TRALES

TRANSNATIONAL LEARNING FACTORIES

Final result

Reference number: 2021-2-DE02-VET-000050734 - Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Education and Culture Executive Agency (EACEA). Neither the European Union nor EACEA can be held responsible for them.

Title: TRALES - Transnational learning factories

Year: 01/03/2022 – 01/03/2023
Program: Erasmus+ small scale partnership
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Partnership

VHS-Bildungswerk GmbH, Branch Thüringen, Germany (coordinator)

Solski center Skofja Loka, Skofja Loka (Slovenia)

Aristotelio Panepistimio Thessalonikis, Thessaloniki, Greece

Eurocultura, Vicenza (Italy)

Co-funded by the European Union

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TRALES – Transnational Learning Factories

1. Introduction

Vocational education and training is a key factor in shaping the ecological and digital change in a sovereign Europe ((COM (2020) 102 final, Brussels March 10, 2020)). The acquisition of specialist, human and social skills to cope with the requirements associated with change should be realised on the basis of vocational pedagogical concepts that impart job-oriented professional skills. Learning factories offer great potential for this, since training can be very job-oriented and close to professional practice (Wilbers/Windelband, 2021, p. 25 ff; Dehnbostel, 2021, p. 127).

Basically, learning factories are

- Places of teaching and learning for vocational training in accordance with the vocational pedagogical goal of complete action, which is geared towards the ability to act
- Place of cooperation and networking in terms of the transfer of knowledge and experience as well as a hub for the exchange of learning cultures, ideas and solutions

The guiding principle is the model of complete action. On the methodological level, activating methods that support self-regulation of learning will be integrated: hybrid and asynchronous learning formats, guiding texts, learning projects, work-based learning approaches (WBL).

> "In the learning factory concept, learners should have authentic opportunities to work on professional tasks with job-specific work equipment in a realistic learning environment. The learning factory should make an operational context conceivable in which real working conditions are simulated for learners. This is not the case of a simple theory-practice supplement, but a complex, demanding spatial and didactic-methodical conceptualization." [1]

The "small partnership" TRALES has taken up the learning factory approach in order to implement the "Council Recommendation on the Vocational education and training for sustainable competitiveness, social justice and resilience" ((COM (2020) 275 final, Brussels, July 1, 2020)) to address:

[1] Lernen in aufwendigen technischen Real-Lernumgebungen – eine Bestandsaufnahme zu berufsschulischen Lernfabriken, Bernd Zinn, 2014

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> "Learning on the job and in particular apprenticeship training are effective approaches to ensure that vocational education and training are relevant to the labour market. However, in a recession, small businesses may not be able to offer apprenticeships. A primarily preventive approach and a stronger focus of the youth guarantee on apprenticeship training as well as suitable support measures in the form of cross-company training centres or the dissemination of digital training tools can contribute to a stable supply of training places even under unfavourable economic conditions. (...) A better quality of vocational education and training will only be possible with well-trained, motivated teaching and training staff. Staff employed in VET need support in developing skills and providing tools to master new technologies, work in multicultural environments and anticipate changing labour market needs. Motivation, career development and well-being of VET teachers and trainers are key factors in increasing the attractiveness of their profession."

In this respect, "TRALES - Transnational Learning Factories" set itself two main goals that could only be achieved in a European, transnational context:

- the outline of a didactic concept for a transnational learning factory for the professions "toolmaker" and "mechatronics technician"
- the formulation of a catalogue of requirements for teachers (instructors, trainers, teachers) at transnational learning locations

The partnership consists of 4 institutions that were able to get to know each other in other transnational project contexts and jointly developed the idea and application:

- Solski Center Skofja Loka, Skofja Loka, Slovenia – an industrial and technical vocational training centre with a focus on metal and wood (www.scsl.si)
- EUROCULTURA Srl, Vicenza, Italy – a non-profit research, training and careers advice organisation (www.eurocultura.it)
- Aristotelio Panepistimio Thessaloniki – the largest university in Greece with currently 72,000 students (www.auth.gr)
- VHS-Bildungswerk GmbH, Thuringia branch – non-profit institution, managing the inter-company vocational training centre in the AWZ Gotha with a focus on industrial metal and electrical professions and mechatronics

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In these VET and academic institutions, knowledge and skills are imparted in the respective national vocational training system at EQF levels 3 - 5[2] in occupations that - such as toolmakers (SLO) and mechatronics (D) - in the context of digital and ecological change are significant.[3]

TRALES selected these professions because they have a number of intersections with each other in operational practice and a comprehensive understanding of the quality of the training and subsequent skilled work is important.

The didactic guiding principle of the "TRALES learning factory" is the model of the complete action. Based on a customer order, the learning processes are planned, carried out and reflected upon. This is reflected in the didactic concepts.

The concept of the learning factory, especially in a transnational context, places special demands on the training staff. These are described in the "TRALES catalogue of requirements".

The selected work packages correspond to the experiences of the partner institutions involved and their functions in the respective vocational training systems. The joint work process across the "borders" of the respective vocational training systems was exciting, instructive and experience-giving. The willingness to learn and the openness to new approaches were essential factors for the good atmosphere in the work phases and project meetings.

All partners involved are examining internally the possibilities of using the opportunities offered by ERASMUS+ for further joint initiatives on the basis of the results presented here.

[2] at the AUTH degrees on the academic level 6 – 8 can be achieved

[3] Industrie 4.0 – Auswirkungen auf Aus- und Weiterbildung in der M+E-Industrie, Gerd Spötl et al., 2016

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2. Didactic concept of a learning factory with a focus on the profession "Mechatronics Technician" (VHS Bildungswerk, Gotha)

1. The learning factory as an action-oriented method in vocational training

A learning factory offers the opportunity of a realistic or didactically reduced mapping of manufacturing processes in a learning environment. Learning factories serve to impart the knowledge and skills needed to cope with work tasks.

Due to their not only spatial proximity to the workplaces of the learners, teaching-learning arrangements in learning factories have the potential to close the gap between basic theoretical and practice-oriented experiential knowledge and to enable the learners to work competently.

Learning factories complement training in in-company and intercompany vocational training institutions in many ways. These include, in particular, the pronounced practical relevance, the associated action orientation, the close proximity to the labour market and the flexible feasibility of learning modules in the learning factory.

From a vocational pedagogical point of view, Prof. Bernd Zinn (Zinn, 2014) summarises the demands on a learning factory as follows:

> "In the Learning Factory concept, learners should have authentic opportunities to work on professional tasks with job-specific work equipment in a realistic learning environment.
>
> The learning factory is intended to make a business context conceivable in which real working conditions are simulated for learners. It is not a simple theory-practice supplement, but a complex, demanding spatial and didactic-methodological conceptualization.
>
> It requires a state-of-the-art real-life learning environment.
>
> Three central technical and procedural criteria must be met:
>
> 1. The degree of reality of a learning factory is represented by the presence or lack of machines, plants and equipment. Under these conditions, it is possible to impart specialist knowledge according to the current state of the art.
>
> 2. Different combinations of production planning in the sense of operational case studies can be presented.
>
> 3. Analysis and evaluation of technology and work organisation are possible under the condition that products can be manufactured using different processes and in different work organisations."

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Learning factories are currently used in Germany mainly in science, in the in-company training of large companies and in vocational schools (cf. Abele, Tenberg et al., Darmstadt, p. 5; Wilbers, Windelband, Berlin, 2021). Their application in small and medium-sized enterprises or in inter-company vocational training institutions (ÜBS) is rare.

The ÜBSes in particular, as places of learning that supplement and support inner-company and vocational training, are suitable for the learning factory approach. In accordance with their professional orientation, they usually have production-related equipment, experienced trainers and are closely networked with the training companies in the value-added process.

These, in turn, meet the requirements of the transformation process driven by demographics, digitization and decarbonization. Holistic, action- and process-oriented vocational education offers therefore support the achievement of the goals of the EU Commission and the regional companies.

1.1 Work process-oriented learning

In the course of the increasing networking of production processes, work process-oriented learning is becoming increasingly important. According to this development, future skilled workers should be able to act in a networked manner in their professional context - in the sense of cross-workplace and cross-activity.

As part of the training, holistic thinking "in process contexts and networked systems" (Windelband, 2020, p.159) is to be promoted.

Trainees and trainers should learn to understand and question these processes, but at the same time to be able to independently develop new approaches and solutions to problems (cf. ibid. p.158 f.).

The concept of work process-oriented learning is about "integrating the workplace and the work processes to be mastered here into the training measures in order to better meet the changed qualification requirements" (Howe, Gessler, 2018, p.489), i.e. teaching and learning in job-typical situations.

In the concept of work process-oriented learning, the term "learning on behalf of customers" (ibid.) is known. The customer order is executed as a complete action and is based on the six phases (see below; cf. Ott, Grotensohn, 2005, p.60).

By integrating work processes into learning within the framework of training along the phases of complete action, the trainees acquire work process knowledge that they also need directly as the specialists for the respective work process (see Dehnbostel, 2018, p.398).

The methodical-didactic implementation takes place in the learning factory.

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1.2 The model of the complete plot

Glossary German-English	
Modell der vollständigen Handlung	Model of the complete action
Informieren	inform
Planen	Plan
Entscheiden	Decide
Ausführen	Execute
Kontrollieren	Control
Bewerten	Evaluate

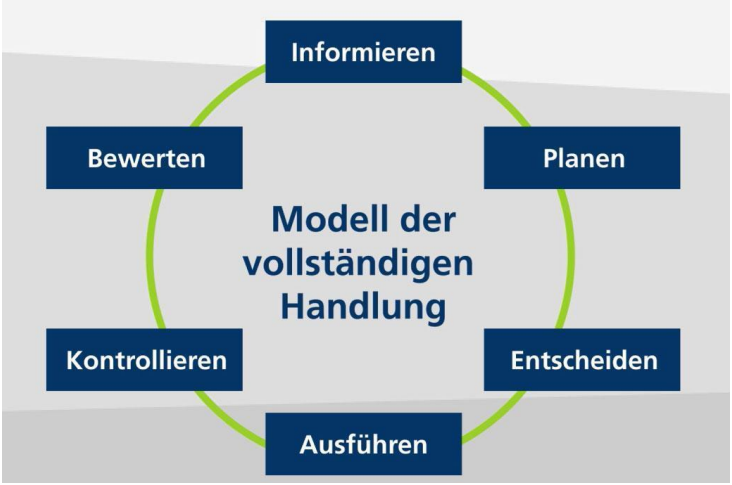

Figure 1: the model of the complete action

The model of the complete action comes from ergonomics and was developed in of in-company training as a learning concept (cf. Federal Institute for Vocational Education and Training, Bonn, n.d.).

This model promotes independent, self-critical and self-responsible Task processing of the trainees. Build the steps shown in Figure 1 and enable feedback from these (cf. ibid.). The first step "Inform" provides that trainees receive a task.

In order to complete this task, the trainees must obtain the relevant information independently. In the second step "Planning", an organisation of the process of execution of the individual work orders is planned (cf. ibid.). Subsequently, consultation with the trainer about this planning is held and a decision is made on the further course of action.

This is followed by the "execution" of the work steps and the subsequent (self) "control" in the form of a target/actual comparison with the control sheets given by the trainer (cf. Federal Institute for Vocational Education and Training, n.d.).

Finally, the "evaluation" (step 6) is carried out in the form of a reflection of the solutions and the results. The trainer supports the trainees as required in the respective steps (cf. ibid.).

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1.3 The training occupation "mechatronic technicians"

Mechatronics are responsible for the construction, assembly, commissioning, maintenance and repair of complex mechatronic systems in industrial production.

They manufacture these systems from mechanical, electrical and electronic assemblies and components. In addition, mechatronic technicians are responsible for programming and installing the associated software. Thus, they carry out activities in the fields of metal construction, electrical engineering and information technology.

Based on their field of activity, the relevance of mechatronics (technicians) in the context of digitization also becomes apparent: The basic system of mechatronic systems with which mechatronics work are made electronic and with one of mechatronics engineers controlling and regulating previously installed software. In addition, additive manufacturing processes such as 3D printing as well as the networking of production plants in the field of mechatronic technicians.

2. The customer order "Production of a perforator" as an example of the action-oriented training in the profession "mechatronics engineer" in the learning factory

Figure 2: the learning factory, metal area

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2.1 The order "Production of a perforator"

The trainees receive the order from the person of the learning companion to produce a perforator for a hole size and a hole spacing according ISO 838.

This perforator can be produced in two variants: on the one hand with a colourless base plate, on the other hand with a lacquered base plate. The variants are flexible and can be adapted to the respective situation in the VET institution. Variants are didactically useful in order to enable problem-solving skills, communication and cooperation (cooperation with other areas, departments, locations) with regard to the promotion of human and social skills in addition to specialist skills.

The trainees in the occupation of "mechatronics technician" work independently on the "perforator" task in the second half of the first training year and proceed according to the model of the complete action.

In the occupational profile positions

5 – Digitalization of work, data protection and information security

6 – Operational and technical communication

7 – Planning and controlling work processes, controlling and evaluating work results

8 – Quality management

9 – Checking, marking and marking

10 – Manual and mechanical machining, cutting and forming

Skills, knowledge and abilities are acquired in a self-directed manner. In addition, parts of the corresponding additional qualification are acquired with the additive manufacturing of the base plate. The learning companion is available with hints, suggestions and explanations.

In addition to the "Metal" area, the areas of "Additive Manufacturing" and "Colouring" are included in the processing of the specific customer order. This may vary in other VET institutions. From a didactic point of view, the integration of other areas pursues the goal of learning cross-departmental cooperation – also with regard to cross-departmental order processing in industrial companies – and enabling the acquisition of corresponding experience. This collaboration on behalf of customers also simulates the transnational dimension.

In addition to manual workstations, conventional lathes and milling machines with and without position measuring systems, CNC lathes and milling machines with various controls, CAD programs, analogue and digital measuring equipment and a 3D printer (filament) with a working area of 300 x 300 mm are available in the learning factory in the Gotha plant.

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2.2 Basic introduction

The following applies to the learning factory:

- All stations and areas have an incoming goods inspection and a final inspection to map a real supply chain (within digitised/networked SMEs).
- Shipping approvals and quality management are carried out by QR codes.
- The information is passed on through a secure network ((reference to standard occupational profile item 5 (D))
- The networked areas also demonstrate the globalised supply chains and the possible interaction of different learning venues in a transnational learning factory.

In the learning factory scenario, the teaching trainer will take over the position of a learning companion. The learning companion is a professionally trained person who supports trainees in individual learning processes.

The order "perforator" is fed into the network of the departments involved by the customer (learning companion). This order is sent to a process manager appointed from the group of mechatronics trainees.

This person coordinates/delegates the subtasks contained in the order, assemblies as well as the entire production process virtually (possibly even simulation-based) to the participating stations and areas with the help of smart devices.

In this way, the process owner can monitor or intervene in the individual intermediate production steps. The person responsible for learning support also has the option of digitally accompanying the process.

The trainees and the learning companion always have an eye on the current condition of the machine tools, even if they are not currently at the machines. On the PC/tablet, data such as order status (cross-departmental), utilisation or parts list can be checked.

The completion of the contract must be regarded as a separate phase in the project and perceived as such, as it is a good way to identify if/when a project has actually been successfully completed and the pre-formulated goal definitions by all persons involved have really been achieved.

During the final phase, the person responsible for the process must determine whether there are still any unfinished tasks (e.g. logistical processes) and, if necessary, name and distribute them.

Once all subtasks have been completed, the project results are evaluated and recorded in writing. This is done in a final report and through a presentation.

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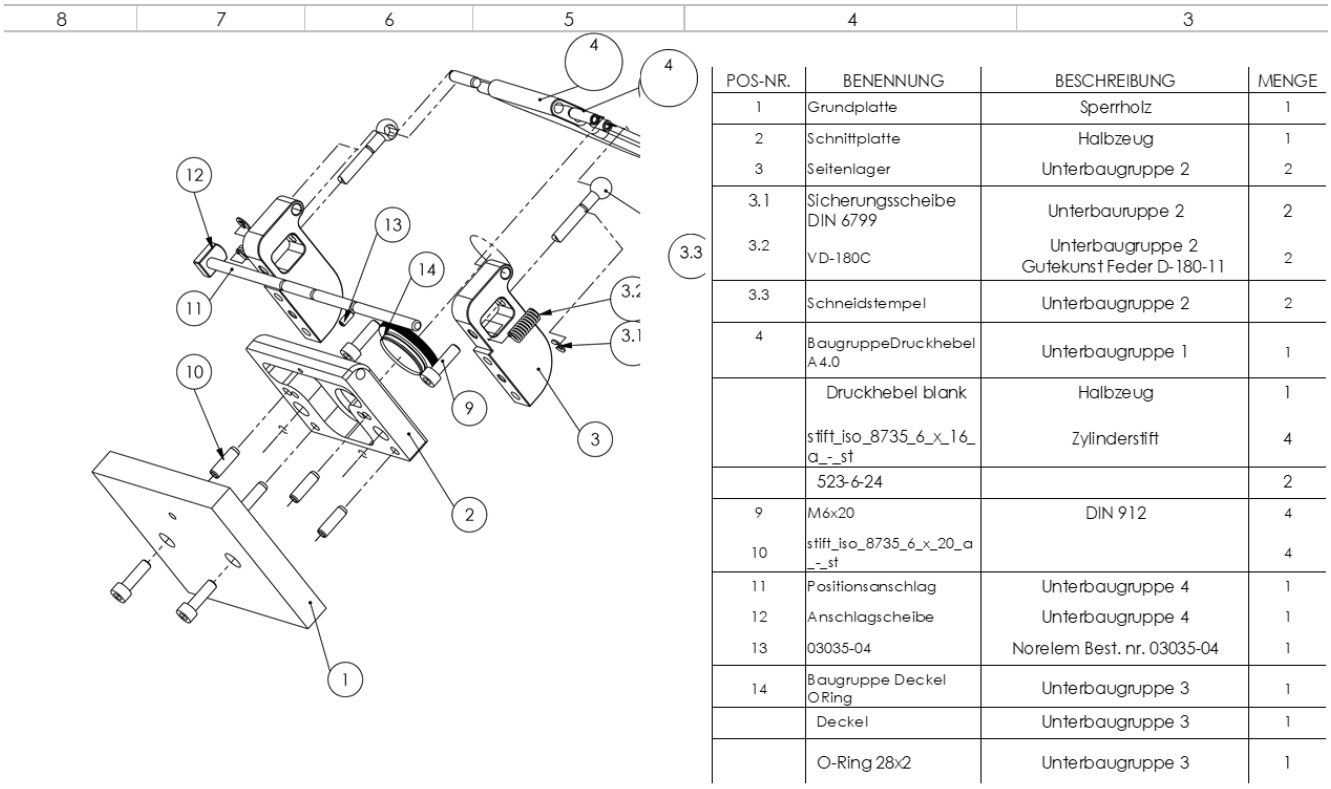
Afterwards, a final session will take place together with the learning companion. The group of trainees presents the results and the way of achieving the goals.

Group processes are reported, additional successes are shown if necessary, paths to success were and/or possible alternatives are reflected. These experiences can be transferred to future projects/work orders.

2.3 Production of a perforator – processing of the customer's order



POS-NR.	BENENNUNG	BESCHREIBUNG	MENGE
1	Grundplatte	Sperrholz	1
2	Schnittplatte	Halbzeug	1
3	Seitenlager	Unterbaugruppe 2	2
3.1	Sicherungsscheibe DIN 6799	Unterbauruppe 2	2
3.2	VD-180C	Unterbaugruppe 2 Gutekunst Feder D-180-11	2
3.3	Schneidstempel	Unterbaugruppe 2	2
4	BaugruppeDruckhebel A 4.0	Unterbaugruppe 1	1
	Druckhebel blank	Halbzeug	1
	stift_iso_8735_6_x_16_a_-_st	Zylinderstift	4
	523-6-24		2
9	M6x20	DIN 912	4
10	stift_iso_8735_6_x_20_a_-_st		4
11	Positionsanschlag	Unterbaugruppe 4	1
12	Anschlagscheibe	Unterbaugruppe 4	1
13	03035-04	Norelem Best. nr. 03035-04	1
14	Baugruppe Deckel ORing	Unterbaugruppe 3	1
	Deckel	Unterbaugruppe 3	1
	O-Ring 28x2	Unterbaugruppe 3	1

Figure 3: Exploded view of the perforator

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2.3.1. Constant part of the value chain

The trainees and the learning companion have agreed on the assignment "perforator". Now the tasks of the trainees into the areas/hierarchies are divided according to the rotation principle in the "factory".

All communication and the order status of the areas take place in real time via the network (real-time transparency).

The tasks of the QR code are defined as follows:

- This refers to a stored file in the network of involved areas/stations, which contains all product specifics of the order and qualitative requirements.
- The QR code can be read by the divisions (and virtual suppliers or other participants in the transnational learning factory) but cannot be edited.
- Only the person responsible for the process can edit the product specifics/qualitative requirements of the order in the QR code file. This only until the order has been transmitted to the other areas. Any subsequent changes can only be edited in consultation with the departments.
- By scanning the QR code after processing or at goods receipt/goods issue, it forwards the current processing status to the network of the stations involved. (Real-time visibility)
- Scanning the QR code after processing or goods issue confirms the OK status.
- The scanning of the QR code in the goods receipt only indicates that the half part has now arrived in the respective area and is being processed on time.
- In the metal, 3D printing and colour stations, there is one reception and one shipping issue.
    - The reception indicates whether the respective half part arrived on time and without damage.
    - The shipping issue is used to check the work carried out in the area (final inspection).

2.3.1.1. Scenario 1 after the constant part of the value chain

The person responsible for the process in the metal sector asks via the IT network in additive manufacturing (A area) whether the base plate with the correct dimensions/hole pattern and certain colouring is to be delivered to the assembly department in the metal sector within a certain time.

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The A area, in turn, asks the colour range via the computer network whether the specific colouring is feasible for the base plate within a certain time frame. After the positive feedback on the feasibility and scheduling for the colouring of the base plate to the A area, the person responsible for the process - metal is informed about the termination of the A area.

Production scenario 1

The person responsible for the process - metal assigns the order "perforator - base plate" including QR code to the A area (additive manufacturing).

Additive manufacturing supplies the manufactured "perforator base plate" with the product specifics contained in the QR code to the colour range. This process is coordinated internally by the colour & A area.

After the colouring, the "perforator base plate" is returned to the A area.

The A area (additive manufacturing) checks the "perforator base plate" (final inspection/shipping) and gives it to the assembly located in the metal area for final production.

The final production of the order "perforator" takes over the assembly

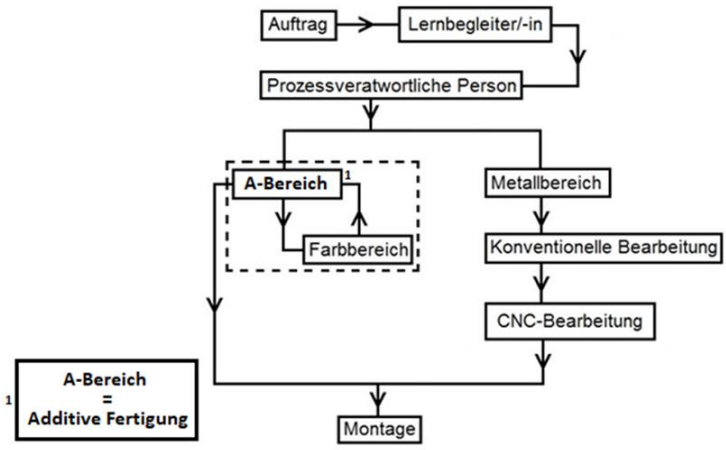

Figure 4: Production scenario 1

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2.3.1.2. Scenario 2 after the constant part of the value chain

The person responsible for the process in the Metal division asks via the network in additive manufacturing whether the base plate with the correct dimensions, the correct hole pattern can be manufactured and delivered in a certain time. At the same time, he/she passes on the request for the specific colour scheme to the colour range and coordinates the scheduling of the two areas in the event of a positive order confirmation.

Production scenario 2

The person responsible for the process - metal assigns the order "perforator base plate" including QR code to the A area.

Additive manufacturing supplies the manufactured "perforator base plate" with the product specifics contained in the QR code to the colour range. This process is coordinated & initiated by the person responsible for the process – metal.

During an incoming goods inspection, the colour range checks the correct processing of additive manufacturing in order to ward off "complaints".

After the colouring, the "perforator base plate" is checked again for OK in the shipping area and continues to the assembly in the metal area for final production.

The final production of the order "Locher" takes over the assembly.

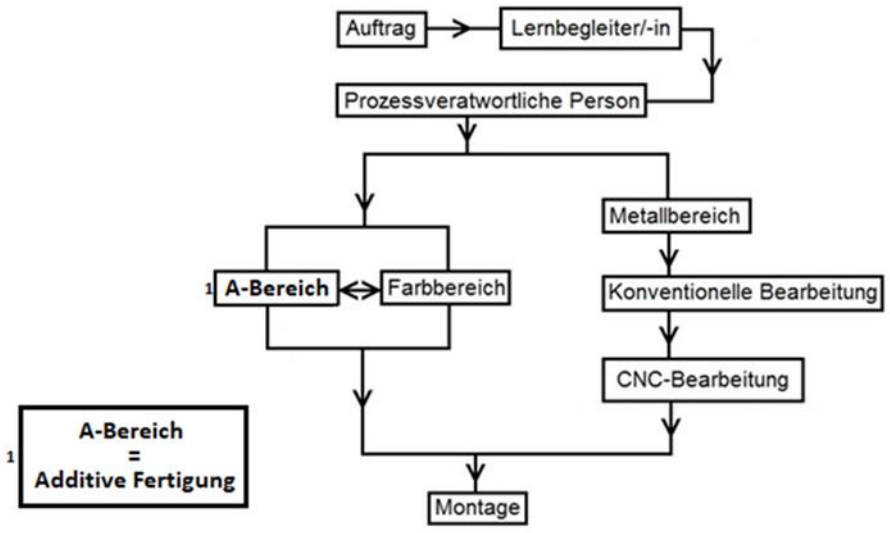

Figure 5: Production scenario 2

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2.4. The distribution of tasks

2.4.1. Division of tasks for punch order in the metal sector

Process-responsible person-metal:

- delegates the team
- Awarding of orders/scheduling to the respective departments
- Achievement of the objective
- Conflict management
- Professional and factual responsibility for the team
- Management of project activities
- Compliance with guidelines, procedures and work instructions
- Communication within the team and with the training supervisor

Conventional lathe/milling machine:

- Drawing = control/supplement/creation: semi-finished NC machine
- Manufacturing = for NC machines
- Control = of semi-finished parts for NC machine

NC machine:

- Drawing = control/supplement/creation: assembly part
- Existing CNC programs are adapted and/or reprogrammed
- Manufacturing = for assembly
- Control = of semi-finished part for assembly

Assembly:

- Installation = instructions control/supplement/creation
- Stock = control/replenishment (picking)
- Assembly tool = control/completion
- Production = assembly of the order
- Final
- Goods

2.4.1. Division of tasks for order "Perforator" in the field of additive manufacturing

Techniques for working and developing 3D printed products:

- Drawing = control/supplement/creation: base plate
- Production = base plate
- Control = of semi-finished parts for the colour range

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2.4.2. Division of tasks for the paint job

Paint application techniques:

- Colour mixing = control/supplement/creation: base plate
- Production = paint is applied to the base plate
- Control = of semi-finished parts for the assembly area

2.5. Assembly

2.5.1 Structure

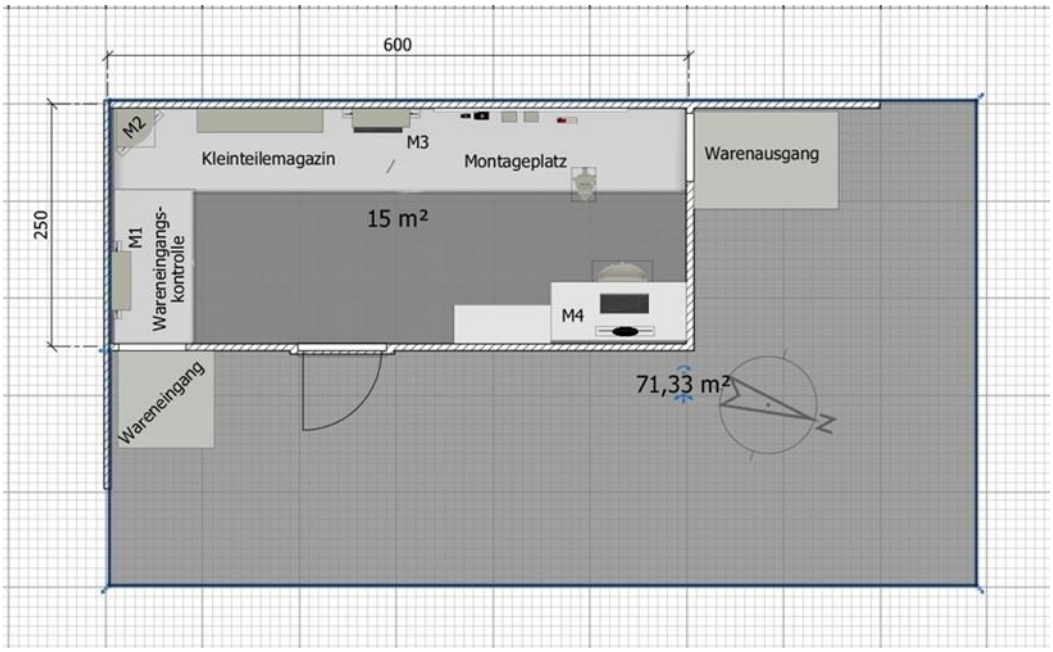

Figure 6: the assembly area

2.5.2 Reception

There, the semi-finished parts are recorded and registered by means of a scanner in the incoming goods inspection PC (WK-PC).

M1 💻 The monitor in the incoming goods inspection provides information as to whether all parts necessary for assembly are available or when they should arrive.

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2.5.3 incoming goods inspection

In the incoming goods inspection, the quality of the semi-finished parts is visually checked.

M2 💻 The monitor between incoming goods inspection and small parts warehouse displays general process data.

- Which component is in the assembly program
- Machine utilisation rate
- Web-Cam Pictures of CNC Machining
- Small parts storage
- Assembly tools = stock overview

2.5.4 small part storage

- The small parts magazine has all purchased parts (Zk parts) that cannot be produced in the process, such as screws, metal pins, metal springs, etc. in addition, each magazine box has two LED lamps.

- Green LED provides visual information whether the Zk parts contained therein are required for the current assembly order.

- Red LED provides visual information in case of Zk parts defect. If there is a part defect, this is automatically reported to the process owner who then processes it.

M3 💻 The monitor between the small parts magazine and the assembly station provides information about which Zk parts are required for the assembly process and to what extent and which assembly steps are to be carried out and how (dialog control).

2.5.5 Assembly

The individual parts are assembled on the assembly station until the finished product goes to the goods issue.

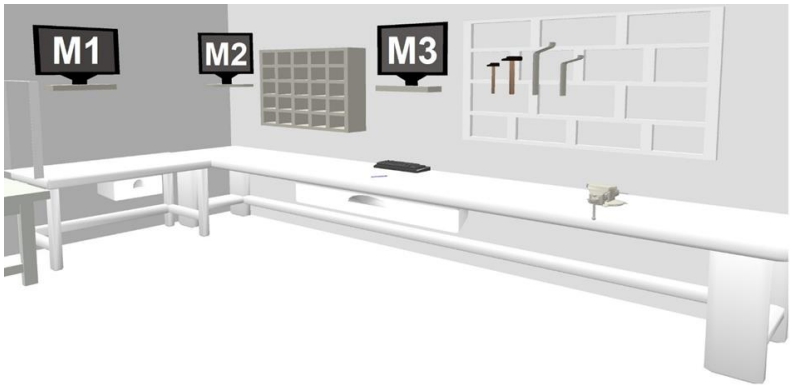

Figure 7: the assembly stations

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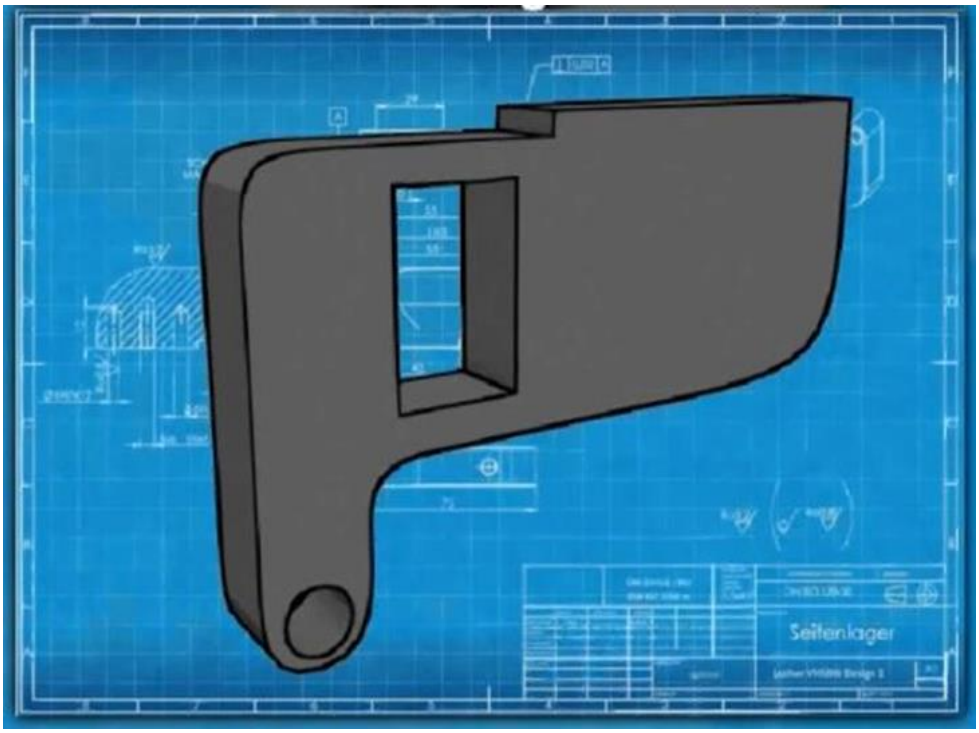

Figure 8: the side bearing

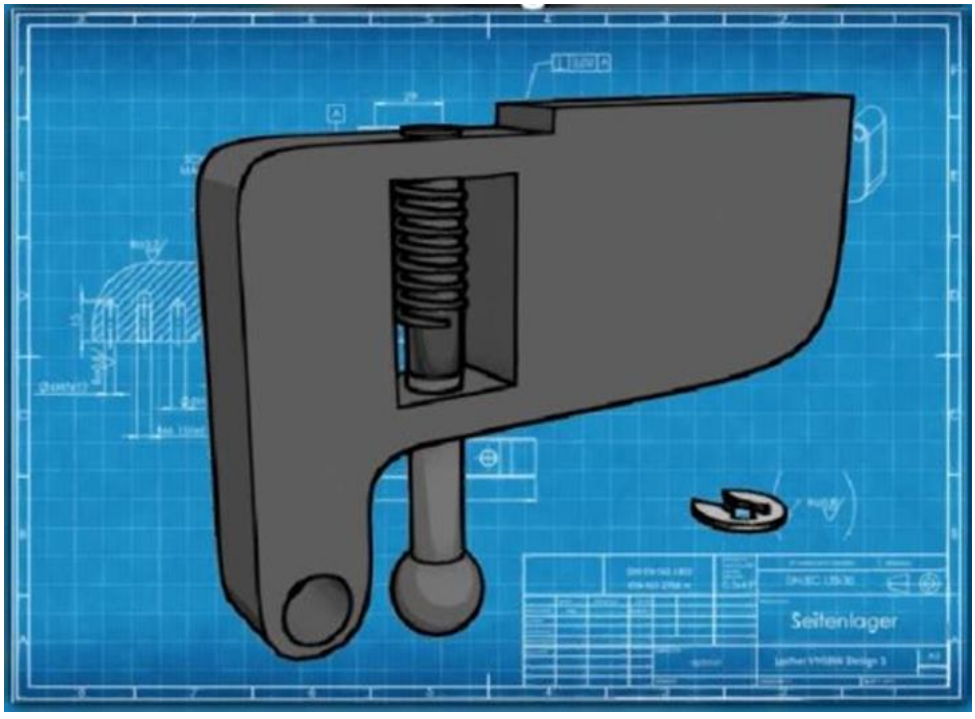

Figure 9: the side bearing with cutting punch, spring and locking disc

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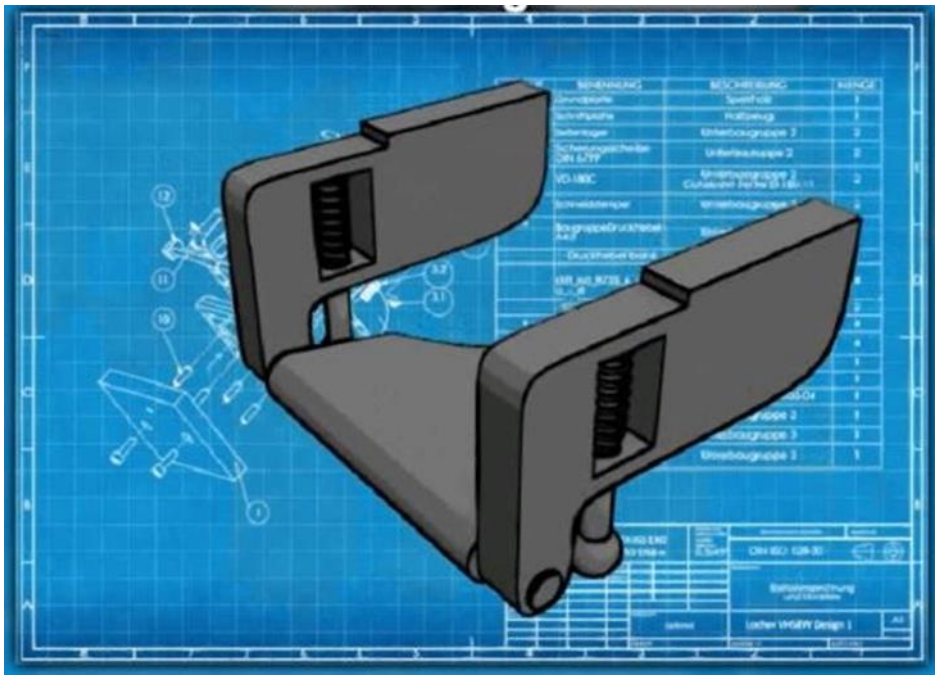

Figure 10: Side bearing and pressure lever mounted

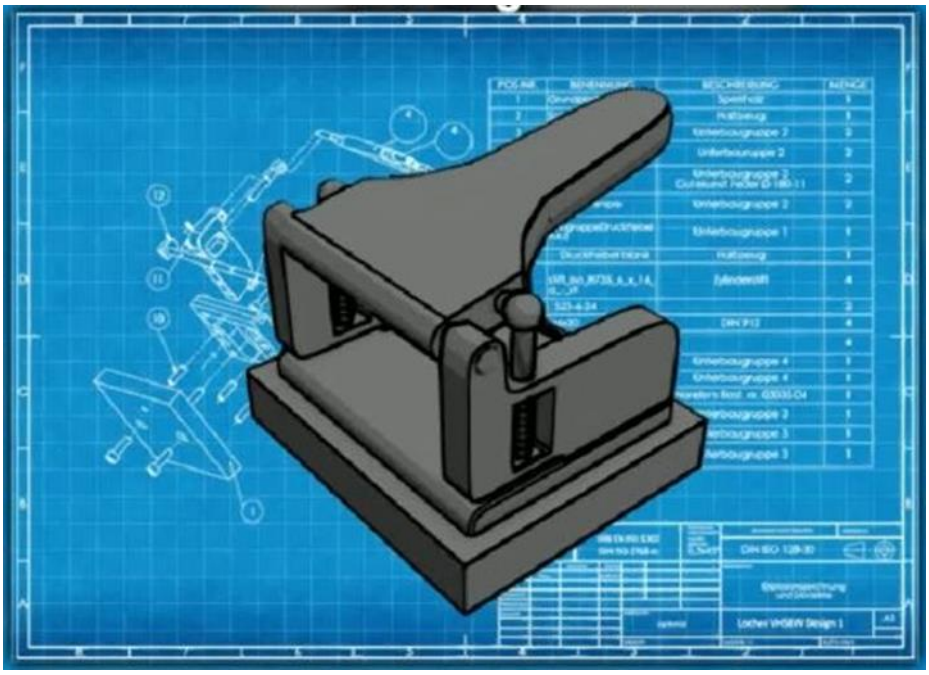

Figure 11: the mounted perforator

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2.5.6. Shipping

Here, the people involved in the process can examine their workpiece.

The project has been completed in terms of the manufacturing process.

M4 The PC station in the assembly (opposite the assembly station) is used to process the assembly instructions and the assignment of the small parts magazine.

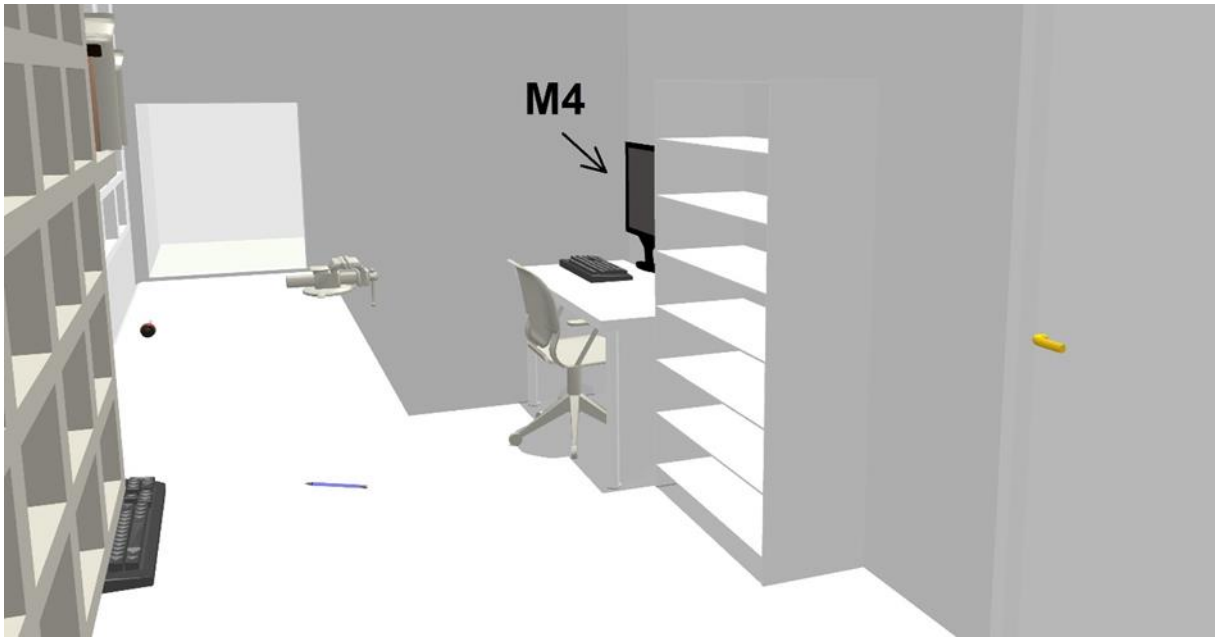

Figure 12: the goods issue

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3. Didactical concept of a learning factors with a focus on the profession “Tool maker” (Šolski center Škofja Loka)

Introduction

The project TRALES, under the Erasmus+ programme, aims to develop a didactic concept for a transnational learning factory. Part of the project is the development of a didactical example of a typical work process in the toolmaking sector, which includes an implementation based on the principles of a learning factory.

In our case, this means that we have developed a didactic case for teaching technical content that responds in real time to the needs for technical knowledge and professional competences, both in schools and in the training of human resources in companies.

The delivery of knowledge in the case study presents specific technical knowledge and skills in a way that also integrates the acquisition of knowledge and experience in soft skills/transversal competences as intuitively as possible in the individual steps.

We are looking for an optimal consensus of strictly technical and soft skills, knowledge and competences that will enable the learner to acquire the necessary skills to successfully perform a specific task and build a career in a comprehensive, fast and efficient way.

In a concrete proposal, we have presented a learning process for the production of a part of the tool for the "injection moulding process for plastic product", which indicates how an effective learning process could be carried out according to the learning factory principle for all other parts of the tool and a demonstration of the functionality of the tool as a whole based on simulations of the functionality of the digital twin of the tool.

To a greater or lesser extent, we are integrating learning factory pedagogies such as: collaborative learning, hands-on learning, problem-based learning, inquiry-based learning and integration of theory and practice.

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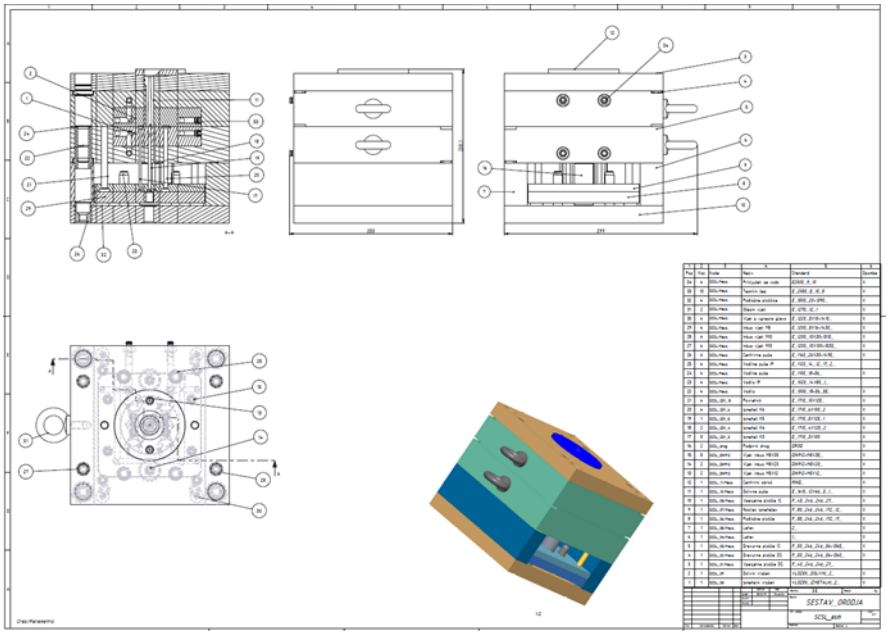
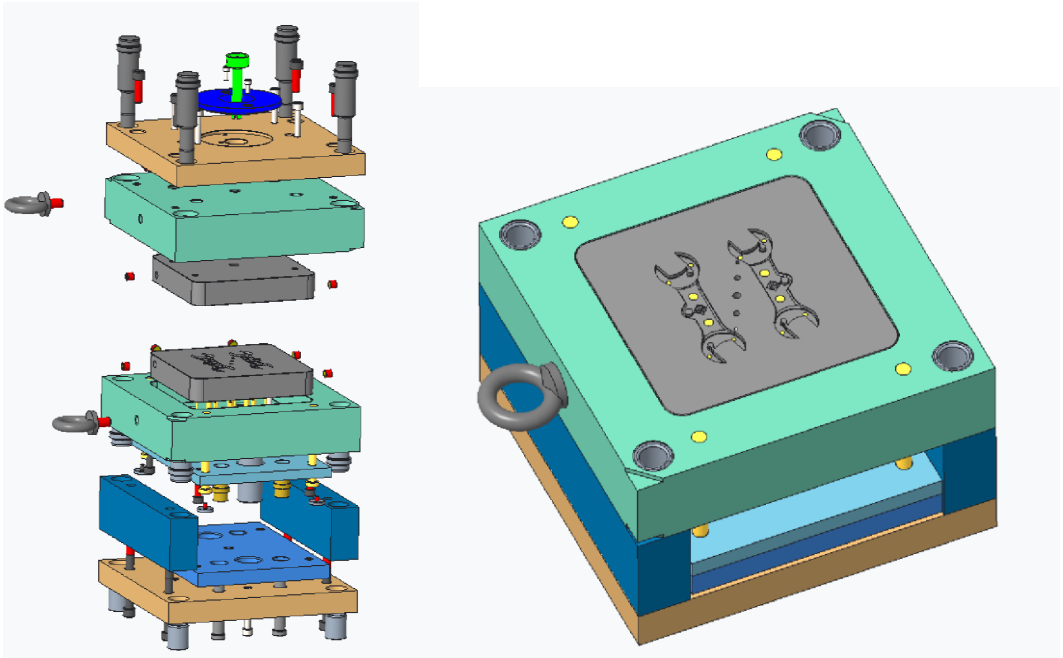
2 The process of manufacturing a part of a tool (example of a tool for making a "wrench" product)

2.1. General description of the tool and detailed description of one element of the tool to be manufactured, with technical drawings and 3D model





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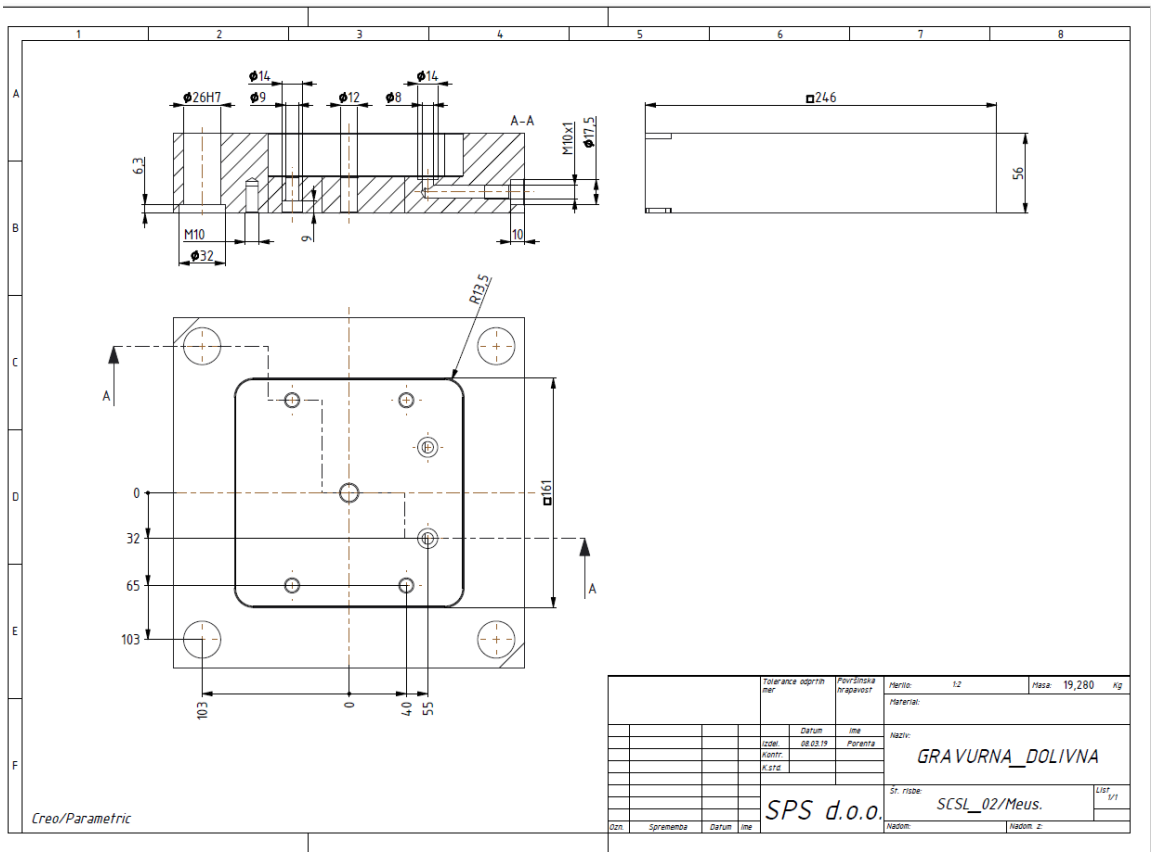
2.2. Tool upgrade with sensors (cooperation with an industrial partner)

For the subsequent mechatronic upgrade and normal operation of the tool, it is necessary to add sensor elements, which we agree with the company, with whom we coordinate solutions that will be optimal for training both in the company and in the school.

2.3. Determining key data and procedures, required for the tool manufacturing processes, performance of simulations and analysis and definition of manufacturing technologies for the selected tool element (tool insert) as in case:

Cutting of the material and preparation of the raw material for the manufacture of the flexible insert to be used for the preparation of the procedure for the manufacture of the product ENGRAVING BOTTOM PLATE.



*(Authors of this case are: Primož Šturm, Alojzij Kokalj, Ivan Mavri and Mojca Šmelcer – SCSL)

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Step 1: Mentor/mentor describes the work task

The mentor introduces the apprentice to his/her task and explains that he/she will prepare the raw material for the production of the flexible insert. The mentor points out that the basis for each work task is the technical documentation, which usually includes a work order and a shop drawing.

The mentor introduces the apprentice to the different phases of the work task, according to the time sequence:

- e-retrieval of the work order
- pick up the material in the warehouse -sector 7 and return the rest of the material to the pick-up point
- cutting of the material at the sawmill No 1-3 - sector 7
- checking the dimensions of the raw material
- delivery of the raw material for further processing at the TOOL-SHOP site - Processing Centre 2
- e-confirmation of the completed task in the work order

To help the apprentice understand the task to be performed, the mentor shows the apprentice the product to be produced on the basis of the raw material to be produced by the apprentice.

Step 1.1. Workplace preparation

The mentor introduces the apprentice to the workplace and gives the apprentice guidance on how to prepare the workplace, tools and equipment for safe working. The apprentice shall endeavour to take an active part in ensuring that the work is healthy and safe and that the health and safety of his/her co-workers is taken into account.

Senior apprentices prepare the workplace themselves, and the mentor checks the preparation and points out any irregularities.

Step 1.2. e-retrieval of the work order

The mentor opens the work order electronically at the prescribed workstation for the apprentice. He explains and demonstrates the process of electronically validating the acceptance of the work order. The apprentice, under the supervision of the mentor, then performs the electronic acceptance of the technical documentation for the given task, which comprises:
WORK TASK NO: 2020-001 and SHOP DRAWING for the product FLEXIBLE INSERT-RAW MATERIAL.

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1.2 Work task for the preparation of the raw material for the production of the FLEXIBLE INSERT

WORK ORDER Nr.: 2020-001 FLEXIBLE INSERT – raw material preparation	*QR code of the product*
Buyer(company): *name and address*	
Customer: *name and surname, function in the company*	

Task type: Cutting - preparation of raw materials for the product **Quantity:** (specify no. of pieces): 5 **Material:** 1.2343	**Task code**: barcode/QR code of the work operation **Task Name(s):** FLEXIBLE INSERT - raw material preparation Drawing: (drawing number): TL-4_5_1-FLEXIBLE_INSERT-RAW MATERIAL

Technologist's guidelines:

- e-retrieval of the work order
- pick up the material in the warehouse -sector 7 and return the rest of the material to the pick-up point
- cutting of the material at the sawmill No 1-3 - sector 7
- checking the dimensions of the raw material
- delivery of the raw material for further processing at the TOOL-SHOP site - Processing Centre 2
- e-confirmation of the completed task in the work order

Time: 2 hours

Responsible toolmaker: name and surname
Responsible designer/technologist: name and surname

Confirmation 1 of the acceptance of the task: Worker code: *(selection -menu)****, Day:*** *(selection -menu),* ***Time:*** *(selection -menu)*

Confirmation 2 of the acceptance of the task: Worker code: *(selection -menu)****, Day:*** *(selection -menu),* ***Time:*** *(selection -menu)*

****Note - Implementation of the task****: to be carried out during the apprentice intro process - estimated time +1 hour.*

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Step 1.3. Consideration of the work order and the shop drawing

If necessary, using questions, the mentor guides the apprentice to read the work order number and explains that it is in line with the company's internal documentation standards, which provide an insight into the history of work processes on the product.

DELOVNI NALOG ŠT.: 2020-001 GIBLJIVI VLOŽEK- priprava surovca

The apprentice asks questions and participates, depending on his/her previous knowledge. The mentor encourages and guides the apprentice through explanation and questions so that he/she answers the questions and understands the work task to be completed.

The mentor explains to the apprentice what a barcode or QR code is and what it is used for. The explanation is illustrated with a practical example, where the apprentice recognises and understands the importance of the role of coding systems in Industry 4.0., which is also read as content, not a process.

Črtna Koda/ QR koda izdelka 

The apprentice reads out the customer's details on the work order. The mentor explains that this information is important for monitoring the processing by customer.

Kupec(podjetje): *naziv in naslov*
Naročnik: *ime in priimek, funkcija v podjetju*

Vrsta naloge : Razrez – priprava surovcev za izdelek Količina: *(navedi št. Kosov)* : 5 Material: 1.2343	Koda naloge: *Črtna Koda/ QR koda delovne operacije* Naziv/*ime naloge:* GIBLJIVI VLOŽEK- priprava surovcA Risba: *(številka risbe)* : *TL-4_5_1-gibljivi_vložek-SUROVEC*

On the work order, the apprentice reads out the content of the type of work operation, the definition of the number of pieces to be made, the type of material and the code.

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In the first year, the mentor explains to the apprentice that a more detailed description of the work task also identifies the link to the workshop drawing number (explained on the drawing).

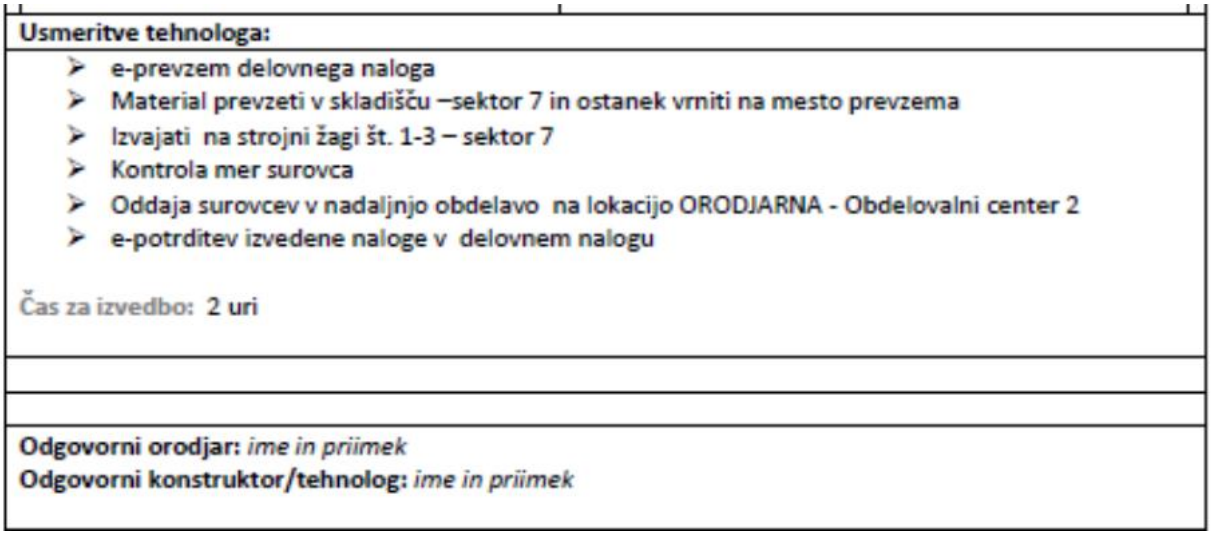
The mentor presents to the apprentice the technologist's guidelines, written as a sequence of work operations, which are necessary to achieve the objective defined by the work task and the shop drawing.

At the same time, he/she also provides the apprentice with information about the preparer of the work order and the person responsible for the production, so that the apprentice can read on the work order the definition of the type of work operation, the definition of the number of pieces to be produced, the type of material and the code.

In the first year, the mentor explains to the apprentice that the more detailed description of the work task also identifies the link to the workshop drawing number (explained on the drawing).

The mentor presents to the apprentice the technologist's guidelines, written as a sequence of work operations, which are necessary to achieve the objective defined by the work task and the shop drawing.

At the same time, the apprentice is provided with information about the preparer of the work order and the person responsible for the production, so that in case of misunderstanding or confusion, the apprentice can cooperate with competent colleagues and work in a group... in case of misunderstanding or confusion, the apprentice can cooperate with competent colleagues and work in a group.



Usmeritve tehnologa:

- e-prevzem delovnega naloga
- Material prevzeti v skladišču –sektor 7 in ostanek vrniti na mesto prevzema
- Izvajati na strojni žagi št. 1-3 – sektor 7
- Kontrola mer surovca
- Oddaja surovcev v nadaljnjo obdelavo na lokacijo ORODJARNA - Obdelovalni center 2
- e-potrditev izvedene naloge v delovnem nalogu

Čas za izvedbo: 2 uri

Odgovorni orodjar: *ime in priimek*
Odgovorni konstruktor/tehnolog: *ime in priimek*

The mentor then explains to the apprentice that the last part of the work order is to confirm acceptance and confirm completion of the work order. The apprentice checks off the confirmation point in the work order and performs the acceptance of the work order.

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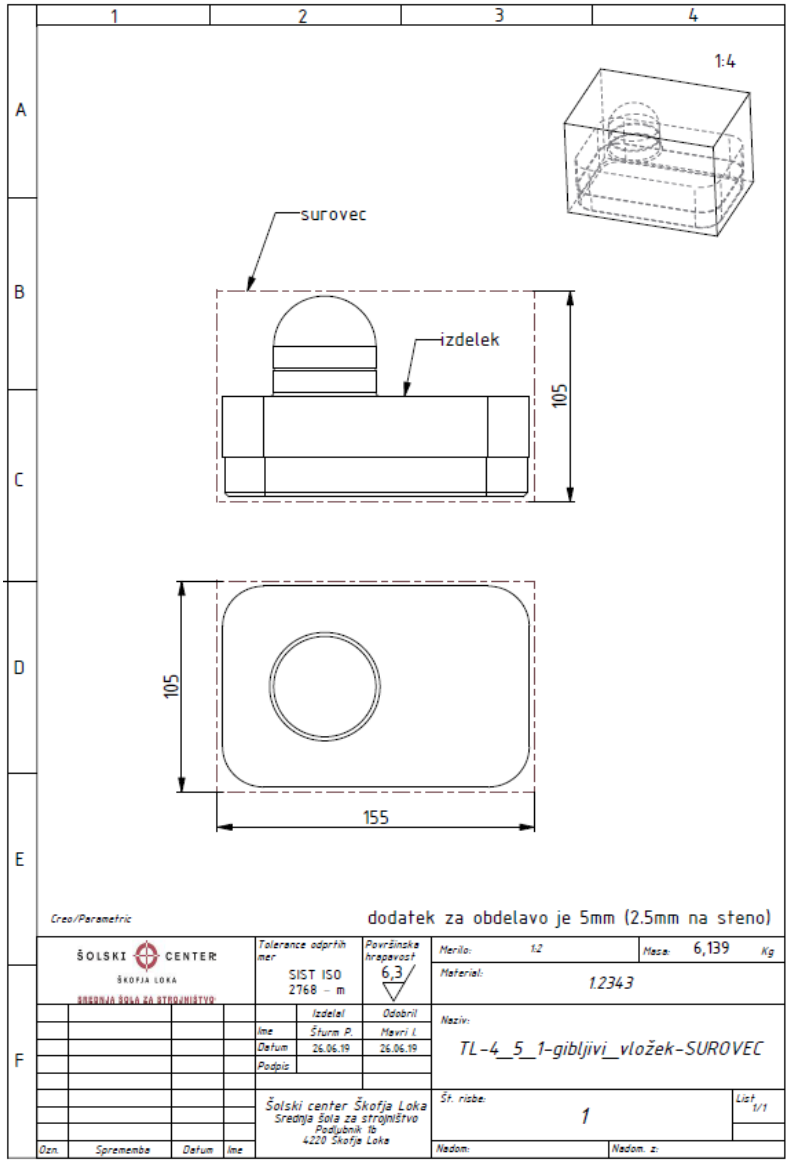
Potrditev 1 prevzema naloga: **Šifra delavca:** (izbor –spustni meni) , **Dan:** (izbor –spustni meni), **Ura:** (izbor –spustni meni)
Potrditev 2 izvedbe naloga: **Šifra delavca:** (izbor –spustni meni) , **Dan:** (izbor –spustni meni), **Ura:** (izbor –spustni meni)
*op- Izvajanje naloge: izvaja se v procesu uvajanja vajenca – predviden čas obdelave +1 ura.

1.3.1 Shop drawing for the product FLEXIBLE INSERT-RAW MATERIAL



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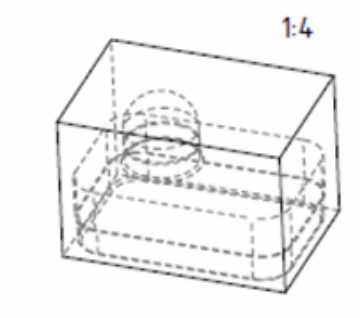
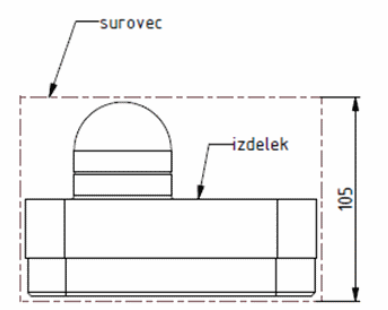
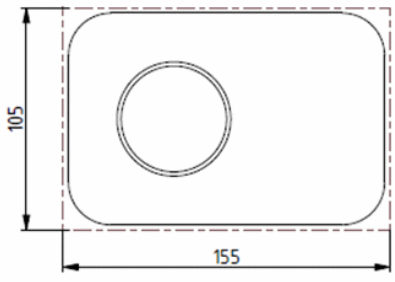
Based on the work assignment and the product drawing, the mentor explains the structure of the workshop drawing and the meaning of each notation or number, code or mark on the work order. During the explanation, the apprentice answers specific questions from the mentor and confirms by his answers his understanding of the procedures to be followed.



3D model of the raw material as it will look like after cutting



Dimensions of the raw material in-plan view to be achieved



Dimensions of the raw material (product) in-plan view

The necessary further processing allowance must be strictly observed!

The processing allowance is 5 mm (2.5 mm per wall).

The mentor encourages the apprentice and asks questions in such a way that the apprentice integrates as much as possible his/her theoretical and practical background in reading technical documentation.

Based on the mentor's explanation, the apprentice reads the name of the product in the title field of the drawing header. The mentor explains that, to facilitate traceability, the drawing should also indicate the type of tool and, if necessary, the customer, product and tool iteration codes. The mentor points out that this depends on the size of the company or internal standardisation.

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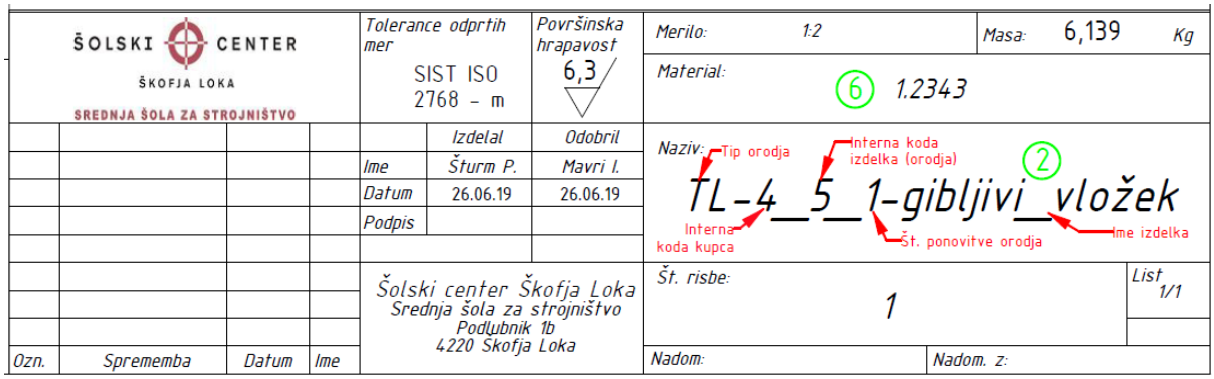
The mentor explains to the apprentice that for quick and easy understanding of the work task, the shop drawing often includes a 3-D model of the product. The apprentice reads the 3-D model of the component from the shop drawing and deduces the scale at which it is drawn.

The apprentice can tell from a drawing the type and thickness of lines, hatching, dimensions. Using technical regulations and standards, the apprentice explains the characteristics of a component. The mentor explains the technical regulations and standards relevant to the product and guides the apprentice with questions and explanations, if necessary.

The apprentice learns the mechanical, physical and technological properties of metals and alloys, and the division of steels and cast irons according to their use. Using a mechanical engineering handbook, the apprentice writes down the standard designation of steel and cast iron.

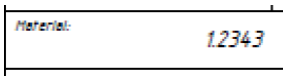
The mentor explains to the apprentice the meaning of each field in the header of the shop drawing, focusing on the fundamental properties of the material, the quality of the required finish (surface roughness) and the meaning of each letter or number in the title and number of the drawing, which also relate to other drawings and documentation of the finished product.

Header of the shop drawing:



The mentor explains to the apprentice that the standard code for the material to be used to make the part is to be entered in the required place in the drawing header.

The apprentice reads off the code for the type of material required to complete the work task on the shop drawing. Using a mechanical engineering manual, the apprentice describes the standard code for the material specified on the drawing to be used to make the part.



The apprentice shall read off on the shop drawing the surface roughness requirement of the product specified for the work task. Using a mechanical engineering handbook, the apprentice describes the standard roughness code and its meaning in practice.

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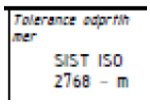
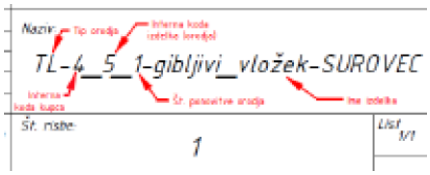
On the shop drawing the apprentice shall read off the requirement for the product tolerances specified for the work task. Using a mechanical engineering manual, the apprentice describes the meaning of the written standard and its relevance to the practical manufacture of the product.



The apprentice reads off the product name and drawing number on the workshop drawing and, through discussion with the mentor, consolidates the understanding of the individual marks, lines or numbers.



Step 1.4. Receive the material at the warehouse and return the remaining material to the collection point

The mentor accompanies the apprentice to the material store (in case it is the first time the apprentice is doing this procedure), where the apprentice collects the material trolley from the store clerk. The mentor guides, explains and familiarises the apprentice with the roles and responsibilities of the colleagues with whom he/she is working in the material collection process. When the cutting is complete, the apprentice returns the remaining material to the warehouse staff member.

Step 1.5 Cutting of material on machine saws No 1-3

The mentor explains the structure of the machine saw, the way the machine works, its usability and adaptability, the rules for safe use of the machine and the dangers at work. The mentor then asks the apprentice questions so that the apprentice can use the questions to identify how and what it means to handle the machine safely and to identify the type and importance of protective equipment.

The mentor then demonstrates how to check the operation of the machine, checking for possible defects and the correct setting of the tools. The mentor explains how to identify tool wear and demonstrates how to replace the tool. The mentor demonstrates and explains how to determine and set the machining parameters on the machine. He emphasises the importance of using protective equipment and health protection at work.

The apprentice listens to and, if necessary, writes down the instructions and uses the protective equipment. The mentor starts the main switch of the machine saw and checks the settings.

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The apprentice uses a shop drawing to monitor and compare the settings on the machine and read off the measurements recorded on the shop drawing.

The mentor then demonstrates the correct and safe clamping of the material. The apprentice checks the intended length of the raw material with a calliper or a tape measure, as instructed by the mentor.

The mentor asks the apprentice questions by repeating the instructions for working safely with the machine. The apprentice then switches on the main switch of the machine saw and together they control the machine and monitor the cutting of the piece.

The apprentice then carries out the previously demonstrated procedure on his/her own, following the instructions of the mentor. The trainee independently clamps the material on the work table of the machine and the mentor physically checks the quality of the clamping. The apprentice cuts the first piece of raw material and removes the cut product to the intended place.

The apprentice then plans the work on the machine himself. In the first year of training with the employer, the apprentice is able to select and use the appropriate tools and machine tools, as instructed by the mentor. Based on a demonstration and under the guidance of the mentor, the apprentice is able to clamp the workpiece and the tool correctly and safely. The apprentice is able to read the information written on the shop drawing, use technical terminology and set the appropriate parameters on the machine. In the presence of the mentor, the apprentice controls the machine tool and operates it as instructed by the mentor. The apprentice plans work tasks responsibly under the guidance of the mentor.

In the third year, the apprentice plans, implements and controls the machining process on the machine. He/she identifies tool wear and replaces the tool. The apprentice is able to plan the production process of a complex product using several machining processes and independently selects the appropriate machining techniques, machines and tools. The apprentice is able to think critically and control his/her own work.

After completing the cutting process, the apprentice cleans the machine and tidies up the work area, as instructed or demonstrated by the mentor, and returns the remaining material to the storekeeper in charge at the designated place.

Step 1.6. Checking the dimensions of the raw material

After cutting the first piece of raw material, the mentor demonstrates to the apprentice how to check the dimensions of the product using a tape measure or a calliper.

Then, after each new piece is cut, the apprentice checks the dimensions independently under the supervision of the mentor.

The mentor shall introduce the apprentice to the importance and influence of tolerances on the technological process, production time, choice of machine, price of the product....

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The mentor shows the apprentice the drawing and explains where (on the drawing according to the standard) the tolerances of the dimensional measurements necessary for the functionality of the product are indicated.

Explain to the apprentice the free tolerances indicated in the header of the drawing.

The mentor checks the knowledge and understanding of tolerances by having the apprentice draw and read shop drawings, component drawings and other technical documentation.

(The mentor explains and demonstrates to the apprentice, using a shop drawing and appropriate measuring tools, the tolerances for functional and free surfaces and records how to state the limit dimensions, limits, numerical values and tolerance classes of the tolerance system).

The apprentice shall read off and explain the tolerances that are permissible on the shop drawing.

Using a calliper, the apprentice measures the actual dimension of the component and discusses with the trainer the tolerance or the maximum allowable dimension of the component according to the tolerance or the difference between the upper and lower limit dimension read on the shop drawing.

The apprentice calculates the tolerance interval, the basic tolerance or minimum tolerance and the nominal measure or the theoretical desired measure of the component as defined by the drawing.

Step 1.7. Delivery of raw materials for further processing at TOOLSHOP-Processing Centre 2

The apprentice, as instructed and accompanied by the mentor, takes the raw **materials** by trolley to the designated disposal shelf in the tool shop next to the machining centre 2.
There, he or she alerts the employee to the delivery and signs the material delivery record sheet next to the machine. The worker at the machine also signs to acknowledge receipt.

Step 1.8. e-confirmation of the completed task (confirmation 2 in the work order)

The apprentice opens the work order electronically at the prescribed workstation.

The mentor checks by discussion and questions that the apprentice has understood the content of the requirements of all items of the work order and the workshop drawing.

The mentor then explains and demonstrates to the apprentice the process of completing the work order electronically. The apprentice then completes the work task electronically under the supervision of the mentor.

The apprentice writes a work report and a workshop log. The mentor reviews it, comments on it, asks for additions if necessary and assesses it.

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2.4. Production of tool parts in the tool shop

Depending on the complexity of the final product, parts of the tool are made partly in the school workshops and partly in the toolshop of a professional partner company.

In case the team decides to create a new product, a new 3D model / digital twin of the tool must also be created. For each part of the tool, a technological manufacturing process has to be defined. Following the example above.

2.5. Production of tool parts with 3D printing technology

Production of the inner part of the tool (engraving according to the customer's order) and external tool parts with 3D printing technology. It depends on customer order and possibilities of producer/ company, school..

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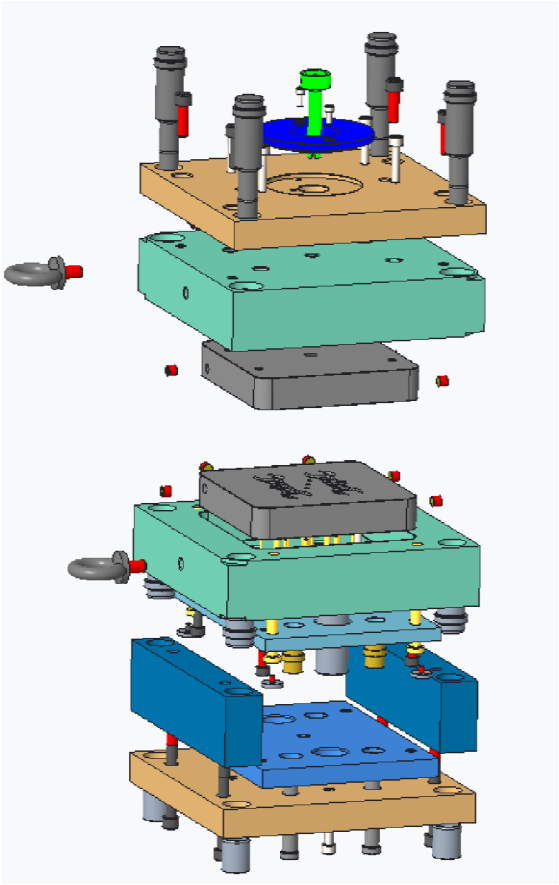
2.6. Tool assembly

Assembly of tools and mechanical tests of matching machine parts and preparation of assembly instructions with appropriate explosion drawing, e.g.:



2.7. Installation of electronic components

In this phase, suitable electronic components must be selected and installed in cooperation with the partner company.

2.8. Feature testing

Testing of all parts for fit and consistency, including the functioning of the electronic components - testing of the functionality of the tool and finalisation of the procedures for the creation of the digital twin of the process of the functioning of the tool.

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2.9. Corrections and elimination of deficiencies

Addressing deficiencies in all respects to ensure that components and fitted systems work perfectly. Any corrections shall be entered in all previous procedures.

2.10. Production of digital tool twins and related processes (functionality, economy, changes of material colours etc…- depending on customer order)

Creating a digital twin of the tool's process and collecting key data for the learning process. Completion with descriptions, short videos etc., using VR/AR technologies for more effective learning and mentoring.

3.0. Conclusion

The project is based on a holistic approach aimed at integrating the pedagogical and professional knowledge and skills needed to achieve a high level of applied knowledge in the shortest possible time. The working methods include flexibility appropriate to the technological development and a wide applicability for the acquisition of important competences in the field of toolmaking for students, as well as for the upgrading of the knowledge of employees in companies and the training of unemployed job seekers. The concept could be a new step towards a common European standard of skills in the EU, which would allow for a fast and efficient transition of the workforce in the area of the countries using the concept, according to the needs of companies or the preferences of individuals.

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4. Requirements for trainers in transnational learning factories: core competences (Aristotelio Panepistimio Thessalonikis, Thessaloniki)

The competencies that trainers need to have, in order to be able to respond sufficiently to the environment of a transnational learning factory fall into two categories: Core competencies and soft skills / competencies.

The core competencies that would enable them to contribute to the successful implementation of the project can be grouped into four main areas: technical knowledge and expertise, pedagogical skills, management skills and, language and intercultural competences.

Technical Knowledge and Expertise

The trainers should have a solid technical background in the thematic area of toolmaking and mechatronics. This would involve a deep understanding of the methods and processes used in the field, as well as the ability to stay up-to-date with the latest developments and trends. The trainers should also be proficient in the use of relevant software and tools.

Pedagogical Skills

The trainers should have strong pedagogical skills, including the ability to design and deliver effective learning activities, assess learner needs, provide constructive feedback, and promote learner engagement and motivation. Trainers should also be familiar with a range of teaching methodologies, including experiential learning and collaborative learning.

Management Skills

Management skills are essential for trainers working in a transnational learning factory. They should be able to organize the training sessions, manage the project timeline, and ensure that all participants are meeting the project goals. Additionally, they should be able to monitor and evaluate the project's progress and make adjustments as needed. Their management skills will help ensure that the project stays on track and achieves its objectives.

Language and intercultural Competences

Given that the learning factory involves collaboration among trainers and trainees from different EU countries, language and intercultural competence is important. Trainers should have the ability to communicate effectively with people from different countries / cultures, understand and respect cultural differences, and adapt their teaching style and approach to different cultural contexts.

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1. Technical Knowledge and Expertise

Technical knowledge and expertise that is required as a core competence by the trainers falls mainly into two areas:

- Subject-related technical competencies (STC) in modern production technologies
- Multidisciplinary digital competencies (MDC)

Subject-related technical competencies (STC) are the knowledge, skills and attitudes that enable learners to perform specific tasks in a given domain, such as automation technology, electrical engineering, mechatronics and so on.

These competencies are essential for teaching and learning in a learning factory that simulates a production line and prepares vocational students for the challenges of digitization and interconnection of industrial value chains.

A TLF is a realistic and flexible learning environment that simulates the production processes and challenges of a real factory. A TLF allows learners to acquire practical and theoretical competencies in a collaborative and interdisciplinary way. A TLF also fosters the development of transversal competencies, such as communication, teamwork, problem-solving and intercultural awareness.

In order to design and implement a TLF project in the field of toolmaking and mechatronics, trainers need to have a solid foundation of STC in the following areas:

- Toolmaking: This involves the design, manufacture, testing and maintenance of tools, such as molds, dies, jigs and fixtures. Trainers need to master the principles of tool design, material selection, machining processes, quality control and tool life management. Trainers also need to be familiar with the use of computer-aided design (CAD) and computer-aided manufacturing (CAM) software and equipment.

- Mechatronics: This is the integration of mechanical engineering, electrical engineering, control engineering and computer science to create smart systems and products. Trainers need to understand the concepts of sensors, actuators, controllers, microprocessors, robotics and automation. Trainers also need to be able to design, program, test and troubleshoot mechatronic systems and components.

By developing these STC, trainers will be able to participate effectively in the TLF project and achieve the following objectives:

- To design and manufacture a prototype that can perform multiple functions and adapt to different scenarios.

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- To collaborate with peers from different countries and disciplines to exchange ideas, feedback and solutions.
- To apply the principles of lean manufacturing and continuous improvement to optimize the production process and reduce waste.
- To document and present the results of the project using appropriate formats and tools.

- **Multidisciplinary digital competencies (MDC)**

MDC are defined as the combination of technical, social and personal competencies that enable individuals to use digital technologies effectively and creatively in various contexts. MDC are essential for the development of innovative and sustainable solutions for the **advanced manufacturing (AM)** sector, which is a key driver of employment and prosperity in Europe.

The project aims at the development of a didactical concept for a transnational learning factory of vocational education for the professions and activities in tool making and mechatronics.

A transnational learning factory is a complex learning environment that contains authentic replicas of real production systems and value chains, so that participants can learn based on experiences, in a hands-on fashion.

The concept will be designed in such a way that the overall process of production can be taught using digitalized technologies and teaching/learning activities can take place interactively.

The MDCs that are required ideally by the trainers for the successful implementation of the project can be classified into three main categories:

- Technical competencies: These include the ability to use digital tools and platforms, such as data analytics, big data, digital twin, augmented and virtual reality, etc., to design, monitor, optimize and improve the machining processes and products. Technical competencies also involve the understanding of the principles and applications of AM technologies, such as additive manufacturing, robotics, automation, etc., as well as the knowledge of quality standards and regulations in the AM sector.

- Social competencies: These include the ability to communicate, collaborate and coordinate effectively with different stakeholders across national and cultural boundaries, such as peers, teachers, customers, suppliers, etc. Social competencies also involve the development of intercultural awareness and sensitivity, as well as the respect for diversity and ethical values in the AM sector.

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- Personal competencies: These include the ability to learn autonomously and continuously, as well as to adapt to changing situations and challenges in the AM sector. Personal competencies also involve the development of creativity, innovation, critical thinking and problem-solving skills, as well as the motivation and self-confidence to pursue personal and professional goals in the AM sector.

The project will contribute to the enhancement of MDC among students and teachers in vocational education and training in the thematic area of toolmaking and mechatronics. This will enable them to participate effectively and competitively in the AM sector, which is expected to grow significantly in Europe in the coming years. The project will also foster cooperation and networking among educational institutions and industrial partners across Europe, creating a transnational community of practice that will exchange knowledge, experience and best practices in AM education.

2. Pedagogical skills

The pedagogical skills that are essential for the trainers in order to participate in a successful project implementation include:

- Designing learning outcomes and curricula that are aligned with the professional skills, knowledge and abilities of the target professions, as well as with the overall process of production using digitalized technologies.

- Applying methods that support self-directed learning, such as hybrid and asynchronous learning formats, guiding texts, learning projects and work-based learning.

- Developing intercultural competence and communication skills to facilitate collaboration and exchange among learners and teachers from different countries and backgrounds.

- Integrating digital tools and platforms to enable interactive and flexible teaching and learning activities across borders and locations.

- Evaluating and assessing the learning outcomes and impact of the transnational learning factory on the learners' competence development and employability.

There is a variety of pedagogic procedures that can be used in a learning factory to support teaching and learning. Some of the key principles of teaching and learning may include:

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Hands-on learning: Learning factories are designed to provide students with hands-on learning experiences, so that they can apply what they have learned in a real-world setting. This may involve working on projects that involve the design, production, and testing of real products or prototypes.

Problem-based learning: Learning factories often use problem-based learning approaches, which involve students working on real or simulated problems that they need to solve using their knowledge and skills. This can help students learn how to apply their knowledge in a practical setting.

Collaborative learning: Learning factories often involve students working in teams or groups to complete projects and tasks. This can help students learn how to work effectively with others and develop important teamwork and communication skills.

Inquiry-based learning: Inquiry-based learning approaches can be used in a learning factory to encourage students to ask questions, explore, and investigate problems and concepts on their own. This can help students develop critical thinking and problem-solving skills.

Integration of theory and practice: In a learning factory, students have the opportunity to apply the theories and concepts they have learned in the classroom to real-world projects and tasks. This can help them see the relevance of what they are learning and better understand how to apply their knowledge in a practical setting.

An interesting part of pedagogical aspect in the general context of learning factories are the **eexperiential learning approaches**.

Experiential learning approaches are based on the idea that learners construct their own knowledge and skills by engaging in authentic and meaningful tasks that reflect real-world situations and problems. These approaches aim to foster learners' motivation, autonomy, creativity, collaboration, and critical thinking skills, as well as to bridge the gap between theory and practice. The theoretical background of experiential learning approaches, as well as two of the main teaching/learning activities that fall into this area (Problem-based learning - **PBL** and Inquiry-based learning - **IBL**) are presented in brief.

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Experiential learning approaches are rooted in the constructivist theory of learning, which posits that learners actively construct their own knowledge and understanding through interaction with their environment and other people (Piaget, 1970; Vygotsky, 1978). According to Kolb (1984), experiential learning is a cyclical process that involves four stages: concrete experience, reflective observation, abstract conceptualization, and active experimentation. Learners start by having a concrete experience that triggers their curiosity and interest. Then they reflect on their experience and try to make sense of it by connecting it to their prior knowledge and existing theories. Next, they form new concepts and hypotheses based on their reflections and observations. Finally, they test their hypotheses by applying them to new situations and problems.

Problem-based learning (**PBL**) and inquiry-based learning (**IBL**) are two examples of experiential learning approaches that have been widely used in various educational contexts, especially in science, technology, engineering, and mathematics (STEM) fields.

PBL is a student-centered approach that involves presenting learners with an ill-structured or open-ended problem that requires them to identify and define the problem, gather relevant information, generate possible solutions, evaluate alternatives, and present their findings.

IBL is a similar approach that emphasizes learners' active involvement in posing questions, investigating phenomena, drawing conclusions, and communicating their results. Both PBL and IBL aim to develop learners' problem-solving skills, scientific literacy, self-directed learning skills, and collaborative skills.

3. Management skills

The management skills that are in demand from the trainers of a learning factory project are classroom and laboratory management, and course implementation and evaluation.

Classroom and laboratory management refers to the organization and administration of the physical and virtual learning environments, as well as the allocation and utilization of resources, equipment, and personnel. Some of the key aspects of classroom and laboratory management are:

- Ensuring that the learning spaces are safe, accessible, comfortable, and conducive to learning for all participants.

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- Establishing clear rules and expectations for behavior, attendance, communication, collaboration, and assessment in the classroom and laboratory settings.
- Coordinating with other project partners to ensure alignment and compatibility of curricula, materials, methods, and technologies across different countries and cultures.
- Managing the inventory, maintenance, and security of the learning resources and equipment, including hardware, software, tools, machines, and materials.
- Providing technical support and troubleshooting for any issues or problems that may arise during the learning activities.
- Monitoring and evaluating the performance and progress of the learners and instructors in the classroom and laboratory settings.

Course implementation and evaluation refers to the design and delivery of the learning content, as well as the measurement and improvement of its effectiveness and impact. Some of the key aspects of course implementation and evaluation are:

- Developing and updating the learning objectives, outcomes, competencies, and standards for each course module according to the project goals and requirements.
- Selecting and adapting the appropriate pedagogical approaches, methods, techniques, and tools for each course module according to the learners' needs, preferences, backgrounds, and levels.
- Implementing and facilitating the learning activities in a flexible, interactive, engaging, and learner-centered manner.
- Providing timely and constructive feedback and guidance to the learners throughout the learning process.
- Assessing and documenting the learners' achievements, skills, knowledge, attitudes, and behaviors using various methods and tools such as tests, quizzes, assignments, projects, portfolios, observations, surveys, interviews, etc.
- Analyzing and interpreting the assessment data to evaluate the strengths and weaknesses of the course modules, as well as their relevance, validity, reliability, efficiency, and effectiveness.
- Reporting and disseminating the evaluation results and recommendations to the project partners and stakeholders for further improvement and development.

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These two factors are interrelated and interdependent. They require careful planning, coordination, communication, collaboration, monitoring, and evaluation among all project partners. They also require continuous reflection, innovation, and adaptation to meet the changing needs and expectations of the learners and the project context.

4. Language and intercultural competences

A transnational learning factory is a collaborative network of educational institutions and industrial partners that aims to provide high-quality and innovative training programs for learners across different countries and sectors. The trainers involved in such a project play a crucial role in facilitating the learning process and ensuring the achievement of the project objectives. Therefore, they need to possess certain language and intercultural competences that enable them to communicate effectively, interact respectfully, and adapt flexibly to the diverse contexts and challenges of the project.

Language competences refer to the ability of the trainers to use their native as well as foreign languages appropriately and accurately for various purposes and situations. Trainers need to have a good command of the languages used in the project, which may include English as a common (project) language, as well as the languages of the partner countries. They need to be able to understand and produce different types of texts, such as reports, presentations, manuals, feedback forms, etc., using appropriate vocabulary, grammar, and style. They also need to be able to communicate orally with learners, colleagues, and stakeholders, using clear pronunciation, intonation, and non-verbal cues. Moreover, they need to be aware of the linguistic diversity and variation within and across languages, and be able to adjust their language use according to the level, needs, and preferences of their interlocutors.

Intercultural competences refer to the ability to appreciate and respect cultural differences and similarities among people from different backgrounds and perspectives. Trainers need to have a positive attitude towards cultural diversity and a willingness to learn from other cultures. They need to be able to recognize and avoid stereotypes, prejudices, and ethnocentrism that may hinder intercultural communication and cooperation. They also need to be able to understand and interpret the cultural values, beliefs, norms, and practices that influence the behaviour and expectations of

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learners, colleagues, and stakeholders. Furthermore, they need to be able to negotiate meaning and resolve conflicts that may arise from intercultural misunderstandings or disagreements. Additionally, they need to be able to adapt their teaching methods and strategies to suit the diverse learning styles, preferences, and needs of learners from different cultural backgrounds.

In conclusion, language and intercultural competences are essential for trainers who participate in a transnational learning factory project. They enable them to communicate effectively, interact respectfully, and adapt flexibly to the diverse contexts and challenges of the project. Therefore, they should be developed and assessed throughout the project cycle, using various tools and methods such as self-assessment, peer feedback, online courses, workshops, simulations, etc. By enhancing their language and intercultural competences, trainers can contribute to the success of the project and the quality of the learning outcomes.

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4.2. Research among the trainers regarding the core competencies

Introduction

A questionnaire was drafted during the project meeting in Vicenza (17-18 Jan 2023) and it was used by two of the partners, which are VET institutes (VHS-Bildungswerk GmbH and Solski Center Skofja Loka), in order to evaluate the experience and competences of their actual trainers as candidate trainers for the learning factory project.

The questionnaire comprises of two sections :

In the first section there are six questions about the trainers' educational background, industry experience, and technical skills, while in the second part there are nine questions, which are more specific and technical, regarding teaching and learning approaches, engagement strategies and experiences in open earning environment.

The research was conducted during February 2023 and there were 13 responses in total, 5 from VHS-Bildungswerk GmbH personnel and 8 from Solski Center. The general impression is that it was well accepted by the respondents, although in some questions the majority of them was not able to provide any answer.

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Presentation of the results

A detailed presentation of the responds follows presented per question, but in an aggregated form.

SECTION A.

Q1. Educational background

Most of the respondents hold a University degree.

Q2. Teaching / professional experience

Almost all the respondents have teaching experience.

Q3. Industry experience or certifications

Most of the respondents have industry experience.

Q4. Pedagogical studies/training or qualifications

Most of the respondents have pedagogical studies and/or qualifications.

Q5. Technical or didactic skills/experience relevant to tool making or mechatronics

Almost all the respondents with technical background gave a positive answer.

Q6. Use of methodologies with the scope to develop soft skills

The majority of the respondents gave a positive answer.

SECTION B.

Q7. Have you had any previous experience in process oriented learning environment ?

Q8. If so, please describe your role and responsibilities.

Around 50% of the respondents gave a positive answer to Q7 and presented some details in Q8.

Q9. How do you approach teaching and learning in an open learning environment ?

More than 2/3 of the respondents gave some answer, usually not specific to open learning environment.

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Q10. What are your key teaching strategies and methods?

More than 2/3 of the respondents gave some meaningful but not detailed answers

Q11. Can you provide examples of how you have used experiential learning approaches, such as problem-based learning or inquiry-based learning, in your teaching?

The majority of the Slovenian participants gave clear examples. From the German participants there was one very detailed answer.

Q12. How do you engage students in their learning and encourage collaboration in an open learning environment ?

Less than 50% of the respondents (mainly Slovenian) gave a brief answer.

Q13. Have you had any experience working with industry partners or other external stakeholders in a learning factory or similar project ? If so, please describe your role and responsibilities.

There was no example regarding a learning factory, but there were some positive answers regarding cooperation with industry partners.

Q14. How do you stay up-to-date regarding :

a) the latest trends and technologies in your field ?

b) VET methodologies ?

c) Soft skills development ?

d) Process oriented methods ?

More than 2/3 of the respondents gave detailed and meaningful answers to most of the questions.

Q15. What benefits do you foresee in the process oriented methodology for your organization ?

Less than 25% of the respondents gave answers, which are meaningful and useful.

Remarks and conclusion

The research which was conducted with the use of the questionnaire provided useful information to the project partnership. The number of participants was so low that the findings are just personal opinions of the respondents, with no statistical value. Nevertheless, they indicated a positive attitude, regarding all the issues that the project was trying to bring forward in the environment of the VET systems in the participating countries, through the concept of the Learning Factories.

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QUESTIONNAIRE

Introduction for the orientation of the interviewee

The following questions can help us evaluate the experience and competence of a trainer or, in a broader sense, a participant in a Learning Factory project by gathering information about their educational background, industry experience, teaching and learning approaches, engagement strategies, and technical skills. They can also provide insight into the interviewee and motivations as a trainer and how they hope to impact the learning and development of their students.

Section A

1. What is your educational background ?

2. What is your teaching / professional experience in your subject area?

3. Do you have any relevant industry experience or certifications?

4. Do you have any pedagogical studies/training or qualifications?

5. In case you were asked to be a trainer in a learning factory project regarding tool making or mechatronics, do you have any technical or didactic skills/experience that are relevant to the subject ? If yes, please describe your expertise.

6. Do you use methodologies with the scope to develop soft skills in your classes/students/pupils ?

Section B

7. Have you had any previous experience in process oriented learning environment ?

8. If so, please describe your role and responsibilities.

9. How do you approach teaching and learning in an open learning environment ?

10. What are your key teaching strategies and methods?

11. Can you provide examples of how you have used experiential learning approaches, such as problem-based learning or inquiry-based learning, in your teaching?

12. How do you engage students in their learning and encourage collaboration in an open learning environment ?

13. Have you had any experience working with industry partners or other external stakeholders in a learning factory or similar project ? If so, please describe your role and responsibilities.

14. How do you stay up-to-date regarding :

a) the latest trends and technologies in your field ?

b) VET methodologies ?

c) Soft skills development ?

d) Process oriented methods ?

15. What benefits do you foresee in the process oriented methodology for your organization ?

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5. Requirements for trainers in transnational learning factories: support processes (Eurocultura, Vicenza)

5.1 Catalogue of requirements for teachers and trainers in transnational learning factories with a focus on soft skills

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1. Preliminary remark

Digitalisation, climate change, armed conflicts, inclusion and diversity are some of the challenges that teachers and trainers increasingly have to face. The complexity of the overlapping situations leads to disorientation, fear of the future, learning difficulties and aggressiveness on the part of learners, for example.

Soft skills, also known as key qualifications, are becoming increasingly important for a successful career entry. When applying for a job, companies no longer only assess professional knowledge, but also consider so-called soft factors such as tolerance, self-reflection, organisational talent, manners, teamwork or critical thinking. Globalisation has increased the demand for personnel who can work with and in diverse markets and cultures.

With the European Reference Framework for Key Competences (2018), the European Union has created an innovative foundation to promote transversal key competences such as personal fulfilment, active citizenship and social cohesion, with the aim of improving employability.

The teaching of technical knowledge and professional practice in schools and companies, i.e. the "hard skills", must therefore be integrated with the learning of soft skills. In addition to gaining experience and learning with project work or in a lesson, soft skills should primarily be taught through subject matter.

The Erasmus+ project TRALES aims to develop a didactic concept for a transnational learning factory. Part of the project is the development of this catalogue of requirements for teachers which aims to define the desired soft skills competences that support a successful learning process not only at home but also abroad.

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2. Soft Skills for teaching and training

Soft skills concern personal aspects related to contextual factors and are necessary for teachers and trainers to possess i.e. before their own subject competence is applied. Soft skills facilitate and enrich interactions with learners.

The most important soft skills for teaching and training can be divided into four areas:

Soft skills for dealing with oneself

In order to properly support learners, the following soft skills, among others, are important: - Self-awareness- Self-responsibility - Ability to self-motivate - Self-management - Intuition - Ability to learn - Integrity - Self-marketing.

Soft skills for working with others

The following soft skills, among others, are important when working with learners in school and in the workplace: - ability to work in a team - ability to deal with conflict – problem solving skills - ability to communicate – motivational skills - moderation skills - ability to work under pressure - networked thinking.

Soft skills for leadership

The following soft skills, among others, are important for dealing with learners at school and in the workplace: - Developing teamwork based on individual qualities - Developing the ability to perceive and use structures - Acting as a role model Developing assertiveness and consistency - Goal orientation.

Soft skills for general interaction with others

The following soft skills, among others, are important for teaching and guidance in schools and enterprises: - Respect for others - Empathy - Commitment - Creativity - Ability to be open and stand out - Recognition - Initiative - Critical faculties – Flexibility.

3. Transnational learning factory

Transnational learning factories enable the transfer of knowledge and experience in an international context. They can take place in cooperation with partners from abroad in the teacher's own country, abroad or as virtual project work.

Transnational learning factories enable learners to compare their level of knowledge with others and learn about innovations in a structured way.

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Transnational learning factories offer the education provider the opportunity to offer attractive education courses abroad or in cooperation with foreign education providers for their own learners. But they also mean positioning themselves as a provider on the international market.

Transnational learning factories include not only the transfer of knowledge and work experience but also the application of soft skills in an international learning environment.

4. Soft Skills in transnational learning factory

The implementation of transnational learning factories is divided into four different phases:

- Programme definition with education partner abroad
- Learners preparation either at home or virtually
- Implementation of the transnational learning factory abroad or virtually
- Follow-up and evaluation at home

Teachers' soft skills competences need to be analysed in this context. In the following, some important competences are described that ensure a successful learning process in a transnational setting.

a. Communication skills

Communication skills are required in many professions and they are especially important for teachers in schools. They need to be excellent communicators and know how to talk to a variety of people to do their job effectively. It is essential that they need to know how to speak to people, not just at them.

The ability to communicate efficiently, clearly and effectively is essential for being a good teacher. The teacher is responsible for delivering learning content in a way that is easy to understand. A lesson includes a precise selection of terms and the way the content is presented facilitates understanding. Checking comprehension of the material taught is also important.

Teachers must be open to feedback (for example on homework or tests from both their own role and from the learners) and invite discussion.

In this way, possible criticism can be addressed, improving the classroom climate. As a result, learners are able to apply the learning content in other contexts.

Communication skills do not only mean clarity on the verbal level, but also transparency and unambiguity in written communication.

In the context of transnational learning factories, communication skills are needed in situations such as:

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- Coordination of the programme content of different national curricula
- Motivation for transnational project work
- Determining the programme with the vocational school/company abroad
- "culture shock" for the learner
- Solving problems with accommodation
- Learner's wish to drop out
- Contact with parents

Communication skills consist of:

1. listening = giving the other person one's full attention.
2. mirroring = reinforcing affinity in terms of content and expressiveness.
3. feedback = communicating one's perceptions about the other in a way that is different from one's own interpretations and passing on for one's own evaluation.
4. conciseness = orderly and coordinated use of the three channels of communication to attract attention and promote clarity of understanding.

b. Empathy

The social skill of empathy is essential in everyday school life and in practical training. Empathic teachers actively listen and give feedback to understand the different learning needs and socio-emotional needs of the learners. They adjust their teaching style and behaviour accordingly. As they are able to put themselves in the shoes of their learners, they can understand their perspectives and likely expectations. As a result, they can take anticipatory action.

Furthermore, empathy can ensure that the individual strengths and weaknesses of learners are better recognised. This, in turn, has a positive effect on motivation and learning outcomes in the best case scenario.

Empathy is a key intercultural skill characterised by cultural open-mindedness, fairness and anti-discrimination. With appropriate behaviour, diversity is promoted and bullying prevented.

In the context of transnational learning factories, empathy is crucial in situations such as:

- Learners' fears of international project work
- Learners' fears of going abroad

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- Learners' feelings of frustration when communicating in a foreign language
- Communicating "culture shock" and possible solutions
- Supporting learners in the first days
- Encouraging individual potential for success
- Understanding for insecure parents

Being empathetic also means for teachers to work on their own prejudices in order to develop a more positive attitude towards diversity.

Teachers should always ask themselves questions like:

- What feelings are triggered in learners by certain activities?
- And what is an appropriate follow-up action?

c. Leadership

Teachers need leadership skills to earn the respect of their learners, parents and colleagues. It is important to find a healthy balance. Kindness and respect determine the relationship, but it's also important to communicate what behaviour gets in the way of learning and the consequences. An effective leader in the learning process is aware of the consequences of their actions and inactions.

Leadership is reflected both in the classroom and in the training place and is based on both informal and formal roles as a teacher. Competence facilitates the delivery of learning and supports learners through clarity in the classification and transfer of knowledge.

In communicative work with learners, it's important to use words correctly and to actively listen to what they are saying. It is crucial that the accompanying value system is conveyed between the lines and that what is heard can also be experienced.

This quality is an important navigational tool for learners to understand the complex world of today and a future characterised by uncertainty.

Effective leadership in the classroom and workplace involves finding a common language and approach in response to challenges through conversation and debate.

In the context of transnational learning factories, leadership is needed in situations such as:

- Learners lose sight of the project goal
- Integration of international project work / experience abroad into professional development

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- Rules and sanctions for misbehaviour (non-participation, aggression, alcohol, etc.)
- Show understanding for fears and offer clear solutions
- Encouraging people to step out of their comfort zone (learning a foreign language, abroad)

Leadership competencies in school and education can be broken down into 4 individual competencies:

1. motivation = making others aware of one's own goals

2. interaction = informing and consulting learners to an appropriate extent and in an appropriate way

3. mediation = finding acceptable solutions to incompatible demands

4. training = promoting the development of learners' potential.

d. Adaptability

The only constant in life, school and work is change. Teachers must, therefore, have a positive and optimistic attitude when confronted with difficult situations and unpredictable behaviour. They should use their strengths, resources and networks to find solutions and overcome challenges.

Additionally, they need to be flexible and reflective so that they can evaluate what works and what does not and take a different path if needed. Flexibility is also expressed in the ability to mediate between different interests, in the sense of facilitation.

The soft skill "adaptability" in schools and in workplaces means, among other things:

- using the latest methodological-didactic findings and new media for teaching and practical training
- to take up impulses for school and company development and to consider them within the framework of one's own actions
- expand and deepen professional knowledge and pedagogical competences regarding school and company development through in-service training.

At the same time, it is important to believe in oneself even in difficult situations, which, in turn, keeps the joy of work alive and ensures well-being. Challenges are understood as learning opportunities for personal and professional development.

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In the context of transnational learning factories, adaptability is needed in situations such as:

- Definition of didactics/methods against the background of different education systems
- International project work does not proceed as planned
- Technology for virtual project work does not work as planned
- Communication in foreign language
- New form of company organisation (hierarchy, working hours, language)
- Accommodation with host families
- Contact with family and friends at home
- Self-organisation of leisure time

e. Intercultural Competence

Classrooms and workplaces are becoming increasingly diverse. Companies are increasingly searching for employees who are skilled in dealing with people from different cultures, especially when global teams work closely together.

Consequently, there is a growing need for teachers to be able to deal with cultural differences in interpersonal situations and to recognise both their own culturally determined behaviour and the behaviour of others. Leaders in the classroom and in the workplace need knowledge and understanding of different cultures.

This not only contributes to a more respectful climate in the classroom and workplace, but can also help to build better rapport with learners from different backgrounds.

Teachers can undertake a self-assessment of their own cultural perspectives and/or (often unconscious) biases and actively work to learn more about learners' cultures and life experiences to promote better understanding.

In the context of transnational learning factories, intercultural competence is needed in situations such as:

- Consultation with the foreign partner
- Preparing own learners for international project work / experience abroad
- Cultural mediation in response to questions from learners, parents, school management
- Conflict resolution (course, company, accommodation, etc.)
- Evaluation of learning success afterwards

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Intercultural competence is divided into 4 areas of competence:

1. social competence such as the ability to observe, self-reflection, tolerance and empathy
2. professional competence such as technical knowledge, knowledge of customers, country and cultures and language skills
3. strategic competence such as conflict management, stress management, solution orientation
4. personal competence such as willingness to learn, adaptability, impartiality

f. Problem solving

The job profile of many professions includes the ability to solve problems. And is therefore part of the learning process in schools and workplaces.

Dealing with learners requires teachers to consider the pros and cons of various activities in many everyday situations. Activities, tasks and incidents that are not yet routine or arise spontaneously at school or in the workplace have to be solved quickly and efficiently.

Opportunities, goals and positive aspects must be recognised without neglecting the risks. The ability to solve problems allows (teachers?) to determine the right strategy for teaching and operation.

Effective problem solving takes place in different steps:

- Definition of the problem
- Understanding the learner and the learning situation
- Identifying the cause of the problem
- Identification of possible solutions
- Assessing the feasibility of solutions,
- Investigating possible consequences
- Designing effective implementation plans
- Assessing the impact of a solution

Finding the right solution for conflicts in the class, trainees with a migration background, learning disabilities or difficult family situations creates free space for the potential of the individual, but also of the class. Active participation is encouraged, tensions are reduced or avoided.

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In the context of transnational learning factories, problem solving is needed in situations such as:

- Ability to compromise when teachers have different ideas about content, didactics, methods.
- Social behaviour (lack of respect for teachers, prejudices on the part of learners when implementing international project work, feeling of loneliness abroad)
- Everyday situations abroad (lost identity card, no more money)
- Logistics (technical problems hinder virtual cooperation, missed train, arriving on time during strike, waste separation)
- Learning situations (lessons/practise boring, lack of understanding/patience in foreign language context)

The ability to solve problems is supported by other soft skills such as openness, empathy, assertiveness and strategic thinking.

5. Final remark

Soft skills competences in the context of a transnational learning factory build on the competences that teachers have acquired through their education and training and their practical experience.

The deeper the education and training and the more extensive the practical experience, the easier it is to transfer one's own competence to the context of a transnational learning factory and to behave appropriately in the situation.

As the Erasmus+ programme continues to develop, transnational cooperation between education providers in Europe will continue to grow. More and more learners and teachers will be able to participate in various ways, including mobility abroad or in a virtual classroom.

Against this background, it is necessary for teachers to develop their soft skills competence also from the perspective of international education.

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5.2 Learning Sequences “Soft Skills for teachers and trainers”

The learning sequences are intended for teachers and trainers in VET-schools and companies and aim to develop specific soft skills, necessary for teaching in the classroom, companies and a transnational learning factory.

Learning sequence 1 “Challenges of teaching in a vocational educational context“ aims to strengthen self-reflection through a positioning exercise.

Learners can share their personal challenges in their daily professional life and understand that they are not alone in facing these problems and that their colleagues are also experiencing similar challenges. This exercise also helps develop empathy as a soft skill.

Learning sequence 2 “Involvement and discussion of opinions” aims to strengthen problem-solving skills in international context through a discussion exercise. Learners discuss various situations related to an internship in a foreign country and learn that other cultures can produce results that differ from their own country.

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Learning Sequence 1

Title: Challenges of teaching in a vocational educational context

Learning goals

Knowledge	Ability	Competence
● rating of professional challenges by colleagues	● put into words the own challenges in the profession	● identify difficult situations in classroom where help from colleagues is useful
● dealing with professional challenges by colleagues	● look at challenges from different perspectives	● initiate an exchange about challenges with colleagues in time (before the problem arise)
● understand that the own challenges are also the challenges of colleagues	● list possible solutions to specific problems	● can adapt problem solving to new teaching challenges

Learning context

Length of learning sequence	90 minutes
Materials	Flipcharts, moderating walls, modelling clay, peanuts, mandarin oranges, a high table
Number of teachers	max. 20 from school and companies
Remarks	The classroom must be prepared before the activity so that learners can directly start the walk through the gallery. For information on room division, see Step 2.

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Instructions

Step by step	Time
Step 1. Introduction to the exercise	5 min
Step 2. G*allery walk*	20 min
Step 3. Assessment of the G*allery walk*	15 min
Step 4. Case studies - working on challenges	30 min
Step 5. Presentation of case studies and solutions; assessment/report	20 min

1. Step: Introduction to the exercise

The trainer welcomes the learners in front of the room. He/She briefly introduces the topic "Challenges related to teaching in VET" and explains the "Gallery Walk" method.

The learners see several stations around the room where they are asked to do something and then they receive clear instructions about what to do.

They have a total of 20 minutes to move freely around the room and work at each station. They should look at what others have done/written but talk to each other as little as possible.

2. Step: Gallery walk

Learners start with "Gallery Walk", where they visit various stations with different tasks:

a. *Moderation wall with questions to answer:*

- What are the challenges in the teaching profession?
- What is your biggest challenge right now?

Learners can answer freely or write "+1" if someone else has already written the answer by using markers.

b) There are several empty bowls on the table.

There is a sign in front of each bowl (e.g., empathy, organisational talent, loud voice, large network of contacts, work experience, business contacts ...).

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The question “What is most needed for a good teacher?” is shown on the table.

Teachers (Learners?) are asked to put peanuts or mandarin oranges in the appropriate bowls to express their personal opinion.

c) Modelling clay of different colours is laying on the table.

The question is “How many challenges have you had to face in your working life?”
Learners are then asked to knead a snake as long as the number of challenges they have mastered in their working life.
Each teacher kneads one snake and they put it on the table.

d) In one corner a high table is set up.

Learners have to discuss their current or past challenges and exchange ideas. This is the only activity in which speaking is allowed. If necessary, "seal" the corner visually and acoustically, e.g., by placing a moderation wall in front of it.

e) Several large circles are drawn on a flipchart.

Some circles contain words such as "sport", "talk to colleagues about it", "breathing exercises", "complain", whereas some circles are empty.
At the top of the flipchart there is a question: “How do you cope with the challenges in your daily work? Please write your name in a circle".
Learners write their names into the circle that corresponds to their preferred coping mechanism. New answers can also be entered in empty circles.

f) The trainer can introduce more stations.

After 15 minutes, the trainer announces that the exercise is almost finished and encourages learners to change stations and complete all the assignments.

3. Step: Assessment of the gallery walk

Now the trainer goes through each station with all the learners and discusses the answers. Stimulating questions can be asked, such as "Which answers surprise you?", "Who wrote this? Why?" etc. The main goal is to encourage exchange between teachers and for them to have the opportunity to discuss their challenges.

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4. Step: Case studies - working on challenges

Learners are divided into groups. There are different possibilities here:

a) The trainer can prepare several case studies in advance and divide learners into as many groups as there are case studies.
b) The challenges that the learners wrote down on the moderation wall can be selected.

The trainer asks the learners which challenges they find the most difficult and asks them to present case studies. The learners are then divided into groups based on the given case studies.
Each group receives a case study (option a: written, option b: oral summary of the discussion) and has 30 minutes to discuss the example and take the point of view of the various groups/individuals involved. They should find possible solutions to this challenge, using a flipchart and markers.

5. Step: Presentation of case studies and solutions; assessment/report

After 30 minutes, the groups meet again in the seminar room and present their results. Other groups can ask questions or make comments and propose further solutions if needed.

The trainer concludes the lesson by summarising the most relevant findings of the learning sequence and focusing on situations in which soft skills can help teachers find appropriate solutions to teaching challenges.

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Appendix 1

Sample case studies for Step 4:

a. Your students regularly complain that their lessons are boring and outdated, therefore they are often irritable and distracted.

b. You have already been asked by some student employers to teach other subject-specific topics that better fit the practical part of training.

c. Student employers would like to see more reference to the international perspective of the trained profession.

d. You and the school want to give your students the opportunity to do at least one long internship abroad, but the curriculum makes this task difficult.

e. From the next school year, each student should be assessed after every lesson, and these assessments should be included in the school assessment at the end of the school year, according to the framework curriculum.

f. Conversations among peers are mainly about personal topics and rarely about teaching and current issues/challenges/development.

g. Some students would like to do an internship abroad and they come to you with such a request.

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Learning Sequence 2

Title: Involvement and discussion of opinions

Learning goals

Knowledge	Ability	Competence
● know more about own point of view	● express own opinions in a better and clearer way	● identify that points of view are not always “hop or top”
● understand better other learners’ points of view	● react in an adapted way to other learners’ points of view	● become more sensitive regarding other learner's attitudes and opinions based on different cultures
● acquire and/or deepen discussion method for classroom	● anticipate challenges and problems due to working and living in international context	● prepare own students appropriately for working and living in international context

Learning context

Length of learning sequence	90 minutes
Materials	- one red piece of paper with a note: ‘I disagree’, one green piece of paper with a note: ‘I agree’ - Cards with written opinions/statements
Number of learners	max. 15 20 from school and companies
Remarks	Polling may also be conducted on an online platform such as Mentimeter, for visualisation and documentation. Nevertheless, this exercise also applies to the spatial division of the group, so this part of the exercise should not be skipped.

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Instructions

Step by step	Time
Step 1. Topic introduction	10 min
Step 2. Rules of the exercise	5 min
Step 3. Exercise set	5 min
Step 4. Discussion	40 min
Step 5. Assessment/report	30 min

1. Step: Introduction to the exercise

The trainer introduces the topic and refers to previously conducted activities, e.g. concerning cultural openness or responsiveness. The exercise involves a discussion between participants. The aim is to discuss various topics and show openness to the attitudes of others.

2. Step: Rules of the exercise

The trainer places cards with the notes 'I agree' and 'I disagree' on the floor on the opposite sides of the room and explains the rules to the learners.

During Step 3 the trainer will read several statements and the learners must decide whether to agree or disagree with them. There are no 'shades of grey' (hesitation possibility), so they must choose one side by lining up on the corresponding side of the room ('I agree' side or 'I disagree' side).

3. Step: Exercise set

The trainer reads out the first sentence of the exercise:

"A zebra is a black animal with white stripes."

The learners stand in place with either a 'I agree' or 'I disagree' card. The trainer initiates a discussion on why learners agree or disagree with the statement.

(Notes for the trainer:
a. At this point it should be emphasised that it is about personal opinions, not facts (e.g., if someone claims that it is scientifically proven that zebra ...).
b. If all learners are on the same side of the statement or only one of them takes a different position, the trainer may also take the 'side of the minority' and give arguments for it.
c. After each statement, all learners go back to the centre of the classroom.
d. Learners can also switch sides during the discussion.)

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4. Step: Discussion

All learners go back to the middle of the classroom. The trainer reads out the next statement (see appendix 1) and the learners stand on the corresponding side of the room. The trainer then stimulates the discussion and moderates it between learners by asking questions such as:

"Why are you on this side?"

"Does everyone on this side agree with what has just been said?"

"How do you understand this part of the statement?"

The trainer should also summarise arguments during the discussion to make sure that each learner's statement is properly understood. The trainer can also add further arguments if he/she thinks that the learners have forgotten something important.

5. Step: Assessment/report

After a few statements and depending on the learner's willingness to discuss, the trainer ends the exercise and asks all learners to return to the centre of the classroom and to sit down. The cards with the notes 'I agree' / 'I disagree' are set aside so that the room becomes 'neutral' again.
The trainer then presents a summary of this exercise. As a reminder, the discussed statements can also be shown/rewritten.

The trainer asks the following questions:

- For which statement was it impossible for learners to decide?
- Why did learners change sides?
- Were the learners surprised with different opinions on some of the statements?
- Are there any right or wrong answers?
- What does this exercise have to do with international vocational training?
- What was this exercise good for?

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Appendix 1

Sample list of statements for Step 4 - Discussion

ample list of statements for discussion

Every student should complete at least one educational training abroad during their school education.
Each profession has its own international profile.
It is important to be able to cooperate with people from other countries.
Internationality is not relevant to vocational school.
How a company treats its employees is not an issue for the international community/ society.
Every vocational teacher should have practical experience abroad.

Different statements can be used depending on the group of learners and their subjects, for example.

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6. National training regulations

Mechatronics

Germany	**https://www.bibb.de/dienst/berufesuche/de/index_berufesuche.php/profile/apprenticeship/868686**
	https://wap.igmetall.de/docs_Mechatroniker_VO_2018_b41d5c0e90853e0b11a8e22353105f334b7dfe80.pdf
Greece	https://www.eoppep.gr/index.php/el/search-for/professional-outlines#%CF%84%CE%B5%CF%87%CE%BD%CE%AF%CF%84%CE%B7%CF%82-%CE%B5%CF%81%CE%B3%CE%B1%CE%BB%CE%B5%CE%B9%CE%BF%CE%BC%CE%B7%CF%87%CE%B1%CE%BD%CF%8E%CE%BD
Italy	**https://www.miur.gov.it/istituti-professionali** **https://it.pearson.com/aree-disciplinari/diritto-economia/programmi-ministeriali/istituti-tecnici.html** **https://www.iisscotton.it/offerta-formativa/#**
Slovenia	**https://cpi.si/wp-content/uploads/2020/08/KPU_Mehatronik_operater_2018.pdf**

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Toolmaker

Germany	**https://www.bibb.de/dienst/berufesuche/de/index_berufesuche.php/profile/apprenticeship/585859**
Greece	https://www.eoppep.gr/index.php/el/search-for/professional-outlines#%CF%84%CE%B5%CF%87%CE%BD%CE%B9%CE%BA%CF%8C%CF%82-%CF%80%CE%B1%CF%81%CE%B1%CE%B3%CF%89%CE%B3%CE%AE%CF%82-%CE%BA%CE%B1%CE%B9-%CE%B4%CE%B9%CE%B1%CF%87%CE%B5%CE%AF%CF%81%CE%B9%CF%83%CE%B7%CF%82-%CE%BC%CE%B5%CF%84%CE%B1%CE%BB%CE%BB%CE%BF%CF%85%CF%81%CE%B3%CE%B9%CE%BA%CF%8E%CE%BD-%CE%BA%CE%B1%CE%B9-%CE%BC%CE%B5%CF%84%CE%B1%CE%BB%CE%BB%CE%B9%CE%BA%CF%8E%CE%BD-%CF%80%CF%81%CE%BF%CF%8A%CF%8C%CE%BD%CF%84%CF%89%CE%BD
Italy	**https://www.sangaetano.org/settore-meccanico/**
Slovenia	**https://cpi.si/wp-content/uploads/2020/08/KPU_Oblikovalec_kovin-orodjar_2017.pdf**

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