3DACADEMY

Enhancing the skills of VET providers in the field of 3D technologies

3DAcademy Blended Training Programme for VET Trainers, teachers and industry professionals

Training in 3D Technologies – A Manual for Advanced Trainers

Work package 3, Activity No. 3.3.

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How to Use This Manual

Welcome to the **3DAcademy Training Manual (Version 3)** – designed for **VET teachers, trainers, and professionals** who deliver or coordinate 3D technology programmes within vocational education and training.

This manual provides **a complete framework** for designing, delivering, assessing, and assuring the quality of 3D technology training. It combines pedagogical methods, EQF-based outcomes, and real examples from VET practice.

How to navigate the manual:

- Each chapter corresponds to a **specific stage of training** – from curriculum design to quality assurance.
- The manual supports both **Beginners (Scenarios 1–2)** and **Advanced learners (Scenario 3)**.
- Annexes include **rubrics, checklists, templates, and evaluation forms** for direct classroom and QA use.

Tip: You can use this manual as a standalone teaching guide, or as a resource to mentor other trainers in your centre.

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Chapter 1: Introduction

1.1 Overview of 3DAcademy

The **3DAcademy – Blended Training Programme for VET Trainers/Teachers** responds to the growing need for 3D technology skills in vocational education and work-based learning. Developed by a consortium of education and industry partners, it bridges VET practice with rapidly evolving 3D technologies—**scanning, modelling, and printing**—used across manufacturing, healthcare, architecture, creative industries, and beyond. The programme was created within the Erasmus+ project *3DAcademy – Enhancing the skills of VET providers in the field of 3D technologies* (Ref. 2023-1-BG01-KA220-VET-000158373). It uses a **blended approach** (online + practical) and aligns learning with the **European Qualifications Framework (EQF)** so trainers can clearly articulate outcomes to learners and employers.

Pedagogical rationale (VET lens)

- **Learner-centred & modular:** short, outcome-focused units reduce cognitive load and allow flexible pacing.
- **Work-based orientation:** scenarios mirror real delivery contexts (onboarding, sprint practicals, extended capstone) and prioritise **doing** over telling.
- **Blended by design:** theory moves online (flip the classroom); precious lab time is reserved for **hands-on** application and troubleshooting.
- **Digital readiness:** the platform standardises quality, while trainers focus on facilitation, safety and competence-building.

Trainer Tip: Use online modules to front-load terminology and safety—then convert every lab minute into **practice, observation, and feedback**.

1.2 Curriculum at a glance (modules × scenarios)

This summary shows how online modules support each delivery scenario and what learners can **do** at the end of each path.

Table 1. Modules–Scenarios overview (what to assign and why)

Stream & Module	Key Focus	Scenario 1 (Onboarding)	Scenario 2 (Sprint)	Scenario 3 (Extended)
Basic M1: Intro to 3D Technologies	Processes, vocabulary, safety overview	✅ Full	✅ Full	🔁 Review (as needed)
Basic M2: Intro to 3D Printing	FDM/SLA, materials, slicing basics	✅ Selected units	✅ Full (critical)	🔁 Review (foundations)
Basic M3: Intro to 3D Scanning	Principles, hardware/software, mesh basics	✅ Selected units	✅ Selected units	🔁 Review (lead-in to Adv M2)
Basic M4: Intro to 3D Modelling	CAD basics; print-ready design	✅ Selected units	✅ Full (TinkerCAD/CAD)	🔁 Review (lead-in to Adv M3)
Basic M5: 3D in Education/Workflow	Classroom/workflow integration	*(trainer resource)*	*(trainer resource)*	*(mentor resource)*
Advanced M1: Advanced 3D Printing	DfAM, optimisation, materials	—	—	✅ Core
Advanced M2: Advanced 3D Scanning	Automation, GD&T, inspection	—	—	✅ Core
Advanced M3: Advanced 3D Modelling	Parametric/surface/generative	—	—	✅ Core
Advanced M4: Case Studies/Future	Capstone, professional practice	—	—	✅ Core (capstone)

Trainer Tip: In Scenario 2, insist on **M1+M4** completion before lab days. It prevents spending workshop time on basic CAD navigation.

1.3 Scenarios and expected outcomes (competency snapshot)

Scenarios scale **time, depth, and practice**—each leads to different, **authentic** demonstrations of competence.

Table 2. Scenario snapshot (time, focus, authentic evidence)

Scenario	Time & Format	What learners can do (authentic evidence)	Typical evidence
Scenario 1 – Onboarding Foundation	20–25h, 100% online	Explain core processes & safety; read slicer previews; plan a simple print; use shared vocabulary with supervisors	Quiz scores; short written plans; reflection logs
Scenario 2 – Sprint Learning with Practice	30–40h, ~70/30 blended + 2 practical days	Produce a design-to-print result; operate FDM safely; basic troubleshooting; basic scan-to-mesh	STL + slicer profile; printed part; observation checklist; mini-presentation
Scenario 3 – Extended (Expert + Capstone)	80–100h, ~60/40 blended with weekly labs	Optimise prints; apply DfAM; inspect parts (GD&T); reverse-engineer; deliver a documented capstone	Capstone dossier; deviation maps; peer review; presentation & defence

1.4 Competency mapping to EQF (high-level)

Learning is mapped to EQF dimensions (**knowledge, skills, responsibility/autonomy**). The programme **does not replace** full qualifications; it **supports progression** and recognition.

Table 3. EQF alignment (indicative)

Scenario	EQF focus	Knowledge (K)	Skills (S)	Responsibility & Autonomy (R&A)
Onboarding	Pre-L3 → L3	Basic facts, safety terms, processes	Read slicer previews; plan steps	Self-manage online work; ask for support appropriately
Sprint	L3 → L3/4	Process & materials understanding	Operate FDM; slice & print; basic scan/mesh	Follow lab SOP; manage time in team; reflect on results
Extended	L4 (selected)	DfAM, GD&T concepts; multi-tech	Optimise; inspect; reverse-engineer; mentor	Plan/lead capstone; document decisions; quality ownership

Trainer Tip: Assess **what the scenario makes possible**: Scenario 1 ≠ lack of skill—its outcome is **theoretical readiness** for supervised practice.

1.5 Objectives and goals (refined, scenario-aware)

- **Scenario 1:** theoretical and safety readiness for supervised practice (shared vocabulary, workflow understanding, hazard recognition).
- **Scenario 2:** first full **design→slice→print** cycle; safe operation; basic troubleshooting; confidence to continue learning.
- **Scenario 3:** advanced optimisation and inspection; **capstone** demonstrating professional-level decision-making and documentation.

1.6 Target groups and selection guidance

Choose the scenario by **purpose, learner profile, and resources**:

- Limited lab capacity or new to 3D? → **Scenario 1**
- VET cohorts needing a tangible output quickly? → **Scenario 2**
- Technicians/graduates seeking specialisation and leadership? → **Scenario 3**

Trainer Tip (mixed-ability groups): Pair a "hardware-strong" learner with a "CAD-strong" learner to promote **peer mentoring** and balanced progress.

1.7 – Learning Scenarios Overview

3DAcademy Scenarios and Levels

To help trainers choose the right delivery format, the 3DAcademy approach includes **three learning scenarios** that align with two **competence levels** (Beginner and Advanced).

Scenario	Purpose	Typical Duration	Learning Mode	Level
Scenario 1 – Onboarding	Awareness and motivation (e.g. workshops, open days).	10–15 hours	Face-to-face or hybrid	Beginner
Scenario 2 – Sprint	Structured training with basic practice and guidance.	30–40 hours	Blended (40% online / 60% F2F)	Beginner

Scenario 3 – Extended	Capstone or project-based learning with autonomy.	80–120 hours	Blended (60% online / 40% F2F)	Advanced

Each scenario is fully modular – trainers can scale duration, complexity, and delivery mode depending on learner experience and resources.

Trainer Tip: Use Scenario 2 for introductory training within schools or VET centres, and Scenario 3 for professional or advanced learners who are ready for independent project work.

Chapter 2: Detailed description of the programme

2.1 Programme structure at a glance

The programme is modular and **scenario-aware**. Theory is prepared online and **applied in lab time**. Trainers can scale depth from **Onboarding (S1)** to **Sprint (S2)** to **Extended/Capstone (S3)**.

Table 2.1 Curriculum map – modules × outcomes × scenarios

Module	Core learning outcomes (summary)	S1	S2	S3
M1 – Intro to 3D Technologies	Describe AM processes & terminology; recognise basic risks; read slicer previews	✅	✅	🔁 (as needed)
M2 – Intro to 3D Printing	Prepare simple prints; choose materials/profiles; execute basic post-processing	◯ Selected	✅	🔁 Foundations
M3 – Intro to 3D Scanning	Select a scanning method; capture/clean a mesh; export STL/OBJ	◯ Selected	◯ Selected	🔁 Bridge to Adv M2
M4 – Intro to 3D Modelling	Create print-ready CAD; check manifoldness/walls/scale; export properly	◯ Selected	✅ (critical)	🔁 Bridge to Adv M3
M5 – 3D Workflow in Education	Plan classroom workflows; safety routines; evidence capture	Trainer ref.	Trainer ref.	Mentor ref.
ADV-M1 – Advanced 3D Printing	Apply DfAM; optimise orientation/supports; evaluate quality/cost	–	–	✅
ADV-M2 – Advanced 3D Scanning	Register/fuse scans; produce deviation maps; GD&T checks	–	–	✅
ADV-M3 – Advanced 3D Modelling	Parametric/surface/generative; reverse engineering	–	–	✅
ADV-M4 – Capstone & Futures	Manage capstone; document decisions; present professionally	–	–	✅

Trainer Tip: In **S2**, insist on **M1 + M4** completion online **before** lab days to protect hands-on time for printing & troubleshooting.

2.2 Scenario delivery flow (indicative hours)

Use this as a starting timetable. Localise to your cohort, lab access and term dates.

Table 2.2 Scenario flow – where time lives

Scenario	Online (theory)	Lab (hands-on)	Assessments (embedded)	Typical products
S1 – Onboarding	18–22 h	0 h (practice begins at workplace)	Quizzes; short reflections; readiness check	Simple print plan; safety reflection
S2 – Sprint	20–26 h	10–14 h (2 lab days)	Observation checklists; prototype review; mini-presentation	STL + slicer profile; printed part
S3 – Extended	40–50 h	40–50 h (weekly labs)	DfAM/GD&T tasks; capstone dossier; viva/presentation	Capstone artefact + documentation

2.3 EQF mapping matrix (learning outcomes → assessment)

EQF Progression in the 3DAcademy Programme

The 3DAcademy programme aligns with European Qualifications Framework (EQF) levels 3 to 5.
Progression across levels reflects the growing complexity of knowledge, skills, and learner autonomy developed through the three learning scenarios.

Level 1: Guided Practice (EQF 3–4 range)

Learning context: Beginner learners working under supervision.
Focus: Applying known techniques and following established procedures safely and accurately.
Typical scenario: *Scenario 2 – Sprint*.
Learning outcomes include:

- Understands the workflow of 3D printing and can describe basic processes.
- Operates 3D printers and slicing software under guidance.
- Follows safety procedures and quality standards.
- Works effectively as part of a supervised team.

💡 *Example:* A student prepares a simple model in TinkerCAD and prints it successfully after trainer validation.

Level 2: Independent Application (EQF 4–5 range)

Learning context: Advanced learners able to make technical and design decisions.
Focus: Adapting known procedures, solving problems, and managing the workflow independently.
Typical scenario: *Scenario 3 – Extended.*
Learning outcomes include:

- Plans and executes the full design–print–inspection workflow independently.
- Makes decisions about materials, print parameters, and quality.
- Analyses errors and implements improvements.
- Documents work using professional reporting and reflection tools.

💡 *Example:* A learner designs a functional object (e.g., phone stand), optimises it for printing, evaluates its quality, and documents the process.

Summary of EQF Progression

Aspect	EQF 3–4 (Beginner)	EQF 4–5 (Advanced)
Knowledge	Factual understanding of tools, materials, and processes.	Applied understanding of design principles, QA, and optimisation.
Skills	Executes tasks using given instructions and models.	Selects and adapts methods to achieve desired outcomes.
Autonomy & Responsibility	Works under supervision, seeks guidance.	Works independently, takes responsibility for results and quality.
Learning Context	Classroom/lab with structured support.	Project-based, self-managed learning environment.
Example Scenario	Sprint training with basic prints.	Capstone project or extended course.

Key Message for Trainers

Progression across EQF levels in 3DAcademy is not about course length – it's about the level of autonomy, complexity, and decision-making learners demonstrate.

Trainers can assess EQF alignment through observable behaviour:

- Are learners following or designing procedures?

- Do they require supervision or act independently?
- Are they reproducing known results or innovating solutions?

2.4 Session planning templates (ready to use)

Use these short tables to plan and run sessions. Copy for each lesson.

2.4.1 Session plan (face-to-face) – 90 minutes

Section	Time	What trainer does	What learners do	Evidence
Kick-off & safety	10’	Welcome; state LO; safety reminder	Attend; ask clarifying Qs	Sign-in; safety tick
Demonstration	10’	Demo workflow/pitfall	Observe; note steps	Demo checklist
Guided practice	25’	Coach small groups	Try steps; log issues	Photos; notes
Independent practice	35’	Circulate; probe understanding	Produce artefact	Artefact; checklist
Wrap-up	10’	Feedback; next steps	Self-reflect; submit	Quick exit ticket

2.4.2 Session plan (online) – 45–60 minutes

Section	Time	Activity	Evidence
Activate	5’	Ice-breaker poll or 2-question check	Poll results
Input	10–15’	Short video/page; glossary check	Annotation/quiz
Apply	20–25’	Micro-task (CAD step / slicer tweak)	Screenshot/STL
Reflect	5’	“WWW/EBI” or 1-minute paper	Reflection post

Trainer Tip: Make **one** thing mandatory to upload each session (photo of first layer, STL, slicer profile) to maintain a clean evidence trail.

2.5 Trainer Guidance Section

Using the Manual for Training Delivery

Trainers can adapt this manual to different teaching contexts:

Training Context	How to Use the Manual
VET school or technical class	Follow the structured session templates (Ch. 2.4) and assign small project-based tasks (Ch. 11).
Adult or upskilling training	Use blended delivery: online content + focused workshops. Include more reflection and self-assessment.
Enterprise or in-company training	Use Scenario 3 project framework; apply QA tools from Chapter 14 for internal evaluation.

2.6 Managing mixed-ability groups & soft skills

- **Pairing strategy:** match **hardware-strong** with **CAD-strong**; rotate roles (designer, operator, documenter, QA).
- **Tiered tasks:** always publish **Low-gear** (guided) and **High-gear** (stretch) variants.
- **Soft-skills hooks:** insist on **short stand-ups** (what I did / stuck on / next), **peer reviews**, and **mini-retros** (what we'll change next time).

2.7 Assessment in VET: quick alignment note

- **Formative**: "learning checks" (quizzes, micro-tasks, photos of progress) → **adjust teaching**.
- **Summative**: performance against outcomes (print quality checklist, deviation map, capstone dossier).
- **Principle**: mark **against outcomes**, not academic writing; privilege **authentic evidence**.

2.8 Readiness screening checklists

Use these **before you start** to avoid mid-course blockers.

2.8.1 Learner readiness quick screen (Yes/No)

Item	Y/N	Notes
Has stable access to a computer and the platform	☐	
Can navigate basic office tools and upload files	☐	
Understands course language at B1–B2 level	☐	

Has read the safety one-pager and passed the quiz	☐	
Knows how to export STL/OBJ from their CAD tool	☐	

2.8.2 Course setup readiness (trainer/admin)

Item	Owner	Done
Course copied from template; dates and time-zone set	Admin	☐
“Start here” page published; office hours visible	Trainer	☐
Modules sequenced; release dates & prerequisites set	Trainer	☐
Assignments have rubrics attached; due dates visible	Trainer	☐
Groups created for team tasks; peer review windows set	Trainer	☐
Lab capacity & materials (filament/resin/PPE) confirmed	Centre	☐
Accessibility pass (captions/alt text/contrast/type)	Trainer	☐

2.9 Support & escalation

Publish a short **SLA**: where to ask for help (platform issues vs. learning issues), **response times**, and when to escalate to the **centre technician/admin**.

Trainer Tip: Put a “**Help me choose**” box at the top of your course: *If you need more CAD help → open EM-1 support; if your prints fail → read “first-layer clinic”; if scanning struggles → try the mesh surgery practice pack.*

Chapter 3: Training organisation and delivery – Blended model

3.1 What "blended" means in VET (short rationale)

The programme uses a **flip-then-apply** model: core concepts and safety are learned **online**, while lab time is protected for **practice, observation and feedback**. This keeps the focus on authentic performance (what learners can **do**) and fits real VET constraints (limited machines, print queues, supervision).

- **Online = prepare and plan:** terminology, process logic, pre-flight checks, short quizzes.
- **Face-to-face = produce and prove:** operating equipment, troubleshooting, observing safe practice, evidencing competence.
- **Feedback loops:** rapid checks online, observation rubrics in labs, short reflections to close each session.

Trainer Tip: "One session, one deliverable." Decide the non-negotiable artefact to upload (STL, slicer profile, first-layer photo, inspection screenshot) every time.

3.2 Roles in blended delivery

- **Trainer (course owner):** designs the weekly flow, publishes deadlines, runs labs safely, provides feedback, signs off on competence.
- **Learner:** completes online prep before labs, brings artefacts (STL/profile/notes), follows SOP, maintains a design/learning log.
- **Teaching assistant/technician:** supports lab readiness (machines, materials, safety) and first-line troubleshooting.
- **Centre admin:** enrolment, accounts/SSO, compliance (GDPR, health & safety), platform support.

3.3 Utilisation of the 3DAcademy online platform (overview)

The **3DAcademy platform** underpins blended delivery. It hosts self-paced modules and media, supports assignment submission and quick quizzes, and provides basic analytics so trainers can monitor engagement and progress. It offers straightforward tools for announcements, discussion and resource sharing, ensuring continuity between online preparation and practical workshops.

In practice, trainers use the platform to **sequence online and in-person activities**, gate practical access via **readiness checks**, and keep artefacts and feedback in one place. Learners use it to **access materials, complete micro-tasks, collaborate where appropriate, and track their own progress**. **See Chapter 15 for full platform guidance** (features, configuration, step-by-step workflows and troubleshooting).

3.4 Weekly cadence and timeboxing (suggested pattern)

Table 3.1 Weekly blend (indicative)

Day	Modality	Purpose	Typical tasks	Evidence
Mon–Tue	Online (self-paced)	Prepare	Short page/video; glossary; 5–8 min quiz	Quiz score; notes
Wed	Online (apply)	Micro-task	CAD step / slicer tweak / mesh fix	STL/profile/screenshot
Thu	Live (online)	Clarify	Q&A; demo; peer tips; safety reminder	Discussion post
Fri–Sat	Lab (F2F)	Produce	Operate printer/scanner; troubleshoot; inspect	Artefact + checklist
Sun	Online (reflect)	Consolidate	WWW/EBI post; plan next step	Reflection entry

3.5 Delivery scenarios — operational view

Use this to adapt depth, duration and evidence to your cohort and resources.

Table 3.2 Scenarios at a glance (operations)

Scenario	Online focus	Lab focus	Evidence & checks	When to choose
S1 Onboarding (20–25h, 100% online)	Concepts, vocabulary, safety, slicer reading	— (practice begins in workplace/next course)	Quizzes; short plan; readiness checklist	New hires/new cohorts; no lab access yet
S2 Sprint (30–40h, ~70/30)	M1 + M4 CAD basics; M2 slicing basics	2 lab days: print + basic scan; safe operation	STL/profile; printed part; observation checklist; mini-presentation	VET groups needing a tangible "first print"

S3 Extended (80–100h, ~60/40)	Advanced tasks: DfAM, GD&T, reverse-engineering	Weekly labs; inspection; capstone	Capstone dossier; deviation maps; peer review	Advanced cohorts; upskilling/technician track

3.6 Evidence capture & feedback loops (where it lives)

- **Online:** short quizzes, micro-tasks (screenshots, STL, slicer profiles), short reflections.
- **Lab:** observation checklists, photos of set-ups and first layers, inspection screenshots.
- **After:** WWW/EBI feedback and brief next-step commitments.
- **Where to store:** Platform assignments with rubrics (see **Chapter 15**) and templates in **Annex A**.

3.7 Analytics → Actions (early-warning mini-matrix)

Table 3.3 Signals and interventions

Signal	Trigger	Action
Low logins	No login ≥ 7 days	Message learner; check access; offer catch-up slot
Late work	≥ 2 late items	Discuss workload; adjust plan; signpost support
Weak quiz topic	Avg < 60% on LO-tagged bank	Add recap; revise bank; set a micro-task
Quiet boards	No posts in 1 week	Seed prompts; assign roles (questioner/solver)
Repeated print fails	Two fails in a row	First-layer clinic; change filament/profile; scaffold next task

Trainer Tip: Use "**Message students who…**" (platform feature) to contact exactly those who need a nudge—include a specific, short task and a deadline.

3.8 Safety & inclusion (minimum baseline)

- **Safety:** pre-flight checks, PPE, ventilation/resin handling, machine lock-outs; keep a **quick checklist** on the bench.

- **Inclusion:** provide large-print sheets, high-contrast visuals, captions/alt-text; offer low-gear/high-gear task variants.
- **Data & privacy:** collect only necessary data; inform learners about retention; follow centre policy (see **Chapter 7** and **Chapter 15**).

Chapter 4: Implementation & QA

Centre Readiness and QA Checklist

Before starting a new training cycle, use this checklist to ensure consistency and quality across all sessions:

Area	Checkpoints
Equipment	Printers and scanners calibrated; maintenance log updated.
Software	Slicer and CAD tools tested; licences valid.
Trainer	Familiar with lesson plans, rubrics, and learning outcomes.
Learners	Completed readiness quiz; access to platform confirmed.
Safety	PPE available; safety briefing delivered and recorded.

Documentation QA forms and reflection templates prepared.

Trainer Tip: Keep copies of checklists and trainer reflections in your QA folder – they are part of the EQAVET evidence trail.

Chapter 5: Learner assessment

Integrating Assessment into Learning

Assessment should not be a separate event but a continuous process. Trainers are encouraged to integrate small checkpoints into everyday learning:

- **Formative assessment:** quick observations, reflection sheets, peer reviews.
- **Summative assessment:** based on final project artefacts, documentation, and presentation.
- **Evidence examples:** photos, short videos, slicer files, inspection logs, or reflection notes.

Trainer Tip: Encourage learners to keep a “print log” – it helps track progress and supports authenticity during moderation.

Chapter 6: Lesson plans & learning outcomes

6.1 How the teaching sequence works (modular & scenario-aware)

- **Online first, lab second:** learners meet the language, logic and safety online, then **prove** skills in labs.
- **Scenarios scale depth: S1** builds readiness; **S2** achieves a first complete **design→slice→print** cycle; **S3** adds **DfAM, inspection and capstone**.
- **Evidence every session:** each session captures at least **one artefact** (STL, slicer profile, photo of first layer, scan/mesh screenshot, inspection map).

Trainer Tip: Protect lab time by gating access with short **readiness checks** online (mini-quiz + micro-task upload).

6.2 Learning outcomes by module — Basic stream

The basic stream establishes a common language and the end-to-end workflow.

M1 – Introduction to 3D Technologies

Learners will be able to:

- Explain core AM processes (FDM, SLA) and key vocabulary correctly.
- Identify common materials and basic safety implications.
- Read slicer previews to anticipate supports, overhangs, and print risks.
- Describe how scanning and modelling fit the workflow.
- Demonstrate awareness of lab SOP and personal protective equipment (PPE).

M2 – Introduction to 3D Printing

Learners will be able to:

- Prepare a simple model for print (orientation, supports, layer height, infill).
- Select material/profile appropriate to the goal (time/quality trade-offs).
- Execute a print and perform basic post-processing safely.
- Diagnose and correct frequent issues (bed adhesion, stringing, warping).
- Document parameter choices and justify them briefly.

M3 – Introduction to 3D Scanning

Learners will be able to:

- Choose an appropriate scanning approach (handheld/photogrammetry) for an object.
- Capture and clean a mesh (align, hole-fill, simplify) to **watertight** standard.
- Export in correct format (STL/OBJ) with sensible resolution.
- Describe limitations and sources of error in low-cost workflows.
- Record a short "scan log" (setup, constraints, result).

M4 – Introduction to 3D Modelling

Learners will be able to:

- Create simple print-ready CAD (manifold, wall thickness, scale, units).
- Use constraints and basic parametric edits to improve accuracy.
- Import/export using suitable interchange formats.
- Prepare a model for slicing with minimal rework.
- Present design intent with basic views/annotations.

M5 – 3D Workflow in Education (trainer reference)

Trainers will be able to:

- Plan session sequences, room layout and print queues.
- Integrate short online tasks and lab evidence collection.
- Apply inclusion and accessibility adjustments without diluting outcomes.

6.3 Learning outcomes by module — Advanced stream

The advanced stream deepens professional practice for **S3** (Extended/Capstone).

ADV-M1 – Advanced 3D Printing (DfAM & optimisation)

Learners will be able to:

- Apply **DfAM** principles (feature sizing, support-aware design, consolidation).
- Optimise orientation/supports/parameters for **quality, time, cost**.
- Compare prints using measurable criteria (surface, accuracy, time/material).
- Execute and explain advanced finishing steps where relevant.
- Justify trade-offs with evidence (comparison boards).

ADV-M2 – Advanced 3D Scanning (GD&T & inspection)

Learners will be able to:

- Register and fuse multiple scans reliably; manage large datasets.
- Produce deviation colour maps and concise inspection briefs.
- Apply **GD&T** checks to verify features/tolerances.
- Choose inspection scope proportionate to risk and purpose.
- Communicate findings to a technical audience.

ADV-M3 – Advanced 3D Modelling (parametric/surface/generative)

Learners will be able to:

- Build complex parametric and/or surface geometry; manage references and versions.
- Execute reverse engineering from scans to CAD with validation.
- Use generative/topology optimisation to meet defined performance targets.
- Prepare models for **downstream** processes (simulation, CAM, drawings).
- Collaborate using versioning and change logs.

ADV-M4 – Capstone & Futures

Learners will be able to:

- Deliver an end-to-end 3D project (scan→model→print) meeting a brief.
- Operate with quality ownership: safety, testing, documentation, presentation.
- Reflect critically and propose next steps for improvement or deployment.

6.4 Scenario hooks — which modules matter most (and why)

Table 6.4 Scenario emphasis & products

Scenario	Critical modules	Lab focus	Minimum products/evidence
S1 Onboarding	M1 (language, safety), selected M2/M4 units	— (workplace starts later)	Quiz thresholds; safety reflection; simple print plan
S2 Sprint	**M1 + M4** (must finish online), M2 (slicing basics)	**2 lab days**: print + basic scan	STL + slicer profile; printed part; observation pass; mini-presentation
S3 Extended	ADV-M1/M2/M3 + capstone	Weekly labs; inspection; documentation	Capstone dossier; deviation map; peer review; viva/defence

Trainer Tip: In **S2**, never begin lab day without **M1 + M4** completion—this protects hands-on time for print quality and troubleshooting.

6.5 Lesson blueprints (ready to run)

Use these compact patterns; copy once per session. They align with **Chapter 5** evidence and rubrics.

6.5.1 Printing lab (90 minutes)

Section	Time	Trainer	Learners	Evidence (upload)
Kick-off & safety	10’	LO + hazard reminder	Attend; clarify terms	Sign-in; safety tick
Demo (first-layer)	10’	Show levelling; first-layer checklist	Observe; note	Photo of first layer
Guided practice	25’	Coach pair by pair	Slice with fixed profile	STL + profile
Independent print	35’	Walk the room; probe choices	Print; log params	Photo of print; “why” note
Wrap-up	10’	Feedback; next step	Reflect	WWW/EBI (3 lines)

6.5.2 Scanning lab (60–75 minutes)

Section	Time	Trainer	Learners	Evidence
Induction	10’	Show good/bad capture	Observe	Scan checklist
Capture	20–25’	Support capture setups	Scan object	Raw scan file
Mesh surgery	20–25’	Show quick fixes	Clean/repair	Before/after mesh
Close	10’	Debrief limits/errors	Reflect	Short scan log

6.5.3 Modelling workshop (60–90 minutes)

Section	Time	Trainer	Learners	Evidence
Activate	5’	Quick quiz or two truths	Answer	Quiz result
Build	30–50’	Scaffold difficult step	Model	CAD file

Print-ready	15–20’	Manifold/walls/scale check	Fix issues	Screenshot + notes

6.6 Assessment alignment by module (what to collect)

Table 6.6 Evidence & rubric emphasis

Module	**Evidence to collect**	**Rubric emphasis (see Ch.5)**
M1	Quiz items; short plan; safety reflection	Knowledge; Safety (P/F)
M2	STL + slicer profile; photo of first layer/print; rationale	Practical; Quality & optimisation; Documentation
M3	Before/after mesh; scan log (setup → result)	Practical; Documentation
M4	CAD file; print-ready checks (manifold/walls/scale)	Practical; Documentation
ADV-M1	Comparison board (time/quality/cost); optimised profile	Quality & optimisation; Practical; Documentation
ADV-M2	Deviation map; inspection brief	Practical; Knowledge (GD&T); Documentation
ADV-M3	CAD + change log; REV from scan	Practical; Documentation; Collaboration (if team)
Capstone	Dossier; viva/defence; peer review	All criteria; Moderation (sample ≥ 15%)

6.7 Differentiation & inclusion (low-gear / high-gear)

- **Low-gear (support):** starter CAD files; locked slicer profile; step cards; larger print area for visibility; extra time.
- **High-gear (stretch):** orientation comparison; custom supports; living hinge; hybrid measure+scan; tolerance targets; mini-inspection.
- **Accessibility:** captions/alt-text for all media; large-print handouts; high-contrast UI shots; quiet corner; alternative input devices where needed.

Trainer Tip: Publish both variants up front so pairs can self-select and still converge on the **same outcomes**.

6.8 Preparation checklist (trainer)

- Course shell **published**; deadlines & rubrics attached.
- **M1 + M4** online tasks opened (S2 and S3).
- Printer(s) levelled; profiles tested; spare nozzles & filament.

- Scanning station ready; “mesh surgery” quick guide on bench.
- Safety deck and **first-layer clinic** slides printed/loaded.
- Evidence folders created (STL, profiles, photos, meshes) with naming convention.

Cross-links:

- **Assessment & rubrics** → **Chapter 5** + **Annex A**.
- **Blended organisation** → **Chapter 3** (cadence & scenarios).
- **Resources, Top-5 & accessibility** → **Chapter 10** (+ **Annex C**).
- **QA & evaluation** → **Chapter 7** (+ **Annex B**).

Chapter 7: Programme evaluation & quality assurance

Quality Assurance and Continuous Improvement in the 3DAcademy Programme

The 3DAcademy approach to quality assurance follows a continuous improvement cycle that supports the consistent delivery of high-quality training.
This process aligns with the principles of the European Quality Assurance in Vocational Education and Training (EQAVET) framework and can be applied by all partners and training centres.

The cycle is built around five key stages, which are repeated after every training implementation.

1. Plan

At the start of each delivery cycle, trainers and coordinators prepare:

- Course schedule and delivery plan based on chosen scenario.
- Required equipment, software, and materials (as listed in Chapter 4).
- Trainer readiness (lesson plans, rubrics, and reflection forms).
- Learner enrolment and readiness checks (safety briefing, access to platform).

Purpose: Ensure that both trainers and learners begin with clear expectations and adequate resources.

2. Deliver

Trainers conduct the learning sessions according to the selected scenario.
During delivery, they:

- Apply lesson templates and rubrics from the manual.
- Monitor participation and engagement.
- Encourage reflection and peer learning.
- Record any deviations, technical issues, or learner feedback.

Purpose: Maintain consistency of delivery while capturing evidence of learning and potential improvements.

3. Collect and Evaluate

After each session or course, trainers gather data and reflections:

- Use the *Trainer Reflection Form* to summarise what worked well and what can be improved.
- Review learner assessment results, attendance, and feedback forms.
- Store evidence (photos, print logs, QA forms) in the shared documentation folder.
- Conduct peer moderation where applicable.

Purpose: Create a reliable base of evidence to evaluate effectiveness and learning outcomes.

4. Reflect and Report

Once all evidence is collected, coordinators or QA leads analyse and discuss the results:

- Identify recurring issues or good practices.
- Summarise findings in an *Evaluation Brief* (Annex B).
- Share insights with all partners or training teams.

Purpose: Encourage open reflection and transparency — learning from both successes and challenges.

5. Adjust and Improve

The final stage focuses on integrating feedback into the next iteration:

- Update lesson plans, rubrics, or checklists if needed.
- Adjust scheduling, equipment allocation, or learner grouping.
- Revise training materials to improve clarity or engagement.
- Document all actions in the *QA Action Log* for traceability.

Purpose: Close the feedback loop and continuously enhance training quality.

Summary Table: QA Continuous Improvement Cycle

Stage	Main Actions	Who Is Involved	Outputs / Tools
1. Plan	Prepare schedule, materials, and readiness checks.	Trainers, coordinators	Readiness checklist, session plan
2. Deliver	Conduct lessons, monitor engagement, record feedback.	Trainers	Lesson plans, observation notes
3. Collect & Evaluate	Gather reflections, assessments, and learner feedback.	Trainers, QA leads	Reflection forms, assessment data
4. Reflect & Report	Analyse results, summarise findings, share with team.	QA coordinators, partners	Evaluation brief
5. Adjust & Improve	Implement changes for next cycle, record updates.	Trainers, coordinators	Action log, revised materials

Key Message for Trainers

Quality assurance in 3DAcademy is not about bureaucracy — it's about learning as a system.
Each reflection, feedback, and small adjustment helps to create better learning experiences, stronger partnerships, and more competent learners.

Chapter 8: Learning-teaching scenarios & learner materials

8.1 Teaching scenarios (overview)

Use the table below to choose the **right teaching pattern** for your cohort and resources.

Table 8.1 Teaching scenarios at a glance

Scenario type	Best for	Time / Structure	Core activities	Evidence & assessment hooks
Project-Based Learning (PBL)	Mixed-ability cohorts; motivation via real products	**2–4 weeks**; online prep + lab sprints	Define brief → research → design → make → iterate → present	Prototype, design log, photos/video, **rubric-based** mini-presentation
Collaborative Learning	Teams of 3–5; role clarity; integration	**1–3 weeks** with role checkpoints	Role assignment → parallel build → integration → play-test/review	Team artefact, peer assessment, observation checklist, **retro** notes
Independent Exercises	Skill consolidation; remediation; fast tracks	**Single session** or **1–2 weeks**	Guided task → checkpoint quiz → stretch challenge	Task files, quiz results, teacher notes, quick reflection

Trainer Tip: Decide **one non-negotiable artefact** per session (e.g., STL, slicer profile, first-layer photo). It keeps the evidence trail clean and speeds feedback.

8.1.1 PBL – Example 4-lesson sprint (indicative)

Lesson	Focus	Trainer actions	Learner actions	Evidence
L1 (online)	Understand brief; research	Publish brief + exemplars; safety reminder	Read/watch; post one insight	Forum post or short note
L2 (lab)	Feasibility & planning	Run "first-layer clinic"; coach scoping	Paper prototype; pick material/profile	Photo of sketch/plan
L3 (lab)	Build v1; test	Rove; probe parameter logic	CAD → slice → print small proof	STL + profile + first-layer photo
L4 (lab)	Iterate & present	Facilitate quick user tests	Improve; 3-min mini-presentation	Prototype + slides/screenshots

Assessment hooks: design log completeness; print/scan quality; rationale for parameters; short presentation using **Chapter 5** rubric.

8.1.2 Collaborative learning – Example sequence

Step	What to do	Key checks
Team roles	Assign designer / modeller / print operator / documenter	Everyone knows role + hand-offs
Checkpoint 1	Design freeze at end of L2	Scope creep controlled
Checkpoint 2	Integration test at end of L3	Parts fit; risks known
Review	Play-test & retro in L4	Keep 2 strengths, 2 changes

Assessment hooks: peer assessment (2–3 prompts), observation checklist, integration quality, **retro** notes.

8.1.3 Independent exercises – Example menu

Task	Core goal	Support ("low-gear")	Stretch ("high-gear")	Evidence
Mesh surgery	Make a mesh watertight	Pre-captured scan; 3 faults labelled	Multi-object alignment; decimation strategy	Before/after mesh + notes
Toleranced snap-fit	Design for fit	Given target dims; fixed profile	Learner-defined tolerances; living hinge	CAD + print; fit photo
First-layer mastery	Stabilise prints quickly	Fixed profile; bed-levelling card	Orientation & adhesion comparison	Side-by-side photos + timing

8.2 Learner materials (what to provide)

Bundle the essentials so learners can work **independently** and you can **assess consistently**.

Table 8.2 Materials pack

Material	Purpose	Format	Source / Notes	Accessibility
Task sheet	Step-by-step; success criteria	PDF/Doc	One per task; localise examples	Plain language; ≥11 pt
Design/learning log	Record parameters, issues, decisions	Doc/Sheet template	Align with Ch.5 rubric	Keyboard navigable

Safety one-pager	Induction & reminders	PDF (1 page)	Lab-specific + general rules	High contrast; icons
Checklists & rubrics	Consistent observation & grading	Printable + digital	Annex A templates	Readable A4
Starter files	CAD/mesh starting points	CAD/STL/OBJ	Per exercise	Provide alternatives
Reference cards	Quick how-tos (slicing/supports)	A5 laminated	By toolchain	Large-print option

Trainer Tip: Put everything on the platform **one level down** from the weekly module with the same names learners see in class.

8.3 Training delivery scenarios (applied)

Plan pacing, materials and evidence for each scenario in one place.

Table 8.3 Delivery scenarios (operations planner)

Scenario	Target group	Format & duration	Online focus	Practical focus	Evidence & decision
S1 Onboarding Foundation	New employees; no lab access	100% online; **4 weeks (20–25h)**	M1 + selected M2/M4; safety; slicer reading	— (practice starts in workplace)	Quiz thresholds; readiness checklist → **Ready/Not yet**
S2 Sprint Learning with Practice	VET/secondary groups	Blended; ≈**1 month (30–40h)**	M1 + **M4** completion; slicing basics	**2 lab days**: print & basic scan	STL + profile; printed part; observation pass; mini-presentation
S3 Extended (Expert + Capstone)	Adults, graduates, technicians	Blended; **6–8 weeks (80–100h)**	DfAM, GD&T, reverse-engineering	Weekly labs; inspection; **capstone**	Capstone dossier; deviation map; peer review; viva/defence

Readiness gate (S2/S3): Do **not** start lab day until **M1 + M4** online tasks are complete.

8.4 Piloting plan (5 × 45 minutes)

Use this to test the approach with a small cohort; collect structured feedback.

Table 8.4 Pilot sessions & evidence

#	Focus	Key activities	Materials	Evidence
1	Intro & registration	Platform sign-in; safety; demo prints	Accounts; slides	Attendance; baseline poll
2	3D Modelling (TinkerCAD)	Basic shapes; export STL	PCs; task sheet	STL; screenshot
3	3D Scanning	Scan small object; clean mesh	Scanner/phone; mesh tool	Before/after mesh
4	3D Printing & slicing	Slice; supports; print small part	Printer; slicer; PPE	Slicer profile; print photo
5	Wrap-up & evaluation	Share results; survey; certificates	Survey; certs	Survey results; photo log

Data capture: run a 3-item **weekly pulse** during the pilot and a short **end-survey** (see **Annex B**).
Inclusion: provide alternative tools/files; ensure captions/alt-text; large-print handouts on request.

8.5 Quick troubleshooting (first layer & mesh)

- **First-layer fails:** Clean bed; re-level; raise bed temp; reduce speed; adjust Z-offset; re-orient to minimise brimless overhangs.
- **Warping/adhesion:** Brim or raft; enclosed chamber or draft shield; different build surface; tweak fan/temps.
- **Noisy/dirty meshes:** Re-capture with matte spray; increase features; remove glare; simplify after hole-fill.

Trainer Tip: Keep a **"first-layer clinic"** slide handy and appoint a **first-layer marshal** in class to triage before you intervene.

Cross-links

- **Assessment & rubrics → Chapter 5 + Annex A**
- **Blended organisation & cadence → Chapter 3**
- **Resources & accessibility → Chapter 10 + Annex C**

- **QA & evaluation → Chapter 7 + Annex B**

Chapter 9: Tools & materials package

9.1 How to read this chapter

- **Vendor-neutral** baselines you can meet with multiple brands.
- **Cost bands** (Low / Typical / High) not quotes; localise per market.
- **Date stamp** the table, and update once per semester.
- **Safety first:** PPE and handling rules are **non-negotiable** (see Chapters 4 & 10; Annex A).

Localisation note: Replace € with your local currency, keep the same **Low / Typical / High** logic so partners can compare.

9.2 Baseline specifications (what "good enough" looks like)

- **Workstations (modelling/slicing):** Quad-core CPU; **16 GB RAM**; SSD; mid-range GPU; 1080p+ display; wired network preferred.
- **FDM printer(s):** Build volume ≥ **200×200×200 mm**; heated bed; **0.4 mm nozzle**; reliable bed levelling; enclosure desirable.
- **Resin (optional track):** Entry-level SLA/MSLA; **wash & cure** kit; strict PPE/ventilation/waste SOP.
- **3D scanner:** Handheld/structured-light **or** photogrammetry workflow; tripod/turntable helpful.
- **Slicers:** Cura/PrusaSlicer (FDM); vendor tool for resin; shared profiles locked for beginners.
- **CAD:** Entry (**TinkerCAD/Onshape**), Advanced (**Blender/FreeCAD** or institutional Fusion/Inventor/SolidWorks licences).
- **Mesh tools:** MeshLab (repair/clean); an automated repair option where available.
- **Safety:** PPE (gloves/goggles), fume/vent guidance, fire extinguisher, first aid; **MSDS** available for all materials.

9.3 Cost bands (date-stamped)

Updated: October 2025 (replace on next review)

Category	Low (€)	Typical (€)	High (€)	What's included / notes
Modelling workstation (per seat)	900	1,500	5,000+	PC, display, peripherals; upgrade RAM/SSD before GPU
FDM printer (education-grade)	300	1,200	5,000+	Heated bed, enclosure preferred; spare nozzles & plates
Resin printer (entry) + wash/cure	350	800	2,000+	Strict PPE/vent; include wash/cure station
3D scanner (or photo rig)	500	2,000	10,000+	From phone+turntable to structured-light handheld
Hand tools & post-processing kit	100	250	600	Scrapers, deburring, calipers, IPA trays, UV lamp (resin)
Safety & signage	80	200	500	PPE set, spill kit, safety cards, extinguishers maintenance
Consumables (term starter)	200	600	1,500	Filament/resin, build plates, nozzles, alcohol, wipes
Software (if licensed)	0	300	1,200+	FOSS possible; otherwise edu licences per seat

9.4 Scenario kits (what to procure for each delivery model)

Table 9.4A Scenario 1 – Onboarding (100% online)

Item	Qty	Note
Workstations (modelling)	per learner seat	Browser-based CAD acceptable
Platform access	all	Course shell + quizzes/micro-tasks
Safety materials (digital)	1 set	Safety one-pager; induction slides

Table 9.4B Scenario 2 – Sprint (blended; 2 lab days)

Item	Qty	Note
FDM printers	1 per 6–8 learners	More = shorter queues
Workstations (modelling/slicing)	1 per 2 learners	Headsets for short coaching
Hand tools & PPE kit	class set	Scrapers, calipers, goggles, gloves
Filament (PLA)	~1–1.5 kg per learner (per month)	Start with PLA; PETG later
Scanning option (basic)	1 station	Smartphone + turntable ok

Table 9.4C Scenario 3 – Extended (weekly labs + capstone)

Item	Qty	Note
FDM printers (plus spare)	1 per 4–6 learners	Add enclosure/ABS/PETG if required
3D scanner (improved)	1–2	Structured-light or robust phone rig
Resin track (optional)	1 set	Wash/cure; extra PPE; SOPs
Workstations (adv. CAD)	1 per learner	Parametric/surface workflows
Inspection tools	1 station	GD&T checklist; deviation maps

9.5 Procurement tips (save budget, raise uptime)

- **Buy spares up front:** 0.4 mm nozzles, build plates, PEI sheets, Bowden/PTFE tubes, belts.
- **Standardise profiles:** lock beginner slicer profiles; keep an “expert” copy separate.
- **Prefer enclosure:** stabilises prints, reduces drafts; improves success rate.
- **Bundle training:** one hour of vendor set-up coaching pays back quickly.
- **Leverage FOSS:** MeshLab, Blender, PrusaSlicer reduce licence costs; reserve paid seats for advanced needs.
- **Check serviceability:** local parts, community support, and clear maintenance steps.

9.6 Maintenance & safety (quick reference)

- **Daily:** first-layer checks; bed clean; resin vat/filters (if used); PPE stock glance.

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- **Weekly:** re-level beds; check belts; wipe rails; clean fans/filters; calibration test print.
- **Per 100 printing hours:** replace nozzles; inspect hotend; refresh build surfaces.
- **Resin SOP:** gloves/goggles; closed containers; labelled waste; UV cure leftovers; **never** drain resin/IPA to sinks.
- **Records:** keep a simple **maintenance log** (date, action, who) next to the machine.

9.7 Consumables forecasting (quick model)

- **Filament (PLA): 0.8–1.2 kg / learner / month** in S2; **1.5–2.0 kg / learner / month** in S3 (capstone heavy).
- **Resin: 0.25–0.5 L / learner / month** (heavily design dependent).
- **Build plates/nozzles:** plan for **1 spare plate per printer / term** and **2–4 nozzles per printer / term**.
- **IPA/cleaners: 5–10 L / term** for a 12–16 learner cohort with occasional resin use.

9.8 Inventory & localisation templates

Table 9.8A Inventory register (sample)

Item	Serial/ID	Location	Qty	Condition	Last service	Next due	Notes
FDM printer #1	PR-001	Lab A	1	Good	2025-10-01	2026-01-01	New PEI sheet
Resin printer #1	RS-001	Lab B	1	Good	2025-09-20	2025-12-20	VAT replaced
Workstation	WS-A07	Lab A	1	OK	—	—	RAM upgrade

Table 9.8B Localisation sheet (prices)

Category	Source (local vendor)	Low (local)	Typical (local)	High (local)	Last checked
FDM printer					
Filament (PLA/kg)					
Workstation					
3D scanner					

Update rule: Refresh prices **each semester**; update the date stamp in **9.3** and add any major changes to the QA **Action Log** (Annex B5).

Cross-links

- **Safety & setup** → **Chapter 4** (readiness, zoning, SOPs).
- **Assessment artefacts** → **Chapter 5** (what to collect).
- **Teaching scenarios** → **Chapter 8** (what you'll actually do with the tools).
- **Resources & accessibility** → **Chapter 10** (curated Top-5s & checklist).
- **QA & costs tracking** → **Chapter 7** + **Annex B** (Action Log & KPIs).

Chapter 10: Materials (curated)

10.1 Curation principles (how we choose)

- **Outcome-aligned:** Every item supports a specific module LO or scenario task (see Chapters 6 & 8).
- **Classroom-ready:** Short, structured, printable/screen-friendly; minimal pre-reading; clear examples.
- **Accessible:** Captions, alt-text, high-contrast diagrams, readable typography (≥ 11 pt) and keyboard navigation where interactive.
- **Level-tagged: Beginner / Intermediate / Advanced** so trainers can match mixed ability.
- **Licensing:** Prefer open/educational licences; document access requirements in **Annex C**.

Trainer Tip: Include **one** "why/when to use" sentence with each link so learners know exactly **how** it helps them.

10.2 Category map (what to use and when)

Category	Learning goal	Typical use in course	Notes
Introductory Modelling	Build basic CAD literacy and vocabulary	Pre-lab prep; flipped lessons; homework	Works best before **M4** workshops
Slicing Guides	Translate CAD to printer instructions	Before first prints; troubleshooting	Pair with **M2** first-layer clinic
Mesh Repair	Clean/prepare scans for print/CAD	After scanning demos; remediation	Pairs with **M3** scan-to-mesh
Printing Safety	Safe material handling and machine use	Induction and refreshers	Mandatory before lab access
Scanning Workflows	Capture and process scan data	Scan days; pre-activity prep	Bridge to **ADV-M2** inspection
DfAM References	Design for additive constraints	Advanced track; capstone planning	With **ADV-M1** optimisation tasks
Accessibility & Inclusion	Inclusive practice in VET	All cohorts; teacher reference	Applies across modules & scenarios

10.3 Top-5 curated resources per category (exemplars)

(Replace titles/links with your institutional picks; keep the structure and the "why/when". Live URLs belong in ***Annex C****.)*

10.3.1 Introductory Modelling (Top-5)

1. **"CAD Basics – Sketch to Solid"** (Web, Beginner) — Fast on-ramp to fundamental tools; use before first **M4** session.
2. **"Blender Fundamentals: Selection & Transforms"** (Video, Beginner) — Bite-size videos for home or class warm-ups.
3. **"Onshape Pathway: Parts & Assemblies"** (Web, Beginner) — Browser-based; easy provisioning for schools.
4. **"Fusion 360: Parametric Thinking"** (Web/Video, Beginner) — Bridges to constraints and simple parametrics.
5. **"CAD File Management Basics"** (PDF, Beginner) — Naming, units, versioning; stick it on the lab wall.

10.3.2 Slicing Guides (Top-5)

1. **"FDM Slicing Fundamentals"** (PDF, Beginner) — Orientation, infill, walls, supports; aligns to **first-layer clinic**.
2. **"Resin Quick-Start"** (PDF, Beginner) — Exposure, supports, post-cure; safety reminders built-in.
3. **"Troubleshooting Library (Stringing/Warpage)"** (Web, Intermediate) — Photo-led fault finder.
4. **"Support Strategies & Overhangs"** (Video, Intermediate) — Save time/material; reduce post-processing.
5. **"Build-Plate Adhesion Methods"** (Web, Beginner) — Levelling, first layer, adhesives; pre-print checklist.

10.3.3 Mesh Repair (Top-5)

1. **"Watertightness & Non-Manifold Fixes"** (PDF, Beginner) — Simple checks before slicing or CAD import.
2. **"MeshLab: Clean & Simplify"** (Web, Beginner) — Open-source workflow; step screenshots.
3. **"Automated Repair Essentials"** (Web, Intermediate) — One-click fixes plus manual tidy-up.

4. **“Photogrammetry to Print: Pitfalls”** (Web, Intermediate) — Dealing with texture-only captures.
5. **“Export Settings for STL/OBJ”** (PDF, Beginner) — Scale, units, facet resolution; standard defaults.

10.3.4 Printing Safety (Top-5)

1. **“3D Printing Lab Safety One-Pager”** (PDF, All) — Induction checklist; PPE; emergency notes.
2. **“MSDS Highlights (PLA/ABS/Resins)”** (PDF, All) — Readable extracts from safety data sheets.
3. **“Ventilation & Resin Handling”** (Web, All) — Setup tips; waste disposal; hygiene.
4. **“Electrical & Thermal Hazards”** (Web, All) — Posters/slides for quick refreshers.
5. **“Printer Maintenance Basics”** (Web, Beginner) — Nozzles, beds, vats; routine intervals.

10.3.5 Scanning Workflows (Top-5)

1. **“Photogrammetry Starter”** (Web, Beginner) — Camera paths; lighting; feature-rich surfaces.
2. **“Handheld Scanning: Best Practice”** (PDF, Intermediate) — Avoid drift; marker strategies; reflective surfaces.
3. **“Registration & Alignment 101”** (Web, Intermediate) — Pairwise alignment; ICP; error checks.
4. **“Cleaning & Hole-Filling”** (Video, Beginner) — Visual walkthrough for projection in class.
5. **“Export for CAD vs. Print”** (PDF, Beginner) — Choose topology and resolution by downstream use.

10.3.6 DfAM References (Top-5)

1. **“Minimum Feature Sizes & Tolerances”** (PDF, Intermediate) — Cheat-sheet for design reviews.
2. **“Lattice Structures Overview”** (Web, Advanced) — Weight vs. strength; printability considerations.
3. **“Consolidating Assemblies for AM”** (Web, Advanced) — Reduce parts/fasteners; DFM vs. DfAM trade-offs.

4. **“Support-Aware Design Techniques”** (Video, Intermediate) — Design out supports; cost/time savings.
5. **“Surface Finish & Orientation”** (Web, Intermediate) — Aesthetic/functional trade-offs; inspection tips.

10.3.7 Accessibility & Inclusion (Top-5)

1. **“Inclusive Design in Tech Classrooms”** (PDF, All) — Checklist for lesson planning & delivery.
2. **“Captioning & Alt-Text Quick Guide”** (Web, All) — Meet baseline accessibility for media and docs.
3. **“Large-Print & High-Contrast Templates”** (Doc/PDF, All) — Handout/slide templates to copy.
4. **“Neurodiversity-Friendly Task Design”** (Web, All) — Break tasks; reduce cognitive load; predictable structure.
5. **“Assistive Tech Options for CAD”** (Web, All) — Keyboard shortcuts, speech tools, alternative inputs.

10.4 Accessibility & inclusion checklist (minimum standard)

Criterion	What to check	Minimum
Captions/transcripts	All videos and audio	Closed captions or transcript provided
Alt-text	Images in PDFs/slides/web pages	Meaningful alt-text present
Colour/contrast	Diagrams and UI screenshots	Passes WCAG AA contrast
Typography	Body text & headings	Readable fonts; ≥ 11 pt on A4
Keyboard access	Interactive web resources	Tabbing works; focus visible
Plain language	Instructions, task sheets	Short sentences; action verbs
Downloadability	Key instructions	Printable A4 PDF provided

Trainer Tip: Keep an **accessibility pass** column in your Annex C catalogue; you’ll catch issues **before** class.

10.5 Maintenance & governance (keep it fresh)

- **Refresh cycle:** review and update the Top-5 per category **each semester**.

- **Ownership:** Chapter 10 editor (e.g., **8Cell**) curates inputs from partners; records changes in **Annex C – Change Log**.
- **Retirement rule:** remove items if outdated, paywalled without licence, inaccessible, or superseded by better options.
- **Feedback loop:** collect teacher/learner ratings and comments via the platform; prioritise resources with high impact and high accessibility.

Cross-links:

- **Annex C – Extended Resource Library** (live URLs, access/licensing, accessibility notes, QA status, maintenance log).
- **Annex B – Programme Evaluation** (use end-survey comments to update this chapter).

Chapter 11: Practical assignments

How to Select the Right Exercise

Each practical exercise (EM) is designed for a specific skill level. Trainers should use the following guide to choose exercises:

Skill Level	Suggested Exercises (EM)	Focus
Beginner	EM-1, EM-2	Basic slicing, modelling, safe printing
Intermediate	EM-3, EM-4	Parametric design, troubleshooting
Advanced	EM-5, EM-6	DfAM optimisation, inspection, quality control

Trainer Tip: Combine exercises across levels to create a “learning ladder” — start with EM-2 and end with EM-5 for project progression.

Chapter 12: Trainer toolkit – designing new practical exercises

12.1 Scope & intent

This chapter gives you a **simple, repeatable method** to design new practical activities (Exercise Modules – EMs) that:

- align to **Chapter 6** learning outcomes and **Chapter 8** scenarios;
- collect the **right evidence** for **Chapter 5** assessment rubrics;
- are **safe**, **accessible**, and **time-boxed** for VET delivery;
- can be shared and adopted by colleagues quickly.

Trainer Tip: Design for a **60–90 minute block** with **one non-negotiable artefact** to upload (e.g., STL + slicer profile, before/after mesh).

12.2 Exercise Module (EM) blueprint

Use this format for each new activity so colleagues can deliver it tomorrow.

Table 12.2 – EM blueprint (copy and fill in)

Field	What to write
Title (EM-# + name)	e.g., EM-9: Parametric hinge prototype
Scenario fit	S1 (Onboarding) / S2 (Sprint) / S3 (Extended)
Difficulty	Beginner / Intermediate / Advanced
Module link (Ch.6)	e.g., M4 Intro to 3D Modelling; ADV-M1 DfAM
Objective (1–2 lines)	Action verb + outcome (e.g., "Create a snap-fit that holds under X force")
Prerequisites	Prior online tasks (M1/M4), tools, safety induction
Core steps (short)	4–6 bullets, verbs first (no paragraphs)
Evidence to upload	Files + screenshots/photos + 3–5 line rationale
Safety / SOP	Specific checks (PPE; resin handling; first-layer clinic)
Rubric rows (Ch.5)	Practical; Quality & optimisation; Documentation; Safety (P/F); Collaboration (if team)
Low-gear / High-gear	One support and one stretch variant
Accessibility notes	Large-print sheet; alt-text diagrams; high-contrast UI shots; alternative input options
References	Point to Chapter 10 resources / Annex C links

12.3 Examples of focused EM objectives

- **Printing (Beginner):** "Slice and produce a small bracket with acceptable first-layer and no warping."
- **Scanning (Intermediate):** "Capture and repair a watertight mesh suitable for FDM printing."
- **Modelling (Intermediate):** "Design a snap-fit enclosure meeting a ±0.3 mm fit target."
- **DfAM (Advanced):** "Reduce mass by ≥ 25% via lattice or topology optimisation without losing function."
- **Inspection (Advanced):** "Generate a deviation map and a one-page inspection brief for a printed part."

12.4 Safety & readiness gates (before hands-on)

- **Readiness check online:** short quiz + micro-task (e.g., upload STL or first-layer profile) tied to the EM.
- **Lab gate:** safety tick (PPE, induction, pre-flight checks).
- **First-layer control:** appoint a **first-layer marshal** to triage beds and Z-offsets before you intervene.

Quick bench card (print & place):

- Bed clean → Level check → Z-offset → First layer photo → Proceed/Retry.

12.5 Evidence & assessment alignment (what to collect)

Link your EM to **Chapter 5** rubrics. Choose at least **one artefact** per criterion.

Table 12.5 – Evidence selector

Criterion (Ch.5)	Evidence ideas
Practical	STL + slicer profile; print photo; before/after mesh; CAD file
Quality & optimisation	Orientation rationale; comparison board (time/quality/cost)
Documentation	3–5 line "why" note; scan/repair log; inspection brief
Safety (P/F)	Signed observation checklist; first-layer clinic tick
Collaboration (if team)	Peer assessment mini-form; integration notes; retro bullets

12.6 Differentiation & inclusion (publish both upfront)

- **Low-gear (support):** starter CAD; fixed profile; labelled faults; extended time.
- **High-gear (stretch):** custom profile; tolerance target; multi-object alignment; inspection add-on.
- **Accessibility:** captions/alt-text; large-print handouts; high-contrast diagrams; allow alternative input devices; quiet corner for focus.

Table 12.6 – Low-gear / High-gear planner (fill per EM)

EM	Low-gear (support)	High-gear (stretch)	Accessibility adaptation
EM-__			

12.7 Time & resources (keep it real)

- **Time-box:** 60–90 minutes (or 2×45 minutes).
- **Queue planning:** 1 printer per 6–8 learners (S2) / 1 per 4–6 (S3).
- **Consumables:** plan filament/resin per learner (see **Chapter 9**).
- **Room layout:** clear printer zone; stable scanning area; modelling PCs in trainer's line of sight.

12.8 Quality, moderation & versioning (lightweight)

- **Fit check:** EM objective maps to **Ch.6** LOs and a scenario in **Ch.8**.
- **Moderation:** sample **≥ 3 artefacts** on first run; record result using **Annex A7** (add "EM-ID").
- **Versioning:** date-stamp updates inside the EM ("v1.1 2025-10-26").
- **Retirement rule:** replace EMs that are inaccessible, unsafe, or low-impact for two cohorts.

12.9 Submission flow (centre/partner sharing)

1. Draft EM using **Table 12.2**.
2. Pilot with a small group; collect 2–3 artefacts and short learner comments.

3. Finalise evidence list and rubric rows; add **Low-/High-gear** and **Accessibility** notes.
4. Submit to the Chapter 11 editor for inclusion in the shared bank.
5. Add any live links to **Annex C** and update the change log.

12.10 Quick authoring checklist

- Objective aligns to **Ch.6** LOs and a scenario in **Ch.8**
- Core steps are **bulleted** and **action-oriented**
- Evidence list supports **Ch.5** rubric rows
- Safety and SOPs clearly stated (especially resin)
- Low-gear / High-gear variants + accessibility noted
- Time-boxed; resource needs realistic; printer queue considered
- Moderation plan for first run (≥ 3 artefacts)
- Date stamp and “EM-ID” present

Cross-links

- **Learning outcomes → Chapter 6**
- **Blended organisation & scenarios → Chapter 3** and **Chapter 8**
- **Assessment & rubrics → Chapter 5 + Annex A**
- **Tools, costs & safety → Chapters 4 & 9**
- **Resources & links → Chapter 10 + Annex C**

Chapter 13: Using the 3dacademy online platform (concise guide)

Scope: This chapter gives the **minimum operating standard** for all cohorts. For deeper step-by-step workflows and extended options, see the full platform chapter later in the manual.

13.1 Purpose & alignment

- Reflect **delivery scenarios** (see Chapter 3) in the course shell.
- Map **assessment** to **Chapter 5** rubrics and store evidence in-platform.
- Use this chapter as the **baseline**—every cohort should meet or exceed these settings.

13.2 Roles & permissions (at a glance)

Role	Create/Edit Content	Grade/Moderate	View Analytics	Notes
Institution Admin	Yes	Yes	All cohorts	Accounts/SSO; policy; backups
Course Owner (Trainer)	Yes	Yes	Own cohort	Schedules; rubrics; deadlines
Teaching Assistant	Limited	As delegated	Own cohort (limited)	Marking support; feedback
Learner	Own submissions	—	Own progress	Follows flow; uploads artefacts

13.3 Course structure (minimum)

- **Course Home:** “Start here” page, welcome note, office hours, help channel.
- **Modules:** W01–W08 style naming; release dates; prerequisites where needed.
- **Assignments:** brief + **rubric** attached; correct submission type; due dates visible.
- **Files:** clean folders; versioned assets; consistent naming (e.g., YYMMDD_title).

Trainer Tip: Gate lab access with **readiness checks** (mini-quiz + micro-task upload) 48–72h before workshop days.

13.4 Assignments & rubrics (quick setup)

Type	Use	Key settings
File upload	CAD/STL, slicer profiles, reports	1–2 attempts; lateness policy; rubric + inline feedback
Text entry	Reflections, design logs	Single attempt; short prompts; rubric
Group submission	Team artefact + peer review	Assign to groups; peer-review window; one spokesperson

- Attach the **analytic rubric** (see Chapter 5 / Annex A) **before** publishing.
- In EMs (Chapter 11), define **one non-negotiable file** to upload (e.g., profile or first-layer photo).

13.5 Quizzes (lightweight integrity)

Setting	Recommendation
Question banks	Pool by LO; draw random subsets
Randomisation	Shuffle questions/answers where feasible
Feedback	Show answers after due date; brief item notes
Attempts	2 formative; 1 summative

13.6 Communication & collaboration

- **Announcements:** weekly digest cadence; link current tasks and deadlines.
- **Discussion boards:** Q&A threads; pin "netiquette"; acknowledge helpful posts.
- **Groups & peer review:** auto-allocate teams of **3–5**; use structured rubrics; end with a **short team retro**.

13.7 Analytics → actions (early-warning mini-matrix)

Signal	Trigger	Action
Low logins	No login ≥ 7 days	Message learner; check access; assign catch-up micro-task
Late work	≥ 2 late items	Discuss workload; adjust plan; signpost support
Weak LO topic	Avg < 60% on LO bank	Add recap; update bank; set a short remedial task

Use the platform's "**Message students who…**" feature to target nudges precisely.

13.8 Accessibility & GDPR (minimum standard)

- **Captions/transcripts** for all videos; **meaningful alt-text** for images.
- **Readable typography** (≥ **11 pt**) and **WCAG-AA** contrast on visuals.
- **Data minimisation:** collect only what you need; publish retention policy; obtain consent where required.

13.9 Troubleshooting (quick fixes)

Issue	Quick fix
File won't upload	Check filetype/size; compress; retry wired; if persists, log a ticket
Video won't play	Try another browser; provide download link; report blocked domains
Marks hidden	Unmute column/posting policy; republish feedback

3.10 Operational checkpoints

- **Start-of-course:** copy template; set dates; publish "Start here"; attach rubrics; create groups; test one submission.
- **Mid-course:** run a pulse survey; act on analytics; rebalance lab capacity.
- **End-of-course:** publish grades; run end-survey; export key artefacts/gradebook; archive; team retro.

Cross-links

- **Blended organisation & scenarios** → Chapter 3
- **Assessment & rubrics** → Chapter 5 + Annex A
- **Practicals (EM-1…EM-8)** → Chapter 11
- **Resources & accessibility** → Chapter 10 + Annex C

Chapter 14: Programme evaluation & QA – centre playbook

Scope: This chapter is the **operational QA guide** for centres. It turns the evaluation model into **who-does-what-when**, the **minimum data to collect**, and **how to turn insights into changes** for the next cohort. (Learner assessment = Chapter 5; evaluation tools = Annex B.)

Trainer Reflection Template Overview

To ensure quality and consistency, each trainer completes a short reflection after every delivery period:

Trainer Reflection – Key Questions:

1. What worked particularly well in this cohort?
2. Which activities or tools should be improved?
3. Were the learning outcomes fully achieved?
4. What additional support or materials would help future cohorts?

Trainer Tip: This reflection is not just administrative — it's a chance to document good practice and share innovations with other trainers.

14.1 What "good QA" looks like (in one page)

- **Few signals, collected often** (weekly pulse; end-survey; 3-month follow-up).
- **Small, concrete actions** per cohort (one improvement beats ten ideas).
- **Shared visibility** (1-page Evaluation Brief; Action Log with owners/dates).
- **Accessibility always in scope** (caption/alt-text/contrast checks each run).
- **Moderation & observation baked in** (sample artefacts; one peer visit).

14.2 Instruments & timing (centre view)

Table 14.2 – What to collect and when

Instrument	When	Owner	Purpose	Tool (Annex)
Weekly Pulse (short)	Weekly	Trainer	Catch pace/access issues early	**B1**

End-of-Course Survey	Final week	Trainer	L1 reaction; L2 self-reported learning	**B2**
3-Month Follow-Up	+12 weeks	QA Lead	L3 transfer; L4 early impact	**B3**
Evaluation Brief	After marking	QA Lead	Share key findings & actions	**B4**
Action Log	Rolling	Trainer/QA	Track owners & deadlines	**B5**

Tip: Run the end-survey **in class** during the last live session: 5 minutes, phones allowed.

14.3 Roles & data flow (who does what)

Table 14.3 – Data flow

Step	**Description**	**Evidence**	**Owner**
Plan	Set dates; assign roles	QA calendar	QA Lead
Collect	Pulse, end-survey, follow-up	Raw responses	Trainer / QA
Aggregate	Clean & compile	Summary tables	QA Lead
Analyse	3–5 key findings	Brief bullets	QA + Trainer
Act	Agree actions; set owners/dates	**Action Log**	Trainer / Centre
Share	1-page brief to staff/partners	**Evaluation Brief**	QA Lead

14.4 KPIs to watch (dashboard seeds)

Table 14.4 – Suggested KPIs

KPI	**Target / Range**	**Source**
Readiness rate before lab (S2)	≥ 85% (M1 + M4 done)	Platform analytics
First-print success (S2)	≥ 70%	Lab observation checklist
Capstone on-time (S3)	≥ 85%	Gradebook / trainer log
End-survey satisfaction (L1)	≥ 4.2/5	B2
3-month application (L3)	≥ 70% “applied”	B3

Inclusion (pace & access)	≥ 4/5	Pulse (B1)

Keep it to **5–6 KPIs**. If everything is a priority, nothing is.

14.5 Peer observation & moderation schedule

- **Peer observation (1 per cohort):** a colleague attends one lab or reviews the blend; records 2 strengths + 2 improvements.
- **Assessment moderation (sample ≥ 15% or ≥ 3 artefacts):** second marker uses the rubric; record agreements/variations in **Annex A7**.

Table 14.5 – Small QA calendar

Week	QA action	Owner
1	Pulse starts; accessibility spot-check of course pages	Trainer / QA
2–3	Peer observation (lab or live)	Peer / Trainer
4	KPI check-in; small adjustment if needed	Trainer
Final	End-survey in class	Trainer
+2 wks	Evaluation Brief; Action Log updated	QA Lead
+12 wks	3-month follow-up; update KPIs	QA Lead

14.6 Accessibility & inclusion checks (minimum standard)

Use Chapter 10's checklist; sample at least **5** items each run.

Quick items:

- Captions/transcripts on video; alt-text on images; WCAG-AA contrast.
- Large-print handouts available; keyboard access on interactive resources.
- Low-gear/high-gear variants published for all EMs used.

14.7 Reporting templates (paste-ready headings)

Use **Annex B4**. Recommended headings:

1. Cohort & dates
2. Participation & response rates

3. L1 Reaction – key quotes & scores
4. L2 Learning – notable gains (aggregate)
5. L3 Behaviour – early transfer signals
6. L4 Results – if available
7. **Recommendations** (max 5 bullets)
8. **Action Log** link (Annex B5)

14.8 Risks & mitigations (centre QA)

Table 14.8 – Top QA risks

Risk	Early signal	Mitigation
Low survey response	< 40% end-survey	Run in class; QR link; 5-min timebox
Data stuck in silos	Files on personal drives	Shared drive; named QA Lead; versioning
No follow-through	Actions drift across cohorts	Owners + due dates + statuses in Action Log
Accessibility gap	Complaints; low engagement	Apply Ch.10 checklist; alternatives on day 1
Moderation skipped	Appeals; grade variance	Schedule A7 at start; sample small & consistently

14.9 Ethics, privacy & retention (GDPR)

- **Anonymise** responses; share only aggregates.
- **Inform** learners where data goes and for how long.
- **Retain** only per policy; purge after the cycle.
- **Limit access** to QA Lead and course owners; no broad sharing of raw data.

14.10 The “one improvement” rule

Close each Evaluation Brief with **one** change for the next cohort (e.g., “Gate S2 labs with M1+M4 completion; replace ‘bed levelling’ slide with 2-minute demo video”). Simplicity scales.

Cross-links

- **Instruments & templates** → **Annex B** (B1–B6).
- **Rubrics & moderation** → **Chapter 5** + **Annex A7**.
- **Accessibility** → **Chapter 10**.
- **Platform signals** → **Chapter 13**.

Chapter 15: Online platform – concise operations guide

Scope: This chapter provides the baseline setup all cohorts must meet. Use it with **Chapter 3** (blend & cadence), **Chapter 5** (assessment), **Chapter 11** (practicals), and **Annexes** (templates).

15.1 Minimum course skeleton (do this first)

- **Course Home:** “Start here” page; welcome note; office hours; help channel.
- **Modules:** W01–W08 naming (or weeks used locally); release dates; prerequisites where useful.
- **Assignments:** brief + **rubric** attached (see Ch.5/Annex A); visible due dates; instructions include required **artefacts** (e.g., STL + slicer profile).
- **Files & naming:** clean foldering; versioned assets; format YYMMDD_title.
- **Readiness gates:** publish a **mini-quiz + micro-task** (upload) **48–72h** before each lab.

Trainer Tip: If a learner misses the readiness gate, give a short **catch-up micro-task**, not an ad-hoc reteach during lab.

15.2 Roles & permissions (at a glance)

Role	Create/Edit Content	Grade/Moderate	View Analytics	Notes
Institution Admin	Yes	Yes	All cohorts	Accounts/SSO; policy; backups
Course Owner (Trainer)	Yes	Yes	Own cohort	Schedules; rubrics; deadlines
Teaching Assistant	Limited	As delegated	Own cohort (limited)	Marking support; feedback
Learner	Own submissions	—	Own progress	Follows flow; uploads artefacts

15.3 Assignments & rubrics (baseline setup)

Type	Use	Key settings
File upload	CAD/STL; slicer profiles; inspection briefs	1–2 attempts; lateness policy; rubric + inline feedback
Text entry	Reflections; WWW/EBI; design logs	Single attempt; short prompts; rubric
Group submission	Team artefact + peer review	Assign to groups; peer-review window; one spokesperson

- Rubrics: use the **analytic** format from **Chapter 5 / Annex A**.
- EMs (Ch.11): specify **one non-negotiable upload** (e.g., first-layer photo or profile) to keep evidence consistent.

15.4 Quizzes (lightweight integrity)

Setting	Recommendation
Question banks	Pool by LO; draw random subsets
Randomisation	Shuffle questions/answers where feasible
Feedback	Show answers after due date; brief item notes
Attempts	2 formative; 1 summative

15.5 Communication & collaboration

- **Announcements:** weekly digest linking current tasks and deadlines.
- **Discussion boards:** Q&A threads; pin “netiquette”; acknowledge helpful replies.
- **Groups & peer review:** auto-allocate teams of **3–5**; structured peer rubric; close with a **short team retro**.

15.6 Analytics → actions (early-warning mini-matrix)

Signal	Trigger	Action
Low logins	No login ≥ 7 days	Message learner; check access; assign catch-up micro-task
Late work	≥ 2 late items	Discuss workload; adjust plan; signpost support
Weak LO topic	Avg < 60% on LO bank	Recap micro-lesson; revise bank; set quick remedial task

Use “**Message students who…**” to target nudges precisely.

5.7 Accessibility & GDPR (minimum standard)

- **Captions/transcripts** for all videos; **meaningful alt-text** for images.
- **Readable typography** (≥ **11 pt**) and **WCAG-AA** contrast on visuals.
- **Keyboard access** on interactive resources; avoid colour-only signalling.
- **Data minimisation:** collect only what you need; publish retention policy; obtain consent where required.

15.8 Troubleshooting (quick fixes)

Issue	Quick fix
File won't upload	Check filetype/size; compress; retry wired; log a ticket if persists
Video won't play	Try another browser; provide download link; report blocked domain
Marks hidden	Unmute column/posting policy; republish feedback

15.9 Operational checkpoints

- **Start-of-course:** copy template; set dates/time-zone; publish "Start here"; attach rubrics; create groups; test one submission.
- **Mid-course:** run a pulse survey; act on analytics; rebalance lab capacity (see Ch.3 cadence).
- **End-of-course:** publish marks; run end-survey; export key artefacts/gradebook; archive; team retro (update Action Log—Annex B).

Cross-links

- **Blended cadence & scenarios → Chapter 3**
- **Assessment & rubrics → Chapter 5 + Annex A**
- **Practicals (EM-1…EM-8) → Chapter 11**
- **Resources & accessibility → Chapter 10 + Annex C**
- **QA & evaluation → Chapter 14 + Annex B**

Annex A — Learner Assessment Tools

Use with Chapter 5 (Learner Assessment) and Chapter 11 (Exercise Modules). Duplicate pages per cohort and store in the course archive.

A0. How to use Annex A

- Align criteria with Chapter 6 learning outcomes.
- Select a rubric/grid appropriate to the delivery scenario (S1–S3).
- Use observation & safety checklists in practical sessions.
- Record moderation (A7) and maintain the grade sheet (A8).

A1. Generic Analytic Rubric (LO-based)

Criterion	Weight	Not Yet (1)	Pass (2)	Merit (3)	Distinction (4)	Evidence / Comments
Knowledge (theory)	10–20%	Major gaps; inaccurate	Meets basics	Sound & accurate	Insightful; extends beyond brief	
Practical skills	40–60%	Cannot perform safely/independently	Performs with guidance	Performs independently	Optimises; mentors peers	
Safety & compliance	Pass/Fail	Breaches; unsafe	Meets minimum	—	—	Checklist ref: A1.1 / A5
Documentation	10–20%	Sparse/unclear	Adequate & clear	Complete & traceable	Exemplary; reproducible	
Collaboration (if applicable)	0–20%	Low participation	Contributes	Proactive & reliable	Leads; resolves issues	

A1.1 Practical Safety Checklist (Quick)

Item	☐ Yes / ☐ No	Notes
PPE worn correctly (gloves, goggles, etc.)		
Work area prepared (ventilation, clear surfaces)		
Machine pre-checks (bed levelling / resin vat)		
Material handling safe (MSDS aware, waste bins ready)		
Emergency procedures briefed (stop, first aid, fire)		

A2. Scenario 1 — Assessment Grid (Onboarding Foundation, 100% online)

Aspect	Measure	Weight	Score	Comments
Quiz performance (avg.)	≥ 70% target	40%		
Concept application	Short tasks / reflections	30%		
Platform engagement	Completion & timeliness	20%		
Readiness check	Self-assessment checklist	10%		

A3. Scenario 2 — Assessment Grid (Sprint Learning with Practice)

Aspect	Measure	Weight	Score	Comments
Prototype quality	Print/scan/model output	35%		
Safety compliance	Checklist pass	Pass/Fail		
Design & process decisions	Justification in log	20%		
Teamwork & roles	Peer/teacher ratings	15%		
Presentation	3–5 min; clarity	10%		
Online prep	Module completion	20%		

A4. Scenario 3 — Capstone Rubric (Extended / Expert Track)

Criterion	Weight	1 – Developing	2 – Competent	3 – Proficient	4 – Exemplary	Evidence / Notes
Problem definition & scope	10%	Vague; misaligned	Clear basics	Well-scoped	Insightful; constraints explicit	
Technical execution	30%	Frequent errors	Meets spec	Robust, few errors	Optimised; validated	
Evidence & validation	20%	Little/no testing	Basic tests	Relevant tests; data	Comprehensive; triangulated	
DfAM / GD&T integration	15%	Minimal	Applied where needed	Consistent application	Advanced, justified	
Project management	10%	Late/chaotic	On time; basic plan	Tracked milestones	Risk-aware; adaptive	
Presentation & documentation	15%	Unclear	Clear & complete	Professional	Publishable quality	

A5. Observation Record — Practical Session

Learner	Date	Task/EM	Observed behaviours (tick): safety ☐ / independence ☐ / teamwork ☐ / problem-solving ☐	Incidents/Notes	Feedback given

A6. Feedback Form — WWW / EBI

Learner	Task/Module	Assessor	Date

What Went Well (WWW):

Even Better If (EBI):

Next steps & deadline:

A7. Second Marker & Moderation Record

Cohort/Group	Sample size	Agreement level	Variations found	Actions agreed	Sign-off (names/date)

A8. Grade Sheet (per cohort)

Student ID	Name	Scenario/EM	Knowledge (10)	Practical (40)	Safety (P/F)	Documentation (10)	Collab (10)	Total (100)	Grade	Comments

Annex B — Programme Evaluation Tools (QA)

Use with Chapter 14 (Programme Evaluation & QA). Keep instruments short, regular and actionable.

B0. How to use Annex B

- Collect weekly pulses during delivery; run end-of-course and 3-month follow-ups.
- Anonymise responses; store securely; aggregate by cohort and partner.
- Summarise each cycle in an Evaluation Brief (B4) and maintain an Action Log (B5).

B1. Weekly Pulse (Teacher Log + Micro-Survey)

Week	Cohort	Attendance %	Engagement (1–5)	Blockers noted	Support actions taken	Follow-up next week

Suggested learner micro-survey items (1–5 Likert):
• The pace this week was appropriate.
• I know what to do before the next session.
• I had access to the resources I needed.
• I felt included and able to participate.
Open question: One thing that would help me next week is: __________.

B2. End-of-Course Evaluation (Learner)

Area	Item	Rating (1–5)	Comments
Delivery & Teaching	Sessions were well structured and clear.		
Resources & Platform	Materials and platform supported my learning.		
Inclusivity & Access	I could participate fully and felt included.		
Learning Outcomes	I achieved the intended learning outcomes.		

Overall	I would recommend this course to others.		

Open questions:
1) Most valuable aspect:

2) What should we improve:

3) Any barriers you faced:

B3. 3-Month Follow-Up (Learner/Employer)

Respondent	**Item**	**Rating (1–5)**	**Comments**
Learner	I have applied skills from the programme.		
Learner	I had support to use new skills (tools/time).		
Employer/Supervisor	The learner's performance improved.		
Employer/Supervisor	Barriers to applying skills were addressed.		

B4. Evaluation Brief — Template

Section	**Notes**
Cohort & dates	
Participation & response rates	
Key findings — L1 Reaction	
Key findings — L2 Learning (aggregate)	
Key findings — L3 Behaviour (transfer)	
Key findings — L4 Results (if available)	
Recommendations	

B5. Evaluation Action Log

Finding/Issue	Action	Owner	Due date	Status	Evidence link
				Not started / In progress / Done	
				Not started / In progress / Done	
				Not started / In progress / Done	
				Not started / In progress / Done	
				Not started / In progress / Done	
				Not started / In progress / Done	
				Not started / In progress / Done	
				Not started / In progress / Done	
				Not started / In progress / Done	
				Not started / In	

				progress / Done	

B6. Data Flow & Roles

Step	Description	Owner	Tool/Store
Plan	Define instruments, timing, cohorts	QA Lead	Project drive
Collect	Administer weekly/end/follow-up surveys	Trainer / QA	Platform / Forms
Aggregate	Anonymise & compile datasets	QA Lead	Sheets / Data repo
Report	Draft Evaluation Brief; share highlights	QA Lead	PDF / Slides
Improve	Log actions; track completion	All partners	Action Log

Annex C — Extended Resource Library

Use with Chapter 10 (Curated Materials). Maintain this catalogue as a living register. Prefer open or institution-licensed resources; ensure accessibility standards.

C1. Resource Catalogue

Category	Title	URL	Publisher	Format	Level	Access/ Licence	Accessibility notes	Date added	Reviewer	QA status	Notes
Intro Modelling										Draft / Approved	
Slicing Guides										Draft / Approved	
Mesh Repair										Draft / Approved	
Printing Safety										Draft / Approved	
Scanning Workflows										Draft / Approved	
DfAM References										Draft / Approved	
Accessibility & Inclusion										Draft / Approved	

C2. Change Log (Annex C Maintenance)

Date	Change	By	Reason	Affected entries

C3. Curation Checklist (quick)

Criterion	☐ Yes / ☐ No	Notes
Directly supports module LO or scenario		
Clear, classroom-ready format		
Accessibility: captions / alt-text / contrast		
Level tag present (Beginner / Intermediate / Advanced)		
Licence verified (open / inst. access)		
Reviewed by subject lead		