like Moodle, Blackboard, ILIAS, Learning Space, CANVAS, Schoology, Accord LMS etc.	135	202	58	13
rooms which can be used for teaching with digital media.	46	119	179	47
Other, please specify:	○	○	○	○

### Which learning platforms are appropriate for the metal sector ...

	very appropriate	appropriate	inappropriate	I can't say
Moodle	142	117	4	162
Blackboard	53	41	62	215
ILIAS	87	54	7	147
Learning Space	0	17	66	308
Canvas	8	20	24	256
Schoology	0	22	28	292
Accord LMS	4	55	44	281



Other, please specify: -It's Learning -Office 365	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
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### Do you have any of such didactic materials or resources for the metal sector?

	many	several	just a few	no
Worksheets as WORD documents or PDF	306	89	9	3
Single choice or Multiple choices questions	148	208	37	7
Interactive tasks (like drag and drop questions or ordering questions etc.)	51	128	97	129
Audios	53	171	168	18
Videos	245	114	27	5
Graphics and illustrations	225	125	41	5
Online courses	30	60	122	188
MOOCs (Massive open online courses)	3	9	72	315
OER (Open educational resources)	41	141	116	8
Blended learning scenarios	31	90	222	68
Quizzes	165	97	83	38
Best practice examples from enterprises	301	80	12	4
Learning programmes/ software	30	142	88	39
Other, please specify:				

### Do you think such didactic materials or resources are important for teaching in the metal sector?

	very important	important	less important	unimportant
Worksheets as WORD documents or PDF	245	113	15	1
Single choice or multiple choices questions	81	231	29	4
Interactive tasks (like drag and drop questions or ordering questions etc.)	81	117	97	108
Audios	52	153	148	41
Videos	246	100	54	79
Graphics and illustrations	195	153	28	8
Online courses	43	138	106	115
MOOCs (Massive open online courses)	29	58	121	186
OER (Open educational resources)	57	136	108	5
Blended learning scenarios	89	127	123	29
Quizzes	171	115	61	43
Best practice examples from enterprises	330	79	0	0
Learning programmes / software	79	111	76	40
Other, please specify:	○	○	○	○

## Estimations about digitisation and e-learning/ blended learning courses

**Tell us your opinion:**  
**Currently, digitization is ...**

important	197	195	10	6	0	0	unimportant
interesting	157	216	17	5	0	0	uninteresting
motivating	107	170	56	23	4	0	demotivating
fun	52	147	146	26	10	1	boring
innovative	160	124	88	1	6	0	old-fashioned
helpful	107	225	51	9	3	0	not helpful
useful	94	194	14	3	1	0	useless
necessary	61	164	77	4	0	0	unnecessary
easy to use in teaching	67	105	181	38	8	0	hard to use in teaching
easy to use in learning	69	88	159	62	8	1	hard to use in learning

**Tell us your opinion:**  
**Currently, e-learning courses in the metal sector are ...**

important	166	158	41	16	8	5	unimportant
interesting	143	175	35	15	17	10	uninteresting
motivating	124	176	66	25	6	0	demotivating
fun	44	104	136	59	34	11	boring
innovative	202	163	28	10	0	0	old-fashioned
helpful	100	190	59	36	4	4	not helpful
useful	66	172	41	20	9	0	useless
necessary	117	147	61	8	7	3	unnecessary
easy to use in teaching	36	112	123	77	11	10	hard to use in teaching
easy to use in learning	45	89	143	83	39	13	hard to use in learning

**Tell us your opinion:**  
**Currently, blended learning courses in the metal sector are ...**

important	149	164	44	23	3	1	unimportant
interesting	126	148	55	16	7	3	uninteresting
motivating	119	159	67	27	18	10	demotivating
fun	35	127	133	138	21	12	boring
innovative	173	146	55	11	6	1	old-fashioned
helpful	133	195	45	22	1	0	not helpful



useful	80	146	32	29	9	3	useless
necessary	58	133	61	15	21	22	unnecessary
easy to use in teaching	66	92	150	57	15	5	hard to use in teaching
easy to use in learning	74	74	138	87	17	5	hard to use in learning

## Appropriate assessments

### Which types of assessment are appropriate for e-learning or blended learning in the metal sector?

	very appropriate	appropriate	inappropriate	I can't say
Audio/ podcast creation	89	124	137	36
Video creation	198	163	39	18
Ordering task	215	96	62	55
Wall papers / poster	40	162	119	56
Mind maps / concept maps	66	180	126	29
Practical tasks	338	55	7	0
Formative assessment	60	152	34	52
Summative assessment	40	148	41	72
Other, please specify:	0	0	0	0



## Which other types of assessment are appropriate for e-learning or blended learning in the metal sector?

	very appropriate	appropriate	inappropriate	I can't say
Class tests	251	145	1	8
Online question tests	146	138	69	42
Interactive tasks	136	172	47	26
Case study	76	116	130	76
Realistic/ authentic problem	218	129	29	19
Diagnostic tests	61	214	43	79
Writing tasks	163	158	59	23
Oral assessments	159	150	43	41
Presentations	122	144	97	28
Other, please specify: -Practical examination in a workshop -Workshop audit	○	○	○	○

## Opportunities and Challenges

### What are the opportunities of digitisation and e-learning in the metal sector?

Opportunities of digitisation (summarized answers):

- Online teaching and learning is possible
- flexibility
- Immediate communication
- Independence of place and time
- Sustainable learning and teaching
- Consolidation of teaching and learning materials
- digital skills are fundamental for further working life

Opportunities of e-learning (summarized answers):

- easy way to learn
- attractive and modern way for learning and teaching
- structured teaching
- quick communication between pupils, but also pupils and teachers e.g. via chat, forums





- additional applications such as chat etc.
- Attractiveness of learning content
- increase of teaching and learning motivation
- control own learning pace
- individualization of the learning process

### What are the challenges of digitisation and e-learning in the metal sector?

Challenges of digitisation (summarized answers):

- Cost/benefit
- high training time
- financial resources
- observance of data protection
- continuous training necessary

Challenges of e-learning (summarized answers):

- lack of digital skills among pupils and teachers
- high training costs
- often no end devices for pupils
- intensive support and supervision of pupils

### Do you want to provide other comments on the topic? (Summary)

- Lack of knowledge about some assessments (e.g. summative and formative assessment)
- Lack of knowledge about some digital learning platforms (e.g. Schoology, Accord LMS)