Proposal of the project team for a common curriculum:

Digital Joinery

In response to the increasing digitalisation of the woodworking and carpentry industry, this proposal outlines a comprehensive curriculum for the training of carpenters (digital focus). The curriculum, developed as part of an Erasmus+ project, provides learners with the necessary key competences for the integration of CAD/CAM technologies in modern woodworking processes.

The programme focuses on hands-on experience with CNC programming, machine operation and CAD/CAM software and other digital woodworking tools. This enables students to manage a fully digital workflow - from 2D design to finishing - while promoting energy-efficient and sustainable production practices. Students will also gain an in-depth understanding of materials, tool selection and safety protocols according to current craft and industry standards. This curriculum is tailored to the needs of the evolving European woodworking economy (craft and industry) and ensures that participants are ready to contribute as skilled digital professionals

Didactic/methodological suggestions for teaching digital skills for the common curriculum:

1. **Teacher-centred learning - traditional lectures and homework:**

Description:

Students acquire basic CNC knowledge in instructor-centred lectures. They then deepen their knowledge independently through homework focussing on theoretical understanding and problem solving.

Example:

The teacher gives a lecture on G-code structure and coordinate systems. As homework, the students write a simple CNC milling programme to deepen their understanding of syntax, tool paths and coordinate logic.

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2. Flipped Learning

Description:

Flipped learning with videos allows students to explore CNC concepts such as machine setup, G-code or tool selection at home using instructional videos. This allows lessons to focus on practical application, troubleshooting and collaborative tasks.

Example:

Students watch a video at home that demonstrates how to set up a CNC machine and select suitable tools. In class, they work in pairs to set up the actual machine and test a sample programme. The teacher helps them to reflect and give feedback to their classmates.

3. Differenzierung

Description:

Differentiation means adapting CNC lessons to different abilities, learning styles and interests and ensuring that all students can use and engage with the material effectively.

Example:

Students are given the same CNC task - programming a simple part - but beginners are given step-by-step instructions and templates, while advanced students work independently on additional challenges, such as optimising toolpaths or incorporating subroutines.

4. Headstand method

Description:

The headstand method reverses traditional problem solving. The students are first asked to imagine how a task can fail or be performed incorrectly. Through critical reflection and discussion, they are shown important success factors.

Example:

The students are asked to develop a CNC programme that intentionally generates errors - such as a tool crash or incorrect placement of the workpiece. They then analyse these errors to understand the correct G-code structure, safety procedures and set-up principles.

5. Ball bearing method

Description:

The ball bearing method is an interactive dialogue technique in which students form two concentric circles - an inner and an outer circle - facing each other. Each pair briefly discusses a given question or task before the outer circle rotates and new discussion pairs are formed. This encourages active participation, repetition and joint learning.

Example:

Students in CNC training take turns discussing different steps of a CNC set-up process (e.g. zero point setting, tool selection or material clamping). By explaining and listening to different perspectives, they deepen their understanding of each step and identify common sources of error and best practices.

6. Project-based learning

Description:

Project-based learning enables students to explore real-world challenges in extensive, self-directed projects. Learners take responsibility for the process - from planning to implementation - and develop both technical skills and social skills such as collaboration, problem-solving and critical thinking.

Example:

CNC students are given the task of designing and manufacturing a functional component (e.g. a door or window part) for a specific customer. They must research the requirement, create drawings, write CNC programmes, produce the part and present their results - taking into account the typical work processes and expectations of the industry.

7. Experiential learning according to Kolb

Description:

Kolb's experiential learning is a cyclical model in which learning takes place through direct experience, followed by reflection, conceptualisation and active experimentation. Students deepen their understanding by acting, reflecting on what they have done, drawing conclusions and applying their findings in new situations.

Example:

CNC students operate a milling machine to produce a simple part. They then reflect on tool wear or surface quality, discuss the results, link their experiences with theoretical concepts (e.g. cutting speed or feed rate) and adjust the parameters in the next run - learning through continuous, practical improvement.

Key competences: Digital Joiner

Students should master the following key competences at a routine and/or advanced level. At the routine level, students are expected to be able to perform the key competences mentioned in collaboration with others or in part independently. At an advanced level, students are expected to be able to apply the key competences completely independently.

1. The participant can use CAD/CAM software to create CNC programmes that are used in woodworking for the production and restoration of furniture and building elements.
2. When using CAD/CAM software, the participant can: Carry out a complete workflow with CAD, CAM and CNC.
3. Use CAD software to create 2D contour drawings, work with common exchange file formats and transfer files between CAD and CAM systems.
4. The participant can transfer data to 3D printers and edit/print them as STL format.
5. Transfer drawings to CAM software, select the appropriate postprocessor for the CNC machine, select tools, define toolpaths in the drawing and simulate toolpaths in the CAM software.
6. Use the CAD/CAM system to minimise programming time.
7. Plan a task with a focus on minimising energy consumption and material waste.
8. Document their own work with printouts or computer simulations.
9. After the course, the participant will be able to: start the machine and move it to the reference point, perform stop and emergency stop procedures and operate the machine for a given milling task.
10. Select a programme, measure and mount tools, enter data into the tool library and set the correct spindle speed according to the tool, safety requirements and milling task.
11. The participant also acquires knowledge of the following functions that enable process optimisation: Tool options for CNC milling, spindle motors and tool changers, machine and workpiece zero points.
12. The participant can create CNC programmes in the wood industry. He/she can create CNC programmes in ISO codes (G and M codes), use all four quadrants of the coordinate system, programme in both absolute and relative

coordinates, simulate and edit CNC programmes, save and retrieve programmes and adopt ergonomic working positions.

13. The participant can select and justify materials for the production of components, including the creation of clamping fixtures.
14. The participant is able to select suitable processing methods and tools for processing panel and solid wood parts and knows the safety regulations for shank tools (EN 847-2)
15. The participant is able to measure and maintain tools and prepare the CNC machine for production.
16. The participant can create CNC programmes with tool compensation for internal and external milling with approach and departure paths.
17. The participant can create CAD drawings of product parts, add toolpaths and select post-processors for machines
18. The participant can independently select, set up, operate and programme hand-held CNC machines (e.g. Shaper Origin) to produce practical products both in the workshop and on construction sites.