Training for dimensional metrology in digital manufacturing

# Train4DiM

# Report: evaluation of learning success based on pilot courses

including guidelines on good practices related to evaluation of learning success

Co-funded by the Erasmus+ Programme of the European Union



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### Aim of the document

This document is a summary of lessons learned on the evaluation of learning success as resulting from the pilot courses held in 2023, using the learning materials developed by Train4DiM project partners.

In terms of project deliverable, this document benefits of assessment data and other information provided by the partners of the consortium.

# 1. Methodology

There is a large variety of assessment methods offered by the literature and by several international assessment practices in teaching and training contexts, and the discussion around this topic led to the preparation of the *Guidelines on good practices related to evaluation of learning success* that is available as a separate document.

Given the purposes of pilot courses, for the assessment of learning success it was decided to adopt Multiple choice questions (MCQs) because they allow to be more uniform and consistent in assessment, and independently from the specific background of learners and tutors in different context.

Therefore, a set of MCQs were systematically formulated and revised during the content development process, as an integral part of the project. Such questions were named "Examination questions" to clearly distinguish them from the "Comprehensions questions" that are available to learners inside the learning modules for self-assessment purposes.

After investigating different alternative options for the automation of the assessment tool, Moodle was selected for its wide availability, flexibility and expected lifetime. MCQs were there transferred to the learning platform maintained by CMTrain e.V. and implemented using standard Moodle tools. Lessons learned during this process are documented in a separate document named **Guide on Moodle Question bank** and will be systematically used also in future initiatives of CMTrain e.V. and partners.





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For uniformity in the assessment arrangements, the agreed process was documented in a separate document named *Guidelines for managing final exams* and will be systematically used also in future initiatives of CMTrain e.V. and partners.

# 2. Structure of pilot courses

Pilot courses were structured as follows:

- 1. Entry test available to all enrolled learners
- 2. Access to learning materials only available after completing the Entry test
- 3. Final feedback
- 4. Final test only available after completing the Final feedback form

Learning materials were presented in the following sequence of topics:

- a) Global masterplan
- b) Design

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- c) Manufacturing
- d) Verification

All such elements were identical among partners.

Due to the fact that timing of courses, background of students, level of students, as well as other elements were different (including tutors), for practical reasons it was decided to offer separate courses and related tests.

All courses were offered using the CMTrain e.V. platform.



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# 3. Summary of results

The following table is a summary of courses offered and includes main data, including the overall assessment in terms of average mark and its standard deviation, with reference to 100 scale (max number of assigned points is 100).

Partner	OST	PK	UNIPD	
Location	Buchs	Cracow	Padova	
Period	February-June 2023	May-June 2023	April-June 2023	
Level	Bachelor	Bachelor	Master	
Entry test			1	
Participants	20	31	33	
Mean value /100	75.0	50.9	57.9	
Standard deviation	11.6	14.3	16.3	
Final test			1	
Participants final test	8	31	28	
Mean value /100	83.0	71.1	77.5	
Standard deviation	9.4	17.1	11.6	
Comparative assessmen	it	1	1	
Increase of mean value /100	8	20.2	19.6	

#### Annexes

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Guidelines on good practices related to evaluation of learning success Guidelines on Moodle question bank Guidelines for managing final exams



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# Guidelines on good practices related to evaluation of learning success

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### Aim of the document

This document aims at offering practical guidance to trainers to assess and evaluate individual learning success. It focuses on tools appropriate to assess the extent to which learning outcomes have been achieved by participants.

In terms of project deliverable, this document benefits of all feedback and examples of methods provided by the partners of the consortium.

#### 1. Assessment methods for knowledge and competences

There is a large variety of assessment methods offered by the literature and by several international assessment practices in teaching and training contexts. The assessment tasks and tools vary a lot on the basis of the learning outcomes that learners are expected to achieve and that are to be assessed. It is advisable to design and plan assessment task when preparing the learning outcomes, so that leaners have a clear idea about what is expected from them and can better direct their efforts.

The most important goal is to choose a method which most effectively assesses these outcomes, namely shows how learners demonstrate the achievement of the stated outcomes.

On a general level, assignments to assess declarative knowledge (taxonomy action verbs: i.e. know, remember, recall, identify, combine...) can be, for examples, multiple choice and true/false questions, completions tests; assignment to assess more complex declarative knowledge (taxonomy action verbs: i.e. explain, discuss, compare...) can be essays, oral discussion/interview with structured questions (although also multiple choice questions, if well designed, can serve for this scope); assignments to assess procedural knowledge/skills (taxonomy action verbs: i.e. apply, solve, construct..) can be projects, case studies, problembased scenarios, simulations, plan development; assignments to assess more complex and abstract competences (taxonomy action verbs: i.e. apply, solve, construct..) can be for instance reflective essays.

Some useful guiding questions<sup>1</sup> while preparing assessment tasks can be:

- What are the outcomes to be assessed?
- Is the method of assessment chosen consistent with the outcomes and skills?
- Is the method relatively efficient in terms of student time and staff time?
- What alternatives are there? What are their advantages and disadvantages?
- Are the marking schemes or criteria appropriate?

<sup>&</sup>lt;sup>1</sup> Adapted from: https://www.ucd.ie/teaching/t4media/mcq\_design.pdf



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## 2. Assessment tools

In the following, a brief description of the tools adopted in the project is provided, including the identification of advantages and disadvantages.

#### 2.1 Multiple choice questions (MCQs)

MCQs are widely used in teaching and training for summative and formative assessment as they allow enormous coverage of topics. A multiple choice item consists of a problem and a list of suggested solutions/alternatives, one of which is correct or best alternative, which is the answer, and others incorrect or inferior, known as distractors<sup>2</sup>. This type of questions usually assesses low cognitive-level processes such as 'memorize', 'recognize', 'identify', 'match'. More complex structure of MCQs can also assess higher order skills, but this implies the construction of scenarios where the learner must apply knowledge and make a decision among different options.

#### Advantages and disadvantages

The major advantages are that MCQs offer high level of validity and reliability and can be administered to many participants at the same time, with easy process to mark and analyse results (especially if computer-based). They can be used as in class assessment activities, as short quizzes to collect participants' answers and therefore to get feedback on their understanding of concepts presented.

The major risk of MCQs is to assess knowledge only. More complex MCQs require more time to set and to validate.

#### 2.2 Case studies

A case study can be a very useful assessment task to seeing how learners can apply their knowledge and professional skills.

Cases can range from graphical representations that are commonly used in the practice of a discipline (e.g. a technical drawing of a mechanical part), through to complex plans and proposals which may require analysis and research, where learners are facing a situation and/or a problem and they are asked to sort it out.

#### Advantages and disadvantages

An important advantage offered by case studies is that they represent a real authentic task, with important connections to real-world situations, therefore potentially able to assess very complex skills. Case studies can be combined with other methods.

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<sup>&</sup>lt;sup>2</sup> <u>https://cft.vanderbilt.edu/guides-sub-pages/writing-good-multiple-choice-test-questions/</u>



The major challenge of using case studies is to create complex cases and, more specifically, to prepare comprehensive and clear assessment criteria. Often, cases can envisage different solutions (and this is also desirable, so learners can show how to reach a solution).

#### 2.3 In-tray exercises

In-tray exercises are a role play which requires learners to simulate their behaviour in a given work situation. The main aim is to create the conditions in which learners can perform in a realistic scenario and therefore to assess the abilities and competences put in place in the challenging situation. The level of authenticity of this method is very high because it simulates a real situation, such as a discussion among persons having different responsibilities in the design, manufacturing and verification of a workpiece.

The learner is given with a large number of items and background information about the role and the expected performance and he/she has to analyse the elements, define priorities, find resources, interact with people, solve problems, etc.

The way of assessing the performance can vary from multiple choice format, in which the person indicates how he/she decides to deal with the situation among different alternatives, and/or an oral discussion to present and justify solutions. Often in-tray exercised are proposed in a digital environment, using email correspondence or simulators.

#### Advantages and disadvantages

An advantage of using in-tray exercises is that they offer a chance to assess a complex set of competences learners are expected to achieve.

The major challenge is the preparation, which requires time to set a "real" scenario with all threats and opportunities the learners will analyse.

### 3. Final suggestions

The choice of assessment methods depends on learning outcomes to be measured.

The combination of different methods allows to assess learning outcomes implying different cognitive processes.

A possible effective assessment strategy for courses dealing with design, manufacturing and verification in a digital manufacturing context can be to use, for instance, a combination of the following two strategies:

• To assess declarative knowledge through multiple choice questions and/or short answer questions, in order to assure that participants have acquired basic factual knowledge that is fundamental for the purpose of the training programme.

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• To assess skills and competences through the use of authentic tasks such as case studies and in-tray exercises in order to verify the ability to analyse, solve and manage real situations.

Authors: this guide has been developed based on an analysis conducted by Anna Serbati and Enrico Savio (University of Padova), supported by partners.

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# Guidelines on Moodle Question bank

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# Introduction

This guide describes how to use the Moodle question bank (Moodle version 4.3+) to create, organise, use and manage questions.

# **Moodle Question bank**

The Question bank allows an author to create, preview and edit questions in a database and use them in the Quiz activity.

The following figure shows the Question bank of the Train4DiM Pilot Courses.

	Train4D		course	2						
	Course Setti	ngs Participar	nts Grades	Reports More						
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uestion bank										
All \$ of the following:										
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🗸 🕂 10128 Q 1 🖋 💶 🚯 🕢 🗘 Edit 🗸	Draft ¢	v1	Christoph Battaglia 12 April 2023, 12:58 PM	0		N/A	N/A	0	Never	Christoph Battaglia 12 April 202: 12:58 PM

Question bank of the Train4DiM Pilot Courses

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# **Creating Questions - Alternative 1**

For creating new questions you use the «create a new question» button which is greyed out above the question list. Then choose the question type you would like to use and add it. Now it's up to the author to fill in the question.

# **Creating Questions - Alternative 2**

You can also import questions. For multiple choice questions you can use the Aiken format. To do so use a text editor and format the questions as follows, save the questions as a text file and import into Moodle Question bank.

```
What is the capital of Switzerland?
A) Zurich
B) Bern
C) Geneva
D) Buchs
ANSWER: B
Which are the four national languages of Switzerland?
A) German, Italian, French, Rhaeto-Romanic
B) German, Italian, French, English
C) German, French, English, Rhaeto-Romanic
D) There are only three: German, Italian, French
ANSWER: A
```

Two example questions which can be imported directly into Moodle in this format.

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	Course	Settings	Participants	Grades	Reports	More ~	_		
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Moodle Question bank - Import function

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# **Organizing Questions**

In order not to lose the overview and to be able to use the questions efficiently afterwards, we use tags. You can enter tags while entering the question or afterwards. We use the following structure for tags:

Торіс	Тад	Meaning
Learning Aim Number	10005	Number 10005
Language	EN	English
	DE	German
	«Two-letter codes according to ISO 639-1»	Any language
Target Group	Ар	Apprenticeship
	Ва	Bachelor
	Ма	Master
	«no tag»	Any Target Group
Area	D	Design
	М	Manufacturing
	V	Verification
Question Type	Q	Comprehension question
	EQ	Examination question

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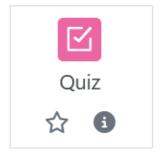
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# **Using Questions**

Questions are used in a quiz. This quiz can be used for comprehension questions as well as for examination questions. To add such a quiz to a course, select «Add activity» at the desired point in the course and select Quiz.



Moodle Activity «Quiz»

Once the quiz has been created, it must be set up via Edit settings...



### Quiz Edit Settings

...or directly in the tab Questions.



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	Train4	DiM   Pilot Course / Example Quiz / Questions QUIZ Example Quiz							
	Quiz	Settings	Questions	Results	Question bank	More ~			
Questions: 0   This questi							Ν	Maximum grade 10.00 Save Total of marks: 0.00	
Ø								🗌 Shuffle 🝞	
								<ul> <li>+ a new question</li> <li>+ from question bank</li> <li>+ a random question</li> </ul>	

Add questions to the quiz using the from question bank option

# **Managing questions**

During the development of questions and during the review process, the status of the question can be set to **Draft**. This prevents questions that have not yet been released from being used in a quiz. As soon as a question has been released, the status can be set to **Ready**. This is particularly important when using random questions from a pool.

□ <b>\$</b> ` T	Question 🌣 ~ Question name / ID number	Actions 🌣 🗸	Status 🌣 🗸	Version 🌣 🗸	Created by Created by First name / Last name / Date	Comments 🌻 🗸	Needs checking? ? *	Facility index 💿 🌣 ~	Discriminative efficiency 👔 🔅 ~	Usage 😮 ✿∨	Last used ⑦ ✿Υ	Modified by V First name / Last name / Date
•	10128 Q 1 🖋 🚺 😰 😯	Edit 🛩	Draft ¢ Ready Draft	v1	Christoph Battaglia 12 April 2023, 12:58 PM	0		N/A	N/A	0	Never	Christoph Battaglia 12 April 2023, 12:58 PM

Setting the status of a question

The most important functions for handling questions can be accessed using the Edit menu.



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□   10128 Q 1 With selected ^	<ul> <li>10128 EN Q V</li> <li>Delete</li> <li>Edit question</li> <li>Duplicate</li> <li>Export as Moodl</li> <li>History</li> <li>Preview</li> <li>Manage tags</li> </ul>	Edit V	Draft 🗢		

Edit menu with important functions

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# Guidelines for managing final exams

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# Introduction

The Train4DiM consortium plans to use in future exams, using the CM Train structure, differs from traditional paper-based exams in terms of their physical settings and supervision arrangements, students are expected to observe an even stricter code of conduct while taking electronic examinations than paper-based examinations. This in-person exams must be held in a traditional classroom setting. These exams will cover material from both the online phase and in-person components of the course (workshops).

This document guide future course coordinators about the practical instructions for promoting the autonomous exams after bLearning courses in every actual partner's venues. Please be aware that students must keep absolute silence in the electronic examination rooms at all times, without communication between participants, as the examinations of other students may already be in progress.

The exams should be completed on computers equipped with a limited set of software and limited access to the internet (course Learning Management System (LMS) provided by CM Train). If possible installation of a control software.

### Preparation of the course exam

Teachers can set up a course-related skills assessment (exams or mid-course checks) that students must complete electronically during the training period and which are integrated into the training material. It's up to the teacher to determine the number of attempts allowed on the exam, the length of time the exam will be available on the electronic system, and how long students will take to complete the exam. Teachers/tutors are responsible for requesting CMTrain manager to create a specific electronic exam, in the assessment system within the used Learning Management System (Moodle or other), defining the number of questions from each topic.

### **Enrolling on exams**

The student will be informed of the time slot available for the electronic exam via email and the LMS in use. The system will show the student all available time slots depending on the available space for the exam, the exam period set by the teacher/tutor, your other bookings, and any special restrictions (rules informed by the tutor) set by the consortium of project partners or the teacher (such as enrolment periods, availability of special software or accessibility).

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Students are responsible for ensuring that they are eligible to take the examination as specified in the course syllabus. Tutors are required to mark students who are eligible to take the exam and inform the LMS manager to provide personal access to the exam, as well as the time window for achieving this exam process. If a student needs a different date to complete an exam due to any constraint, it will be a joint decision of the tutor and the course manager.

# **Starting Process by web browser**

Student should use the computers provided by entity organizer in the exam room to enroll in-person the electronic exam. It's the role of the project partner to provide all needed software to run the exam as well avoiding additional external searches of information.

Login to the LMS at start.cm-train.org or other place if CMTrain Association defined with the course provider.

Enter the Login with username and password used during training phase, that was supplied before the course starting.

### Inside the course page

Once logged into the course, the student will use the search function to find the correct exam if they are enrolled in more than one course, or they can paste the enrolment link that they have received from their tutor by e-mail into the address bar.

Students enroll for the selected exam. Attention: The present tutor must make sure that the student is enrolled in the correct exam!

# Exam preparation according to the tutor's indications

The course LMS manager should prepare a specific exam according to the tutor request sent at least one week before the exam date and following the guide for defining an electronic exam.

### Examination process and exam room access

Disclaimer

Students must complete the electronic examination under supervised conditions. Students must ensure in advance that they will be able to access the facilities at the designated time. Persons are only allowed in the examination room to complete an exam and must use their personal key card to enter the facilities (depending on the facilities). If the student does not have direct access to the facilities, they must arrange access arrangements in advance or obtain access by contacting the tutor/teacher.



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The student may start the examination at any time within the booked time slot. The time available for the exam begins to run from the start of the allotted time. The system will display the remaining time. At regular intervals, the system will automatically save the answers that have been typed or uploaded as attachments. The exam ends when students cancel it, submit their answers, or when the system automatically submits their answers at the end of their time slot.

Any files created by students outside the system will not be marked unless they are attached to their answers. Students will not be able to return to their answers after the exam has finished. User support is not available during electronic examinations (please inform students).

### Exam attempts and enrollment process

During the examination period, only one attempt can be offered. Students will only register for exams in the exam LMS. Any exceptions will be dealt with by the Course Manager and tutor.

### Exam duration

Since each course could have different topics and number of contents, the time limit for the examination will be set by the tutor and the Course Manager. The information is communicated to students on the first day of the course. If any changes in this issue, students must be informed of any changes at least one week before the exam.

### Get out of the exam room during the exam

Leaving the examination room during the examination is not permitted. If a student needs special arrangements, he/she must contact the Course Manager.

### **Room supervision**

Students take electronic exams under supervised conditions, which may include real-time and recorded monitoring of computer sessions, access control and spot checks. These records may be combined to verify the identity of a person taking an examination and to investigate any suspected misconduct. Any disruption or suspected misconduct can be monitored in real time. If necessary, access records may be checked against bookings held in the examination system. Students must present valid ID upon request during and after an electronic exam.

If any student is unable to present a valid ID, the staff will take a photo of the student. Answers will not be marked until your identity has been confirmed. All students must sign an attendance sheet provided before the exams start.

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# **Misconduct and disturbances**

Any student who is guilty of academic misconduct during an examination will be subject to failure of the examination. Tutor decision.

Students who leave the examination room in the middle of an examination, without the tutor's permission, will fail the examination.

Students who are disruptive in the exam room may be asked to leave.

If the exam session is interrupted, or prevented due to technical failure, disturbance in the examination room, fire alarm, or other similar reasons, the Tutor and Course Manager should make arrangements for time compensation. Students can either retake the interrupted exam or submit the answers they saved before the interruption. The Course manager will be informed of the incident and may take the interruption into account when marking their answers.

#### Marking of electronic examinations

Tutors are expected to evaluate students' exams (open and closed questions) and store the results in the LMS records no later than 15 days after students have submitted or should have submitted the exam.

The completion date of an electronic exam, which appears in the student's LMS profile, is the date on which the exam or assignment is completed in the exam room. A notification by email to students about final results, should be sent, as soon the process is completed.

### Accessibility

In order to take an electronic examination, students may request special arrangements (according to the law). Any special arrangements must be agreed by emailing the tutor and/or course manager at least seven days before the examination.

Adjustable desks should be available in electronic examination rooms. Alternatively, students may take electronic examinations (in the presence of course staff) in an accessible examination room at the project partner's facilities.

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