

**Training for dimensional metrology  
in digital manufacturing**

**Train4DiM**

**Pilot Approach Report**  
including the analysis of  
feedback from tutors  
and students

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## Introduction

In the pursuit of delivering high-quality training courses on Digital Manufacturing, the present project established a training model oriented for three training levels (apprenticeship, bachelor, and master). Four Pilot Courses were run in order to test learning content and applications for its management. In first part, this report presents general information on Pilot courses ran within the project.

But what is the most important, is that it is imperative for the project partner's, and other training technical players, to actively seek feedback from their students and teachers. These insights serve as a vital source of information for enhancing the learning experience and ensuring that courses are tailored to meet the needs and expectations of the students. Main part of this report aims to provide a comprehensive analysis of the feedback received from students, and tutors, who participated in several pilot courses, using the developed materials and training model, regarding their pilot course experiences and points of view.

The primary objective of this report is to shed light on the strengths and weaknesses of the training model offered and to identify some parts where improvements were made. By delving into the feedback provided by tutors and students, we gain valuable insights into what aspects of our training courses resonate with them, what challenges they encounter, and how the educational experience can be further optimized.

To accomplish, the present report will provide a comprehensive analysis of the feedback, crossing with the information of the course coordinators and managers, as well as insights derived from in-depth surveys and interviews with the students and tutors.

It is our hope that this document will serve as a valuable resource for teachers, curriculum developers, training content authors, and educational administrators in their ongoing efforts to provide the best possible learning experience for students and help teachers have a better approach. By taking this kind of feedback seriously and acting upon it, we can foster a culture of continuous course improvement and ensure that training programs remain at the forefront of quality education/qualification.

## Pilot Courses overview

There were four Pilot Courses ran within the project. All of them were implemented in CM Train Moodle platform and with use of developed learning material, platform for automated examination and its assessment, prepared base of examination questions and simple test generator (all integrated with Moodle platform). During the Pilot Course it was possible for students and tutors to send they feedback related to each learning module using feedback forms attached to learning modules. After Pilot Courses it was obligatory to send general

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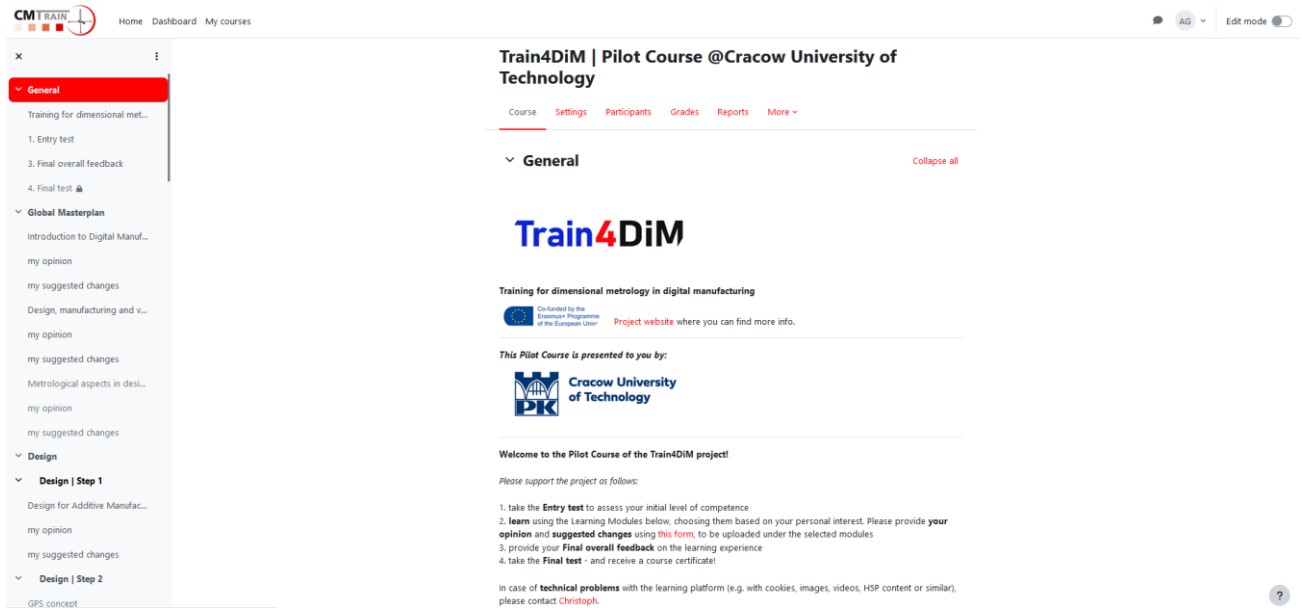


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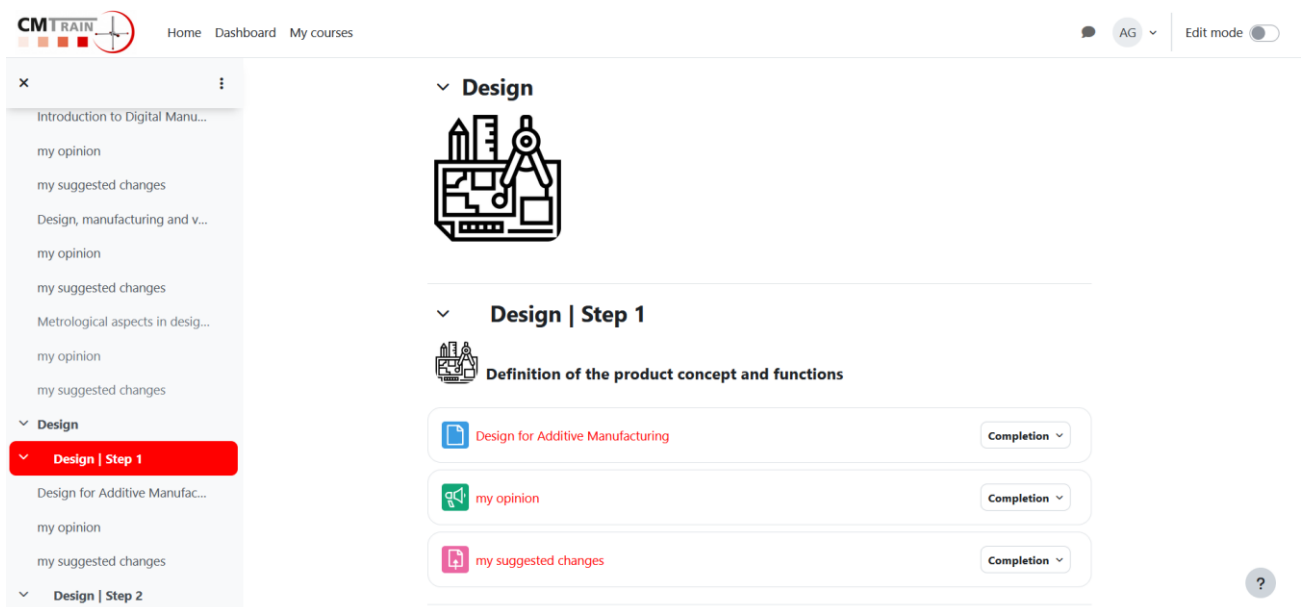
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feedback on course (as one of activities required for completing, before completing whole course).



The screenshot shows the Moodle course overview page. The course title is "Train4DiM | Pilot Course @Cracow University of Technology". The course is categorized under "General". The main content area includes the course logo, the title "Training for dimensional metrology in digital manufacturing", and a list of activities: "1. Entry test", "3. Final overall feedback", and "4. Final test". The page also features a welcome message and a list of instructions for students to support the project.

*General overview of Pilot Course in CM Train Moodle platform with introductory instructions for students*



The screenshot shows the Moodle course overview page for the "Design | Step 1" module. The module title is "Definition of the product concept and functions". The page displays three activities: "Design for Additive Manufacturing", "my opinion", and "my suggested changes". Each activity has a "Completion" dropdown menu. The page also features a welcome message and a list of instructions for students to support the project.

*Appearance of learning module in CM Train Moodle platform with possibility to send the feedback and suggest changes*

Below, general information on each Pilot Course is given:

### ***Pilot Course in Italy***

Organizer - University of Padova, Department of Industrial Engineering, Padova, Italy

Duration - April to June 2023

Number of Participants - 28

Profile of Participants - Master degree students

### ***Pilot Course in Poland***

Organizer - Cracow University of Technology, Faculty of Mechanical Engineering, Cracow, Poland

Duration - April to June 2023

Number of Participants - 34

Profile of Participants - Bachelor degree students

### ***Pilot Course in Portugal***

Organizer - CATIM - Technological Centre for the Metal Working Industry, Porto/Braga, Portugal

Duration - March to June 2023

Number of Participants - 34

Profile of Participants - Apprenticeship students



## ***Pilot Course in Switzerland***

Organizer - NTB/OST Ostschweizer Fachhochschule Buchs, Buchs, Switzerland

Duration - February to June 2023

Number of Participants - 26

Profile of Participants - Bachelor degree students

## **Analysis of feedback**

### **Expectations**

By examining both student and tutors feedback, their answers reflects that the expectation for the training was fulfilled and refer to the realization of the good experience of the participants enrolled in the courses. It contributed to a positive and rewarding learning experience.

### **Course structure**

It was considered a very good pilot course in structure, clarity, and functionality for the majority of students and tutors. The balance between self-learning phase and workshops was optimal.

### **Recommendations**

Based on the analysis, and comments with participants, we will offer actionable recommendations for course enhancement and curriculum development to better meet the needs of our students. This reflection is for the internal consortium use and for external training players.

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The objective is to enhance student engagement by understanding the student's perspective to help in designing courses that engage and motivate learners, resulting in a more positive and productive learning environment.

These Train4Dim bLearning courses where face-to-face instruction with online learning components to enhance the educational training have specific demands. When it comes to technical-based courses, such as those focused on industrial topics such as manufacturing and metrology, effective implementation of blended learning will be highly beneficial. From feedback analysis, the consortium took some recommendations for improving the developed contents, and training model, as well as incorporated procedures for designing and delivering blended learning manufacturing related to digital manufacturing and metrology training courses, in technical Schools or Universities:

**Clear Learning Objectives:** Starting with well-defined learning objectives. Defining what should students be able to do or understand by the end of the course. Ensure that both the online and in-person components align with these objectives. It will help to meet the participants' expectations and satisfaction.

**Online Learning Materials:** According to the feedback, we need always to develop high-quality online materials that cover theoretical concepts, references, and tasks. These contents should include videos, interactive quizzes, images, and real-world examples. Make sure that the content is engaging and interactive to maintain student interest.

**Workshops:** The sessions for hands-on working in Digital manufacturing laboratories, and practical exercises alone and in groups, are very appreciated among students, and teachers, as verification when students apply what they've learned before the eLearning phase, also provide opportunities for students to work with real-world challenges, equipment, and face-to-face discussion with the tutor. Some students claimed that workshops could be longer or more times.

**Course Scheduling:** All participants expressed a very positive opinion about the flexibility in terms of when students can access online materials and when the workshops were planned. This allows learners to study at their own pace and review materials as needed. It's very important to analyze the students' profiles, taking into account if they are regular students or if they come from Industry.

**Assessments:** Assessment in this type of training course is a critical component to ensure that students are achieving the desired learning outcomes and that the course is effectively delivering its content. Typically combines both online and workshop elements, so assessments should be designed to take advantage of this approach. In our training model

implemented pre-knowledge assessment, regular online quizzes integrated into the learning material, and an in-person digital final exam. These assessment moments can also serve as checkpoints for students to gauge their progress. In this pilot course was applied a pre-knowledge test and final test and comparing the results (the final tests were much better than the start test) it is possible to conclude that the course achieved the established goals. All participants didn't give any negative feedback on this testing option. Detailed results of evaluation of learning success are given in separate report on that matter.

**Supportive Online Community:** It was offered a collaborative online environment, through LMS, where students could interact with their tutors and peers. Encourage discussions, and peer-to-peer support for problem-solving some training tasks and preparation for workshops.

**Feedback Mechanisms:** Besides the provided pilot courses for shorter versions, providing prompt feedback on assignments and assessments was well-recognized by participants. Constructive feedback is essential in helping students understand where they need improvement.

**Real-world samples:** It was identified the need to increase of adding real-world examples that show very representative industry scenarios. These examples allow students to apply their skills to practical situations, reinforcing their learning.

**Multimedia Resources:** During the content production, it was used a variety of multimedia resources, including videos, interactive animations, and external sources. Some participants wish for more images and videos, especially for the apprenticeship training level.

**Tutors and Workshop laboratories:** The positive opinion from participants about the workshops, we have sure is related to the good quality of tutors and partner laboratories. This is essential for good hands-on technical training sessions. Tutors guide, instruct, and inspire students, adding well-equipped and well-maintained laboratories to provide a safe and productive environment for practical learning. Together, they ensure that students gain the skills, knowledge, and experience they need to excel in technical fields and make meaningful contributions to their future or actual jobs.

**Use of Learning Management System (LMS):** The pilot courses were implemented, by the CMTrain partner, in a well-known and robust LMS (Moodle) to organize and deliver course materials for different training levels. This LMS helped track student progress, facilitate communication, and manage assessments. All students and tutors considered it easy to use it during their training process.





**Technical Support:** It was not a item asked to the participants, but we ensured that students have access to technical support for any issues they may encounter while using the online platform or software tools. During the pilot course, it happened some singular situations on accessing the platform, were solved promptly. The consortium has experience in this topic, but if a new player wants to run a similar course, must be aware of this critical need.

**Peer Learning:** It was asked some students if they learned alone or with colleagues, and most of them had several moments where they studied together at the same time, especially the younger ones. It's important to encourage peer learning through collaborative projects/tasks, or group discussions Peer learning can reinforce understanding and build teamwork skills.

**Continuous Improvement:** From the feedback from students/tutors, from different pilot courses (different training levels), and also from different countries, the learning model, and materials, make the necessary adjustments to improve all course vectors. This exercise should be maintained in a way to keeps as an internal continuous improvement process.

**Course access:** Most of the students had access to online materials and training information, using mainly laptop computers, and desktop computers, and a few used tablets and smartphones. For these two last types of equipment access, the used eLearning platform from CMTrain partner (Moodle) is prepared for these situations.

## Course Approach

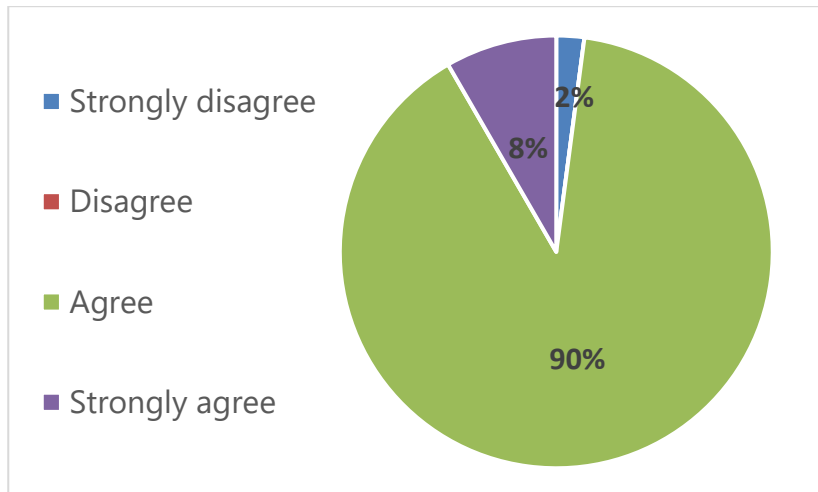
Blended learning in technical courses, like engineering topics (Digital Manufacturing and Metrology), can provide a well-rounded and flexible educational/training experience, accommodating various learning styles and needs. It's important to continuously evaluate the effectiveness of your approach and adapt it based on student feedback and emerging new educational technologies.



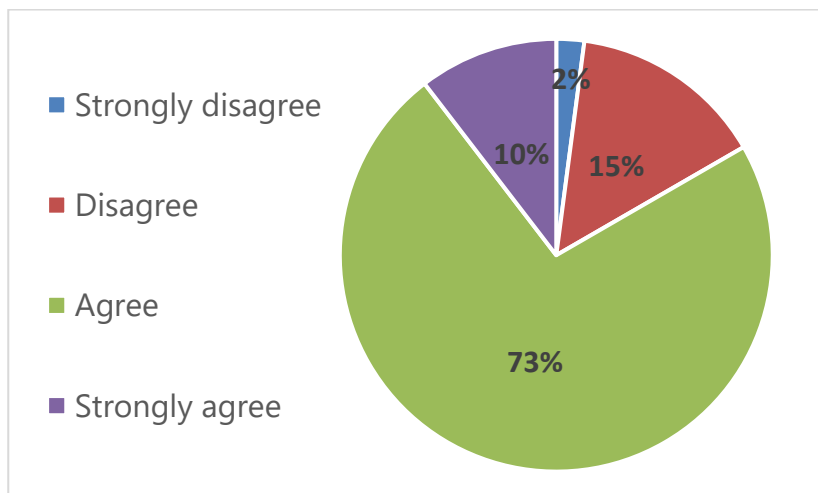
## Annex I – Results from overall feedback analysis

### Pilot Course in Italy

1. The course structure is clear and functional?



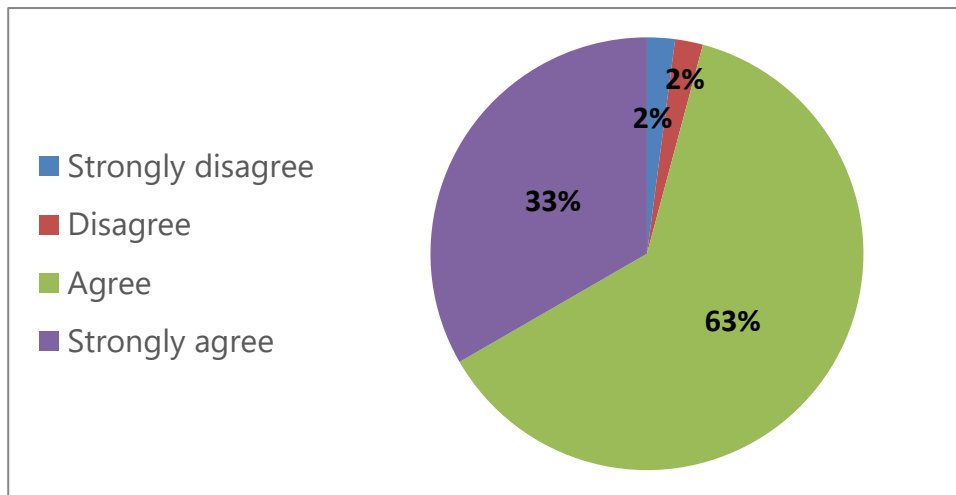
2. My initial expectations are met?



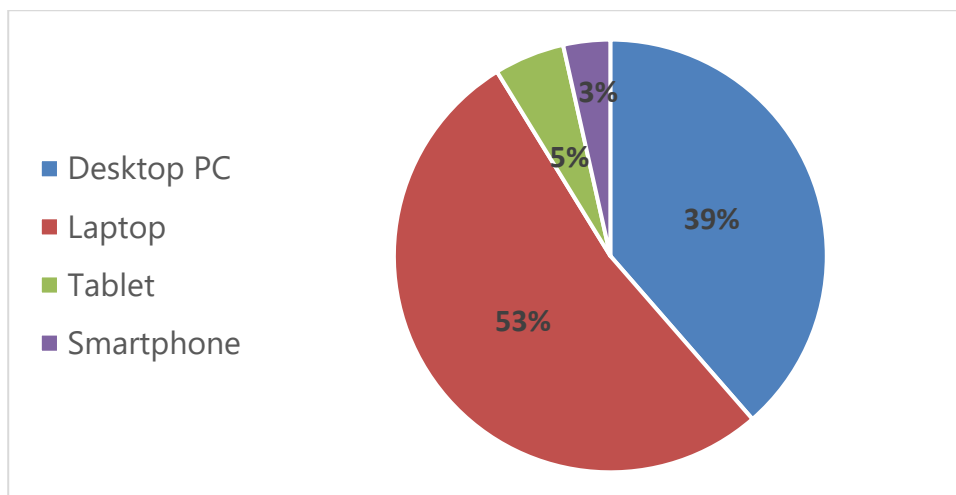
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3. The learning platform is easy to use?



4. Which type of device did you mainly use?



5. Please add below any final comment or suggestion:

Open responses

(some examples are quoted below)

**“This platform is very functional because we can go into details more than in class but if the section would be more precise and detailed could be easily to understand.”**

**“Sections need more photo and video.”**

**“In general, it can be said that it is a well-structured course where you can learn the proposed topics gradually and fairly thoroughly.”**

**“I would have preferred a bit more synthesis in some modules that sometimes seems a bit over complicated. I can understand that is important to be absolutely clear about the topics explained but usually over complicated text result in less**

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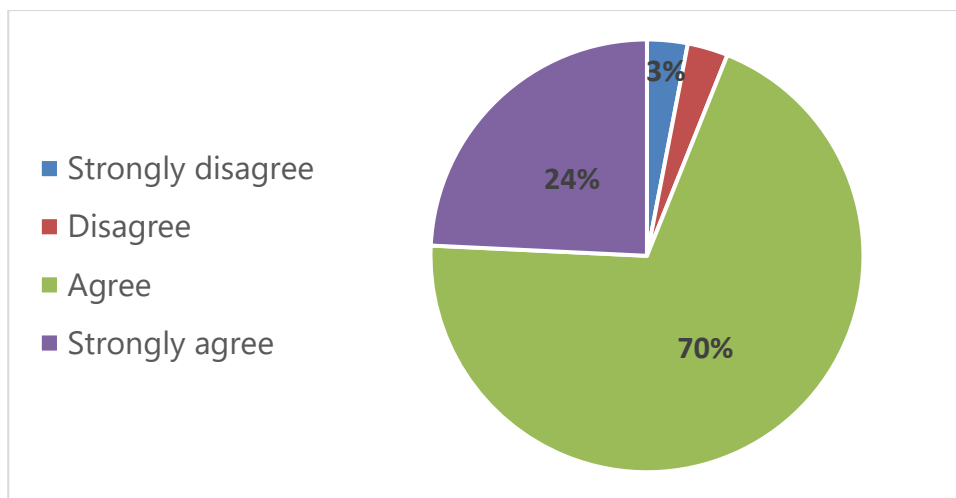
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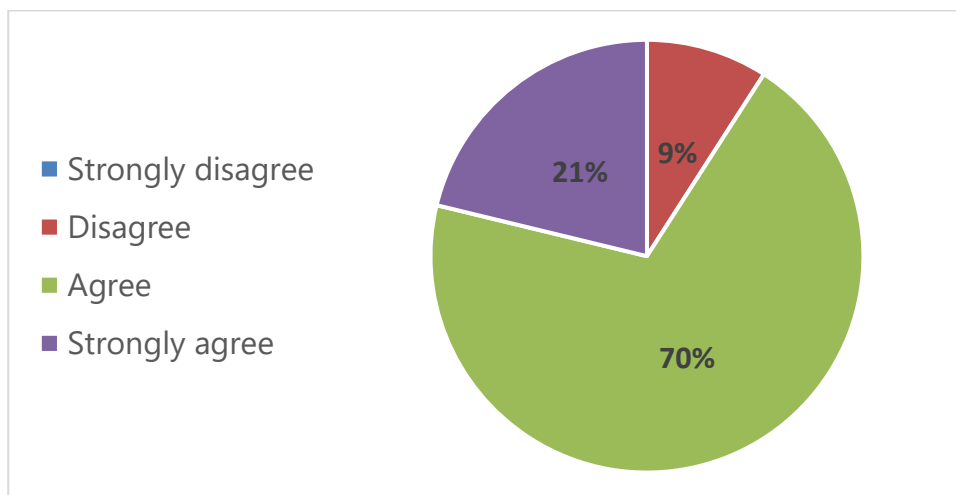
informations recived by the reader. In general the contents are explained quite well, sometimes however the language used isn't easy to understand, especially form a person that hasn't English as main language. I would have preferred a bit less specific information (for example in the modules about the different material) and a bit more context about the topic and why it's important to deepen.”

## Pilot Course in Poland

1. The course structure is clear and functional?



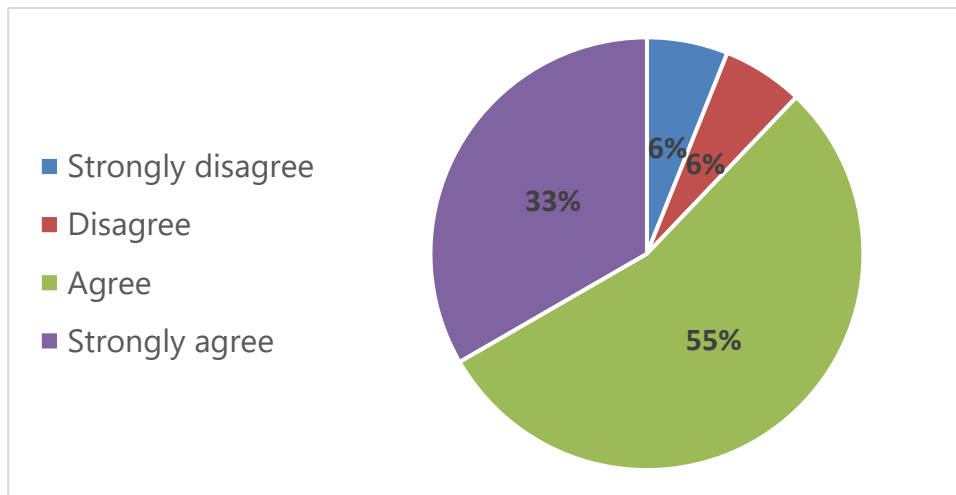
2. My initial expectations are met?



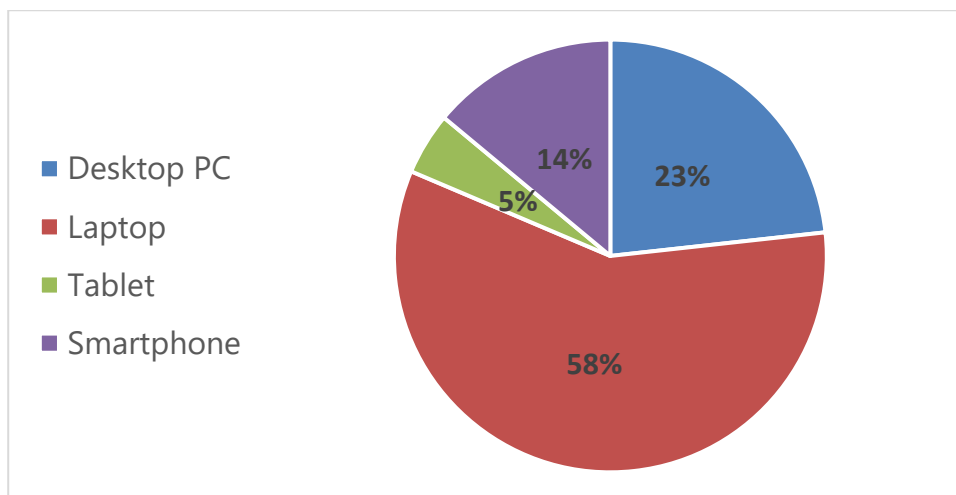
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3. The learning platform is easy to use?



4. Which type of device did you mainly use?



5. Please add below any final comment or suggestion:

Open responses

(some examples are quoted below)

**“Functioning of menu should be improved”**

**“Everything was clear and helpful.”**

**“This course is clear and easy to use”**

**“Clarify learning objectives to ensure they are specific and measurable. Increase interactive elements to engage learners actively. The number of provided examples was excellent, and their visualization was great. The course covers all the necessary**

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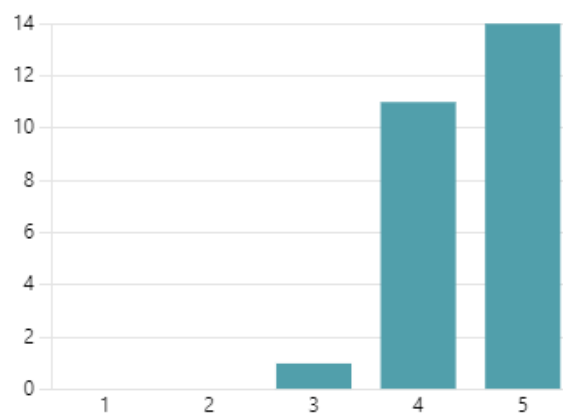
information, and it is very accessible. Thank you for your dedication, and I hope these suggestions can contribute to further enhancing the course.”

“Improving the possibility of using the course in languages other than English”

“In my opinion, everything is very good, I have no suggestions for the course.”

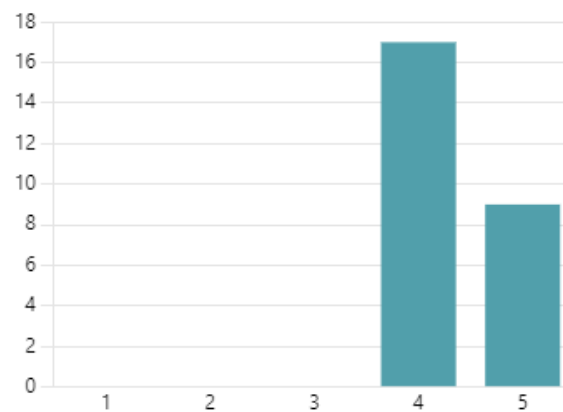
### **Pilot Course in Portugal**

1. On a scale of 1 to 5 (5 most positive), how practical was the workshop in CATIM Braga laboratory?



Average rating 4.50

2. Taking into account the programme of the course you are attending at school, how interesting is the content? Scale from 1 to 5 (5 most positive)



Average rating 4.35

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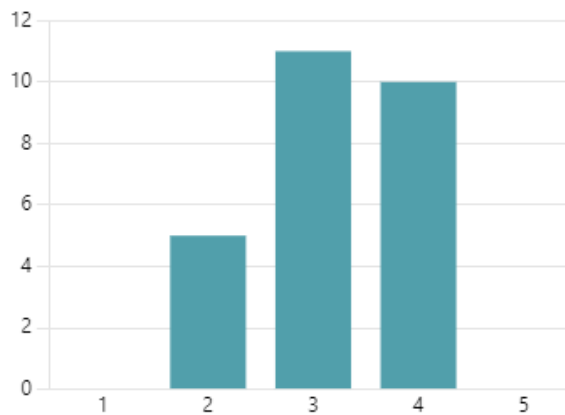
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3. After accessing the eLearning CM Train platform for the contents, how did you carry out the study? (You can choose more than one option)

- Alone 3
- In group of colleagues 18
- Explore inside lectures 20



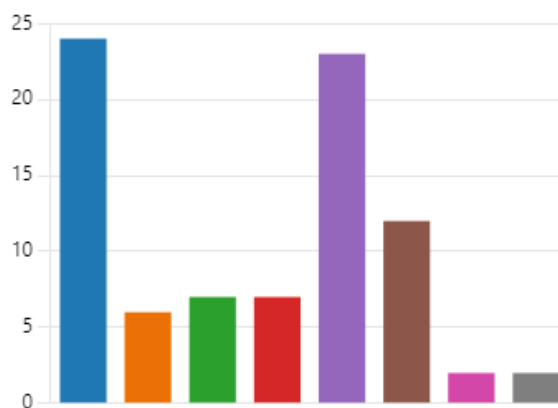
4. How do you rate the degree of difficulty in learning the topics proposed in the content? ( 1. Easy , 5 Difficult)



Average Rating 3.19

5. Which of the proposed topics did you find most interesting and/or useful for your professional future? (you can choose more than one option)

- Design for Additive Manufacturi... 24
- Specification of AM parts 6
- Formats for product data excha... 7
- Characterisation of typical mate... 7
- Testing of AM machines 23
- Measurement Influences 12
- Documentation Overview 2
- Handling of measurement stand... 2



6. Finally, would you like to leave any suggestions for improvement or comments?

Open responses

*From open responses feedback, it was possible to collect a very positive evaluation and the given contributions ideas were (some examples are quoted below):*

**"More videos "**

**"More animations "**

**"More workshops"**

**"Course time could be increased."**

**"High quality of contents and structure"**

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