

Training for dimensional metrology in digital manufacturing

Train4DiM

Report: Train the Trainer concept

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Introduction

This report describes the concept that has been developed for a Train the Trainer Course. And it describes the implementation in the Train the Trainer Pilot course at the project partner CATIM in Porto/Portugal in March 2023.

The Train the Trainer concept also includes the implementation of an officially offered CMTrain course which lasts several weeks. In the pilot course, therefore, a time-optimised Train the Trainer course was conducted.

The developed concept could be successfully implemented and all nine participants successfully obtained the Certificate.

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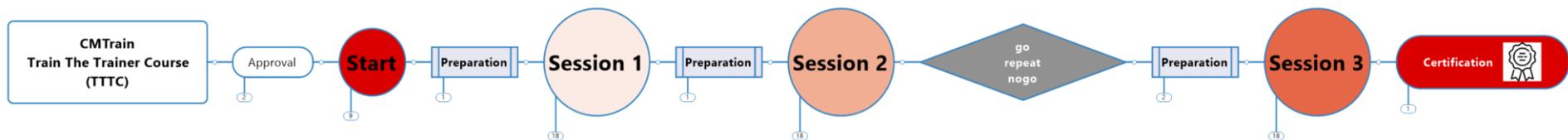
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Train the Trainer - Concept

The core of the training concept consists of three sessions. These three sessions differ mainly in the type of participants, the duration and the scope. Furthermore, there is a launch event at the beginning and the certification at the end. The following figure shows the sequence of a Train the Trainer course.



In the following, we will go into more detail about the start event and the three sessions.

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Train the Trainer - Start

As admission to the start event, a written **approval examination** and an **intake interview** are conducted. The written exam focuses on technical topics. In the interview, motivation and experiences are clarified and the result of the written exam is discussed.

In the start event the Train the Trainer **course schedule** is presented in detail to the future CMTrain Tutor and the **evaluation criteria** for the Train the Trainer certification will be announced. At the point **CMTrain Course Box**, all available materials are discussed. This includes on the one hand material provided by CMTrain and on the other hand material that has to be organised and provided by the corporate member (the organisation to which the future tutor belongs). The Train the Trainer **course structure** will be discussed and the respective preparation for the three sessions will be addressed.

Further, the CMTrain **workshop scripts** will be presented and discussed. Finally, access to the CMTrain **learning platform** is shown and how to use it is explained.

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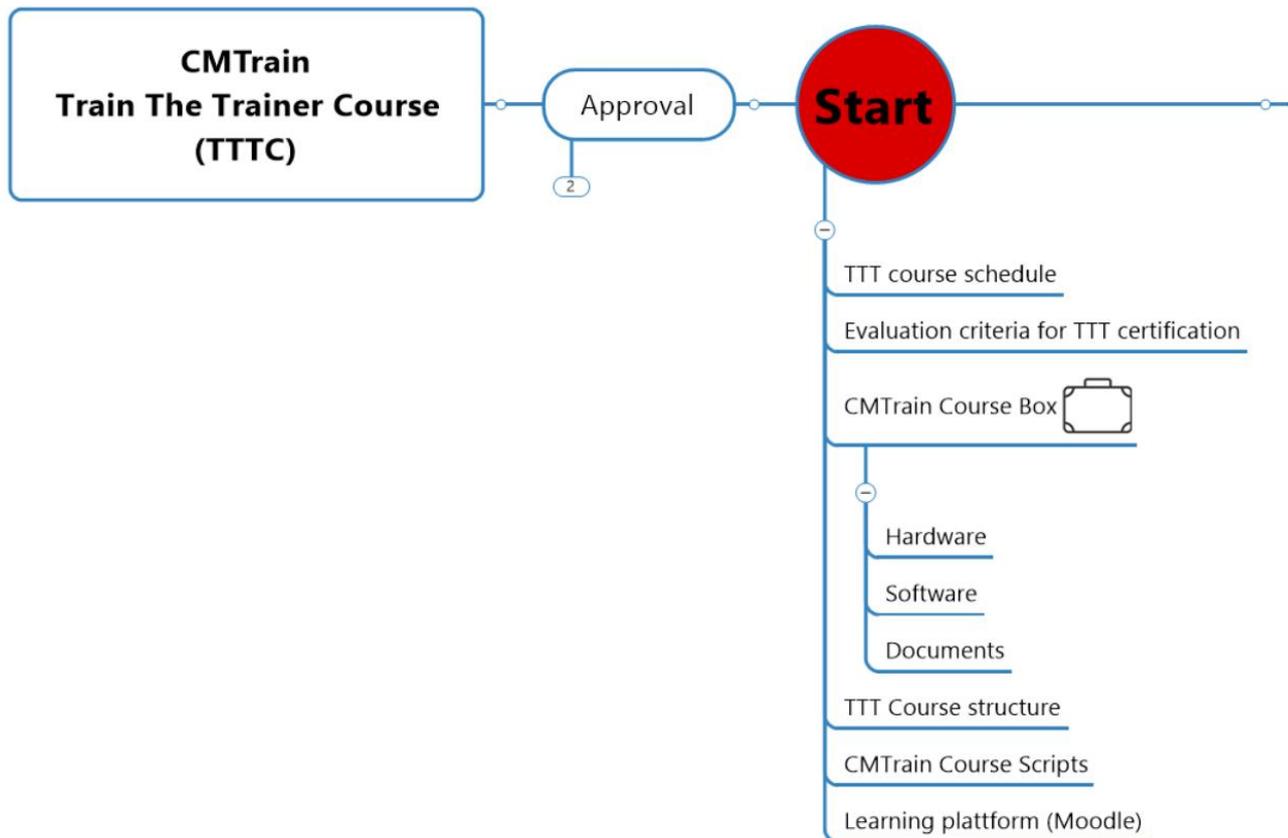


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Train the Trainer - Session 1

The participant gets enough time to prepare for session 1. The idea behind Session 1 is that the participant has to perform excerpts from the different CMTrain Workshops (Start, Intermediate and Final) and the eLearning phase. The CMTrain expert will play the role of the participant. The CMTrain expert behaves like an **«easy» participant**. This means that the CMTrain expert asks simple questions, has a positive attitude and is cooperative.

The participant has to do a self-assessment at the end of session 1 and the expert also does an assessment. The criteria for the two assessments are shown in the figure below.

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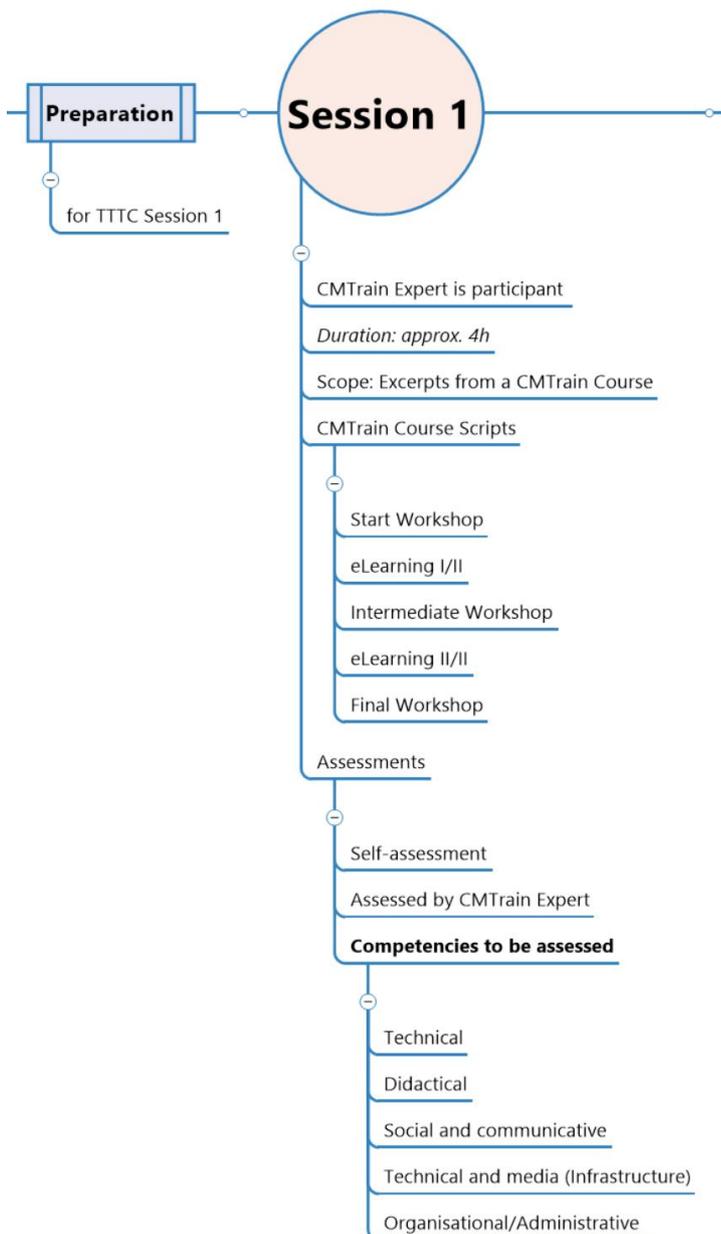


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Train the Trainer - Session 2

Session 2 follows the same pattern as Session 1 with the difference that the CMTrain Expert behaves like an «**difficult**» participant. This means that the CMTrain expert asks difficult questions, has a rather negative attitude and is sometimes uncooperative.



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Train the Trainer - Session 3

After the completion of Session 2 there will be an «go», «repeat», «nogo» decision. This means that assessments of both sessions are evaluated and an assessment is made regarding the suitability of the participant as a CMTrain Tutor. This should provide an opportunity for both sides to have an exit point.

After passing this go/nogo check the future CMTrain Tutor will be actively supported by the CMTrain Expert in the preparation of session 3.

In contrast to Session 1 and Session 2, real people will be the participants in Session 3. This means that the Train the Trainer course participant will run an officially offered CMTrain course and the CMTrain expert will accompany, support and evaluate the participant. The CMTrain expert will provide feedback after each course step during the course.

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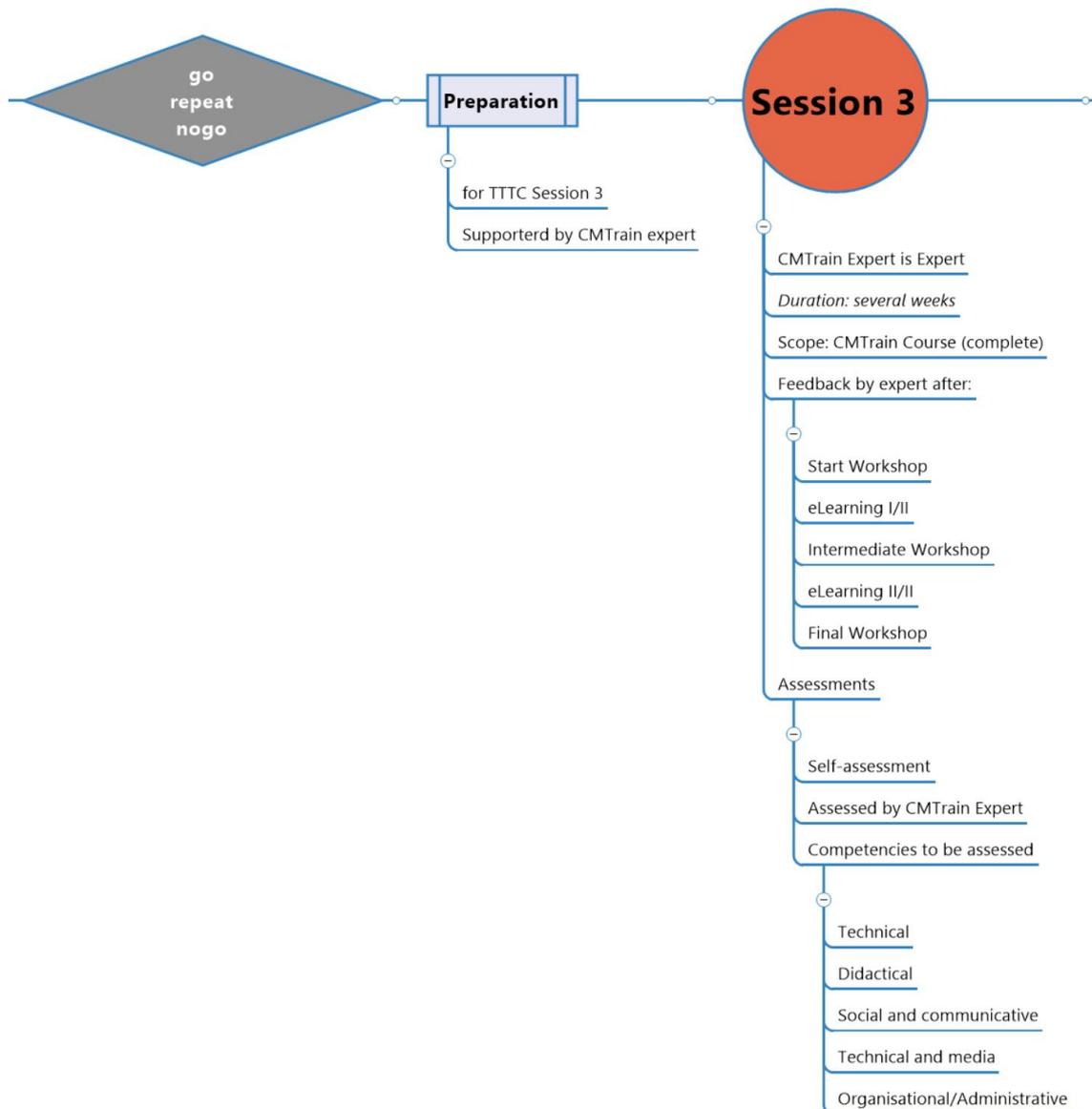


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Pilot course

In the pilot course, exemplary exercises from the different steps of a course were carried out. Someone took on the role of a participant in the Train the Trainer course, which means he acted as a tutor in this pilot course. The other participants from the pilot course took on the role of an easy and difficult participant. The roles were then swapped for a new exercise.

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Participants

| | |
|---------|---|
| CUT | Adam Gąska, Wiktor Harmatys |
| OST | Mario Cerniato |
| CMTrain | Christoph Battaglia |
| UniPD | Enrico Savio |
| CATIM | Luís Rocha, Hélder Guerra, Fernando Ferreira, Zeferino Osório |

Impressions



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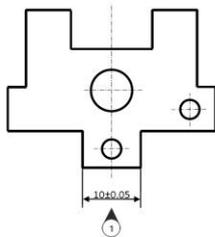
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Start Workshop - Exercise

Basic principle of coordinate measuring technology

You have the task to measure feature (1) on the following workpiece. You decide to use a tactile coordinate measuring machine. Please discuss the following questions in your learning group.

- Using the example of feature (1), explain the basic principle of coordinate measuring technology.
- What is the procedure to decide whether feature (1) is OK or not.

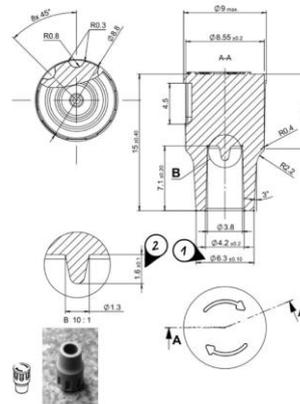


Rubber cap

In Section 2 - Measuring sequence - you learned about the "Measurement procedure in coordinate metrology". Discuss the following points in your learning group.

- Do you understand the same thing under the individual steps?
- What could be assigned to the individual steps?
- Are the 10 steps also found in your company, in your work?
- Do you have to deal with all 10 steps?
- Which ones do you have more to do with and which ones do you have less to do with?

Try to apply the 10 steps to the following workpiece. For each of the 10 steps, write down what you would consider for the feature (1) and feature (2) of the following workpiece.



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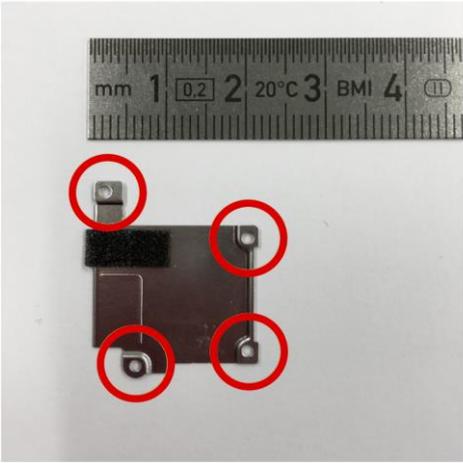
eLearning phases - Exercise

Training for Coordinate Metrology 

Sheet metal part

For fastening the sheet metal part (steel, thickness 0.13 mm +/- 0.02 mm) it is necessary that the four lugs are "of the same height" to avoid distortion. A deviation from this described, theoretically exact position of 0.07 mm is just permissible.

- How would you advise your colleague from the design department to specify the workpiece?
- How would you check this feature on the equipment you have available in the measurement room?
- How would you fixture the workpiece?



CMTrain 1 | eLearning | Exercise

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Intermediate Workshop - Exercise

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Exercise Pairing I/II

Which one of the three shafts fits into the hole?

 Attention - You are only allowed to measure - it is not allowed to try! 



Workpieces



Measuring equipment

CMTrain 1 | Intermediate Workshop | Exercise

Training for Coordinate Metrology 

Exercise Pairing II/II

a) Which of the three shafts fits into the hole?
b) How do you evaluate the result?
c) What other measuring possibilities are there?
d) If possible, implement them...

 Now it's time to try! 



Workpieces

CMTrain 1 | Intermediate Workshop | Exercise



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Qualification process

For the qualification process of a tutor, an evaluation form was developed. In order to pass the Train the Trainer training, in addition to passing the written approval examination, the assessment of Session 3 must have a score greater than 0 in each of the five subject blocks of the following evaluation form.

**Training for dimensional metrology
in digital manufacturing**

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Evaluation form

| Referee | Expert | Theme | Date | Time |
|---------|--------|-------|------|------|
| | | | | |

Rating and Threshold

"-" = -2 points "-" = -1 point "0" = 0 point "+" = +1 point "2" = +2 points

The participant must have a score greater than 0 in each of the five subject blocks in order to pass.

1) Didactical

| Concepts and Methods | -- | - | 0 | + | ++ | Feedback |
|--|----|---|---|---|----|----------|
| Knows and uses concepts to support the self-competence of the participants (appreciation; atmosphere of mutual trust; reliability, respect). | | | | | | |
| Structure, process, execution of the presentation | | | | | | |
| Are the objectives/achievement of objectives realistic? | | | | | | |
| Relevance (significant, important) | | | | | | |
| Presentation | -- | - | 0 | + | ++ | Feedback |
| Preparation / Set up | | | | | | |
| Welcome / End of session | | | | | | |
| Movement / Dynamic | | | | | | |
| Enthusiasm / Engagement / Passion | | | | | | |
| Timelines met? | | | | | | |

2) Technical

| Technical | -- | - | 0 | + | ++ | Feedback |
|------------------------------------|----|---|---|---|----|----------|
| Topic identification and -handling | | | | | | |
| Technically correct | | | | | | |
| fitting examples | | | | | | |
| Quantity suitable | | | | | | |

3) Social and Communicative

| Verbal communication | -- | - | 0 | + | ++ | Feedback |
|---|----|---|---|---|----|----------|
| Speech flow | | | | | | |
| Modulation of speech (tempo, voice, volume) | | | | | | |
| Rhetorical tricks and gimmicks | | | | | | |
| Formulations appropriate to the target group | | | | | | |
| Sentence length, breaks | | | | | | |
| Nonverbal communication | -- | - | 0 | + | ++ | Feedback |
| Body posture | | | | | | |
| Body language | | | | | | |
| Eye contact | | | | | | |
| Interaction with participants | -- | - | 0 | + | ++ | Feedback |
| Does it respond to questions? | | | | | | |
| Let's the participants join in? | | | | | | |
| Encourages participants to join in. | | | | | | |
| Dealing with difficult situations. | | | | | | |
| Spontaneity (e.g. in case of unforeseen situations) | | | | | | |

4) Technical and media

| Media | -- | - | 0 | + | ++ | Feedback |
|---|----|---|---|---|----|----------|
| Typeface legible / appropriate (type, size, colour) | | | | | | |
| Outline / structure of the use of the media | | | | | | |
| Use of design elements (red thread recognisable) | | | | | | |
| Goal-supporting visualisation | | | | | | |
| Use of media (whiteboard, beamer etc.) | | | | | | |
| Media suitable for topic | | | | | | |
| Creative use of media | | | | | | |
| Safe handling | | | | | | |
| Switching between the media | | | | | | |

5) Organisational / Administrative

| Organisational / Administrative | -- | - | 0 | + | ++ | Feedback |
|--|----|---|---|---|----|----------|
| Knows the process and can answer questions about it? | | | | | | |
| Preliminary work clear? | | | | | | |
| Further procedure clear? | | | | | | |



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Certification



After successful completion of the qualification process, the participant receives the certification in the form of the following certificate.



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Recertification

If a CMTrain tutor wants to run a CMTrain course 36 months after successful certification, he should do a recertification beforehand. The recertification process is defined individually. For this purpose, the tutor contacts CMTrain and a plan for the recertification is worked out together.

The basic idea for the recertification process is that the tutor to be certified takes over a part of an ongoing course at another corporate member and will be assessed in the process.

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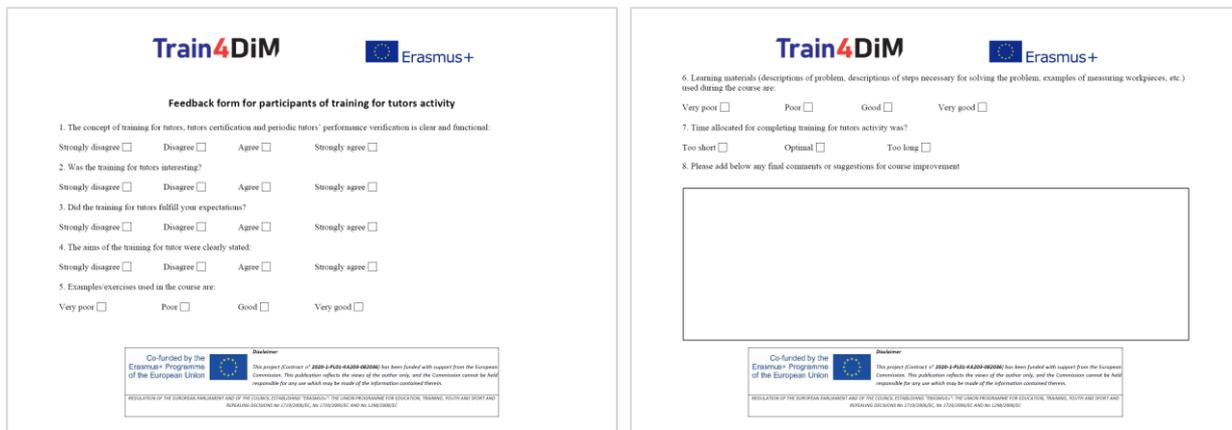
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Feedback form

Feedback from the tutor training participants was obtained using the following form.



Feedback evaluation

A total of five feedback forms from the tutor training participants were received. The evaluation shows a very pleasing result with positive ratings throughout.

| Question number | Question | Strongly disagree [1] | Disagree [2] | Agree [3] | Strongly agree [4] | Mean Value | Standard deviation |
|-----------------|--|-----------------------|---------------|--------------|--------------------|------------|--------------------|
| 1 | The concept of training for tutors, tutors certification and periodic tutors' performance verification is clear and functional: | | | xxxx | x | 3.2 | 0.4 |
| 2 | Was the training for tutors interesting? | | | | xxxxx | 4.0 | 0.0 |
| 3 | Did the training for tutors fulfill your expectations? | | | xxx | xx | 3.4 | 0.5 |
| 4 | The aims of the training for tutor were clearly stated: | | | xxxx | x | 3.2 | 0.4 |
| | | Very poor [1] | Poor [2] | Good [3] | Very good [4] | | |
| 5 | Examples/exercises used in the course are: | | | x | xxxx | 3.8 | 0.4 |
| 6 | Learning materials (descriptions of problem, descriptions of steps necessary for solving the problem, examples of measuring workpieces, etc.) used during the course are: | | | xx | xxx | 3.6 | 0.5 |
| | | Too short [1] | Optimal [2.5] | Too long [4] | | | |
| 7 | Time allocated for completing training for tutors activity was? | x | xxxx | | | 2.2 | 0.6 |
| 8 | Please add below any final comments or suggestions for course improvement: | | | | | | |
| | none | | | | | | |
| | -- | | | | | | |
| | <i>The proposed case studies are well serving the purpose of reflecting on the learner's experience. The hidden challenges of some measurements (e.g. rubber cap) are stimulating examples because may inspire other ideas for enriching the learning experience.</i> | | | | | | |
| | <i>The course is very well planned, it is workshop based (which is good, because it helps to develop necessary practical skills) but the participants also have some time to practice their theoretical skills and to prepare for the workshops. It was also very nice and involving to act as a student, as training participant may anticipate some behaviours of students during the real-life classes.</i> | | | | | | |
| | <i>Very varied material, many interesting illustrations and other forms of presenting the problem.</i> | | | | | | |



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