DiTwin – Digital Twin for VET school

DiTwin Modules

The editing of this document was finished on January 2026.

Project website: https://www.ditwin.eu/

DiTwin is a Cooperation Partnership project in vocational education and training sector (KA220-VET) funded under the Erasmus+ Programme.

Project Number: 2023-1-IT01-KA220-VET-000154611

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This document has been created by the collaboration of the whole DiTwin partnership: Learnable Società Coooperativa a r.l. (IT) -project Coordinator, Digital Smart srl (IT), ETN Training Vision Ireland (IR), University of Malaga (ES). Málaga TechPark (ES), Innovation Frontiers IKE (GR), University of the National Education Commission, Krakow (PL).

Module - Additive Manufacturing technician

Lesson 1 – Observation of a 3D Printer at work.

Setup

Figure 1.1. Bambu Lab X1E 3D printer

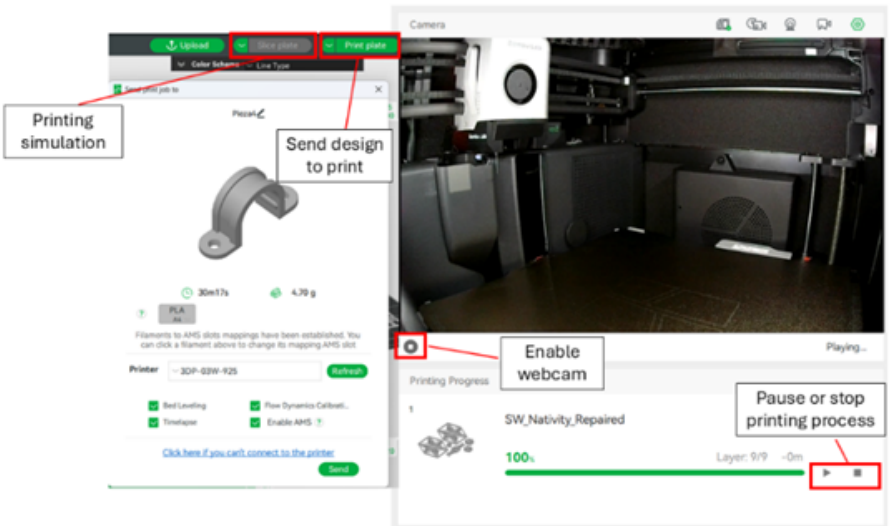

Figure 1.2. Visualise a 3D printer in operation via webcam

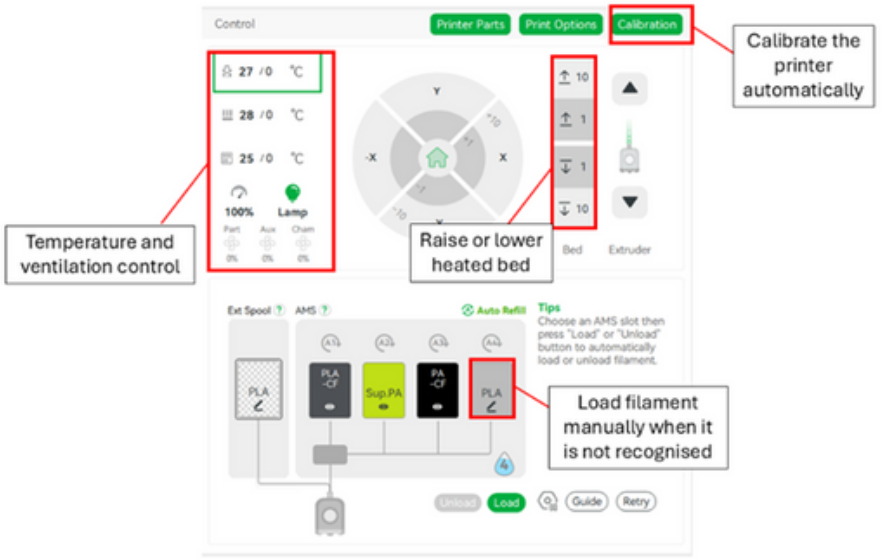

Figure 1.3. Control interface with the physical 3D printer

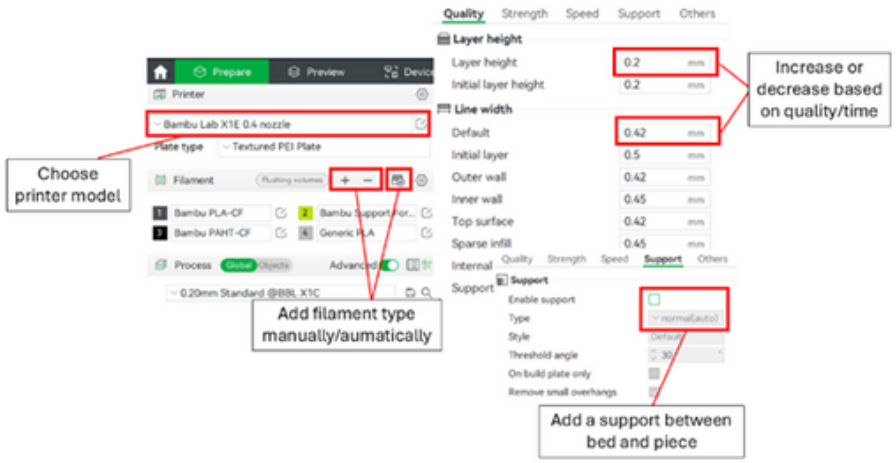

Figure 1.4. 3D printer parameter configuration

Requirements

Basic concepts of additive manufacturing in 3D Printing.

Learning Outcomes acquired

S1.1 To prepare and manage the files for printing.
S1.2 To properly prepare and set up at least 1 additive manufacturing system.

Duration of the lesson

2 hours

Activities and steps to be implemented

Using the Bambu Studio slicer application as a digital twin, the interface and the basic control commands of the Bambu Lab X1E 3D printer (Figure 1.1) will be illustrated. To achieve this, a part design file in STL format will be obtained, and then the printing process will be simulated in the software. Finally, the designed part will be sent to the printer to observe its real-time progress.

In summary, the concepts considered in this lesson are the following:

- Conversion and loading 3D printer compatible files.
- Adjustment of print parameters and 3D printer configuration.
- Simulation of the printing process of a piece.
- Control of the 3D printer through the digital twin.
- Transmission and real-time observation of the printing process.

Figure 1.2 shows a webcam image associated with the 3D printer. This webcam provides a video of the printing process at real time, and Figure 1.3 shows the control interface with information about its status. In this lesson, an initial introduction to additive manufacturing will be carried out by uploading a part design to the slicer application and finally sending it to the printer. For this, the following activities will be carried out:

1. Convert all the files provided in this lesson from OBJ to STL format, which only describes the surface geometry of the part without textures or colours, making the file lighter and easier to process. For this, use the free tool Tinkercad for loading the provided file and then exporting in STL format.

2. Configuration of printing parameters. Using the “Preview” section (see Figure 1.4), choose Bambu Lab X1E 0.4 nozzle as the printer model and select a layer height of 0.2 mm, leaving the other parameters by default. Explore the different types of filaments and create a new one of type Generic PLA in grey.

3. Printer simulation. Once the design of part 1 has been imported and its printing parameters configured, a simulation of the printing process will be carried out using the “Slice plate” option in the “Preview” section. Variables such as the printing time, the amount of material used, the printing speed at each moment, and the operating temperature are shown. Once the simulation is completed, as exercise, obtain the layer number at minute 18 using the green progress bar.

4. Prepare the real printer. Connect the webcam associated with the printer to monitor the status of the printer in real time. Figure 1.3 shows the control interface of the digital twin with the real 3D printer. This control interface includes functionalities as the calibration process, the control of the temperature of the hot bed or nozzle, activation of auxiliary ventilation, or manual movement of the extruder.

Send the designed part and visualize the printer at work. Send the code of the part to the printer and compare the difference between the printing time in simulation and in the real process. Furthermore, the printing status could be controlled, such as pausing or stopping it at any time from the digital twin.

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