

## Report on Survey results

### Introduction

The Industry 4.0 stream uses the achievements in the different areas of computer sciences, introducing new solutions at almost every stage of the production process, just to mention such concepts as: mass customization, cloud computing, knowledge based engineering, virtual reality, rapid prototyping or virtual models of measuring systems. As an example of such diversity the training of industrial design students in field of coordinate metrology can be indicated, which allows them to design the product more consciously taking into consideration also the requirements of quality control departments. Then, finding and developing appropriate education methods adapted to the specifics of individual stages of the production process becomes extremely important issue which can be crucial to properly exploit the potential of the fourth industrial revolution.

The target groups of this project are:

- Target group A: Apprenticeship students (design, manufacturing, quality assurance)
- Target group B: Bachelor degree students (design, manufacturing, quality assurance)
- Target group C: Master degree students (design, manufacturing, quality assurance)
- Target group D: Teachers and tutors
- Target group E: Developers of learning material

One of the intellectual outputs of this section is the needs evaluation of the target groups addressed. The evaluation in the context of "training for dimensional metrology in digital manufacturing" consists of:

- organisational aspects,
- technical aspects in the areas of:
  - design (e.g. model based definition, product manufacturing information),
  - manufacturing (e.g. additive manufacturing processes),
  - quality assurance (e.g. mobile measuring devices such as articulated measuring arms),
- didactical aspects.



Based on the results of this analysis, the basis for a consistent training scheme is given. The impact of this training scheme is a framework that allows seamless learning paths throughout the lifetime of the participants.

A) From the learner perspective (target group A...C), this results in an efficient and effective learning because there is a master plan covering the needs of the different aspect groups. Therefore, the learning methods and the learning content are well aligned and base on each other.

B) From the teachers and tutors perspective (target group D), the master plan allows to point out the new learning aspects and to coach people to connect to already existing knowledge.

C) Form the developers perspective (target group E), the master plan allows to build a consistent curriculum addressing target group A...D with well aligned learning aims and learning outcomes.

This first activity included a preparation and conducting a user needs analysis. The user needs analysis will cover contributions out of the perspective of all partners. This analysis determined the needs of the users. Different aspects in didactics as well as technical area will be taken into account. The analysis was carried out at the beginning of the project to be sure to have the right project development direction. Due to the COVID-19 pandemic situation during this project phase, it was decided that task must be done by questionnaires as the safest method of collecting feedback.

## Methodology

The partnership defined a survey with several questions that was supposed to be more conclusive and representative (see Annex 1). The partners sent it to students, teachers, and other stakeholders like content developers, involved in the educational process and invite them to answer. The survey was run in all partner countries (Portugal, Italy, Germany, Switzerland and Poland) and was conducted in five languages (English, Polish, German, Portuguese and Italian) using the digital tool Lime Survey (<https://www.limesurvey.org/>).



## Statistics

It was possible to collect 249 surveys (incomplete). The most important information taken was that the answers came from educators/teachers that are working mainly at University level, with minor contribution with high schools level.

Nevertheless, for the survey analyses and conclusion, we consider all answers for a better understanding and characterisation of the target public for starting defining the learning aims and teaching approach.

## Analyses of the answers

When asked about "**What is your role at your institution?**", most of the answers are from Students with 52%, followed by Teachers with 34%, Other with 10% and only 4% of Administrative.

When questioned about "**Teaching Level**", much of them replied that they have Bachelor's Degree, with 56%, followed by Master's Degree with 24% and lastly 20% with Apprenticeship only.

As for the "**Location**" of respondents, the countries from which the answers were obtained are mainly from Portugal and Switzerland, with 18 responses from each country, followed by Poland with 12 responses and finally Italy with 2.

The specific "**Region**" of each country, as far as the area of residence, is not very divergent. In Portugal, the answers are all from the North of the Country, Switzerland, from St. Gallen, Poland, from Malopolska and Italy, from Padova.

Regarding the place where they usually study, many respondents answered that they study at home, with a percentage of 58% compared to those who use Schools/Universities as a place for study, 39%. Only 3% answered that they use another place to study.

Asked then, "**which would be your favourite eLearning medium**", most respondents prefer Interactive content, with 38%, but not far from video content, about 32%. Then

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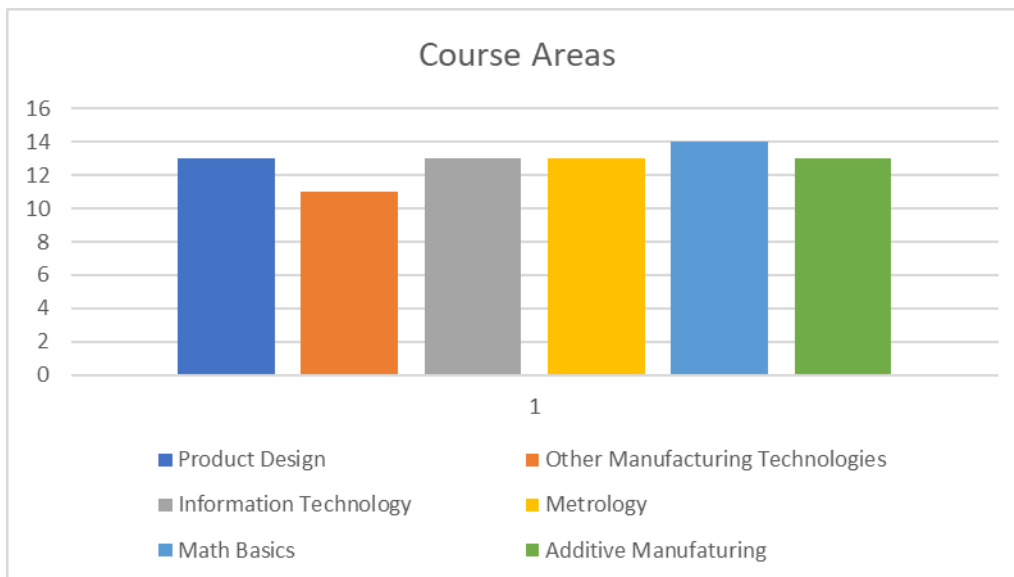
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text with images was the 3rd most chosen, with 24% and finally audio content, with 5% of the preferences .

To the question "**Digital manufacturing initiative been integrated as an additional subject into your school/University?**", the answers "Yes" and "No" get the same percentage, 27% each. 46% said they did not know.

Then, through the graph provided, the average percentage answers of each area are shown to the question "**If you have Digital Manufacturing training course in your School/Institution**", what percentage are the following areas part of that Courses?"



Was also asked whether "**Is there a dedicated digital manufacturing laboratory, or facility, in your school/Institution?**". The answer YES was 35%, NO was 13% and 52% did not know if they had a laboratory at the School or Institution.

Following the question posed earlier, it was also asked whether "**Is there a dedicated metrology lab, or facility, in your school/institution?**". 71% answered YES, 4% answered "NO" and 25% did not know. Next, the answers obtained regarding the question if "YES", what type of equipment/tools are available to students, are shown:

“Metrology devices from the metalworking area”

“Measurement and metrological control instruments”

“Measuring equipment in the field of mechanics.”

“Caliper, Micrometer, Microscope, Profile Projector, Digital Roughness Meter, sine square, standard block kit, tracing table, clamp, tensile testing machine.”

“Optical systems”

“Roughness and contour tracing stylus measuring device”

“Coordinate Measuring Arms, Coordinate Measuring Machines, 3D Scanners”

“Collaborative machines: Leitz PMM12106, Zeiss O-Inspect, Zeiss UWM 850 with Resnishaw, Renishaw Laser Interferometer, Laser Tracker Leica LT 850, Structural Scanner Smarttech hand scanners, profilometers.”

“Gauge Plates, Inductive Sensors, Calipers Modular, Abbe Length Gauges, Contour Graders, Pneumatic Sensors, 3D Scanners, profilometers, laser interferometer”

“Coordinate measuring machines, measuring arm, microscope, instruments and typical equipment for the metrology laboratory.”

“shop microscopes, measuring frames.”

“Coordinate Measuring Machines with contact head as well as with laser triangulation head, Laser Tracker, Coordinate Measuring Arms, 3D Scanners, Universal Microscopes, Profilometers and basic measuring tools like calipers, micrometers etc...”

“skid probe system, stiff projection”

“Fringe projection, Articulated arm CMM with laser scanner.”

“different coordinate measuring machines (tactile, optical, multisensor), roughness contour Contact section measuring device, focus variation measuring device, form tester”

“Hand measuring equipment”

“Stationary and mobile Roughness gauges tactile and optical, stationary and mobile (mobile tactile only).”

“Accompanied by an MA of the laboratory basically all (depends on the request)

In internships (i.e. also under accompaniment) selected ones of the above mentioned  
Without accompaniment hand-held measuring devices. If necessary, students can also  
be introduced to selected measuring devices



(e.g. BA work) -> but is also always accompanied.”

Depending on request, students can also be introduced to devices

“ Structured Light Scanners, Triangulation Scanners”

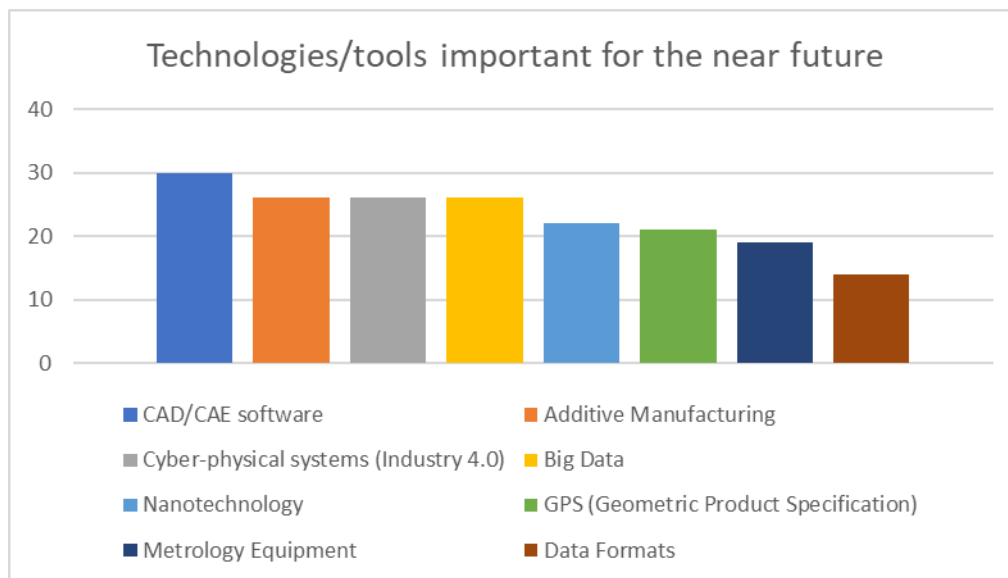
For the question **"What kind of equipment/tools are available for students?"**, the answers were varied, as can be seen below:

“Optical Systems”; “Gauges”, “Micrometers”; “3D printers”; “Industry 4.0 Centre”

“Virtual Lab”; “Hybrid learning factory, assembly line with digital twin”;

“workshop”, “microtechnology laboratory”; “Learning laboratory with automation of assembly processes, PLC, warehousing, Manufacturing stations”; “Scanners 3D”, “CAD, CAE”; “mixed reality smartglasses”;

When asked about **"which technologies/tools they consider most important in the near future"**, a representative graph was generated on the percentage of what they consider most relevant, and CAD/CAE software is the most considered by respondents, followed by additive manufacturing and Cyber-physical systems.

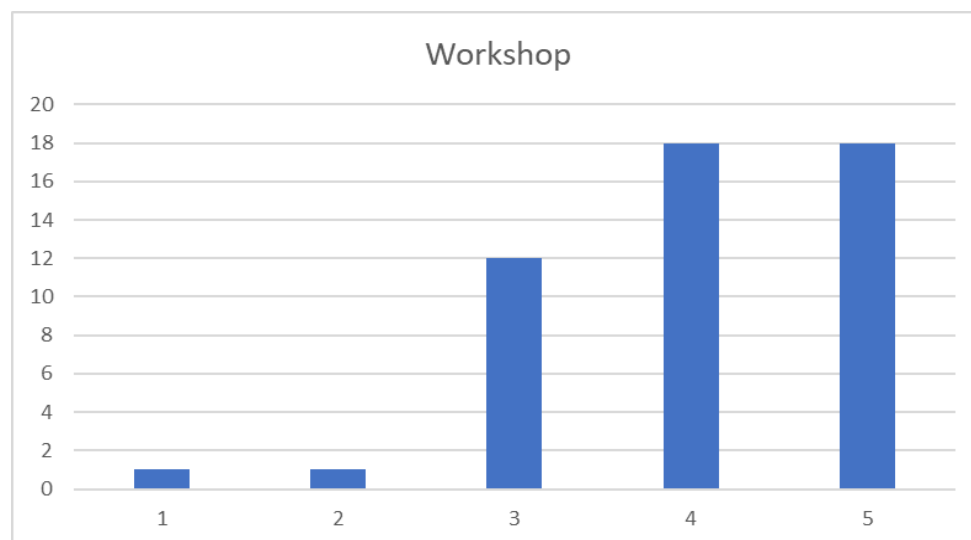
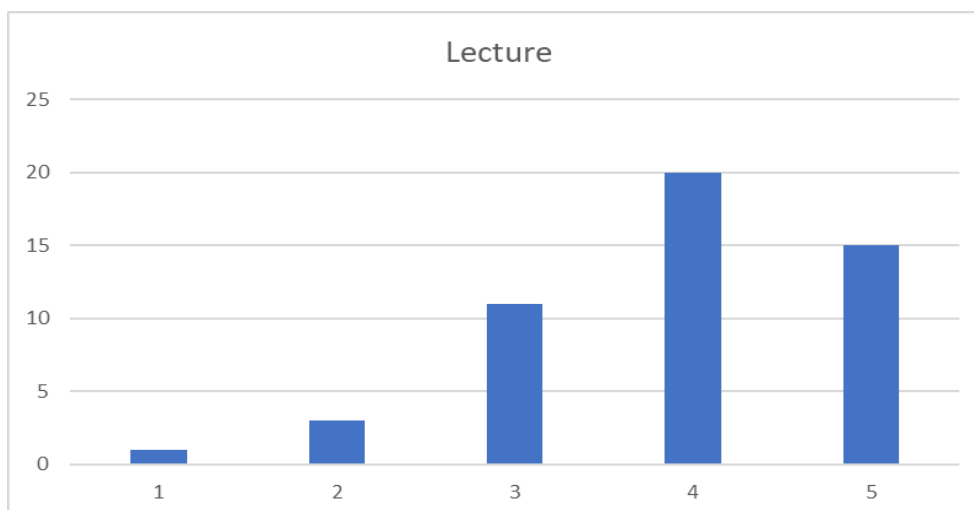


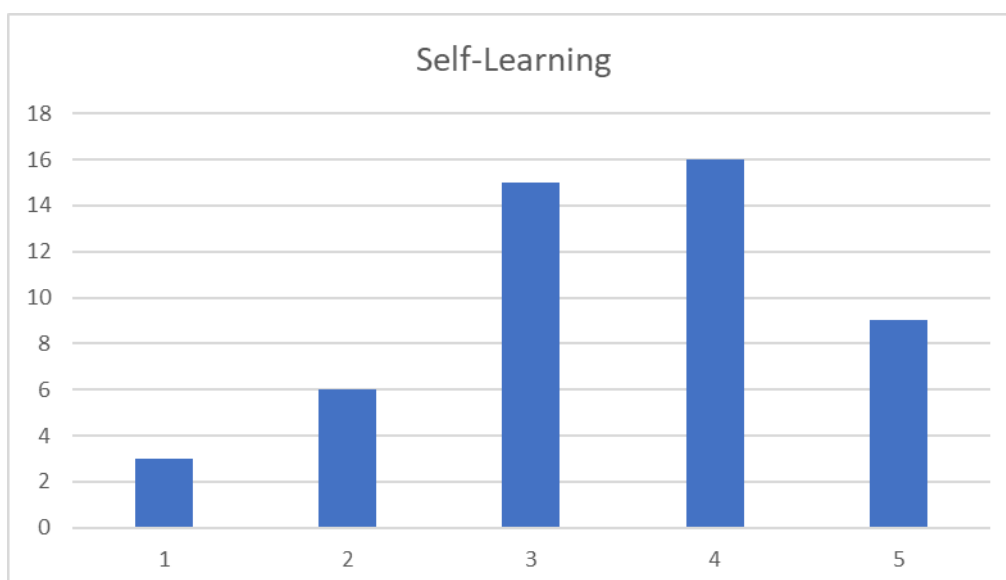
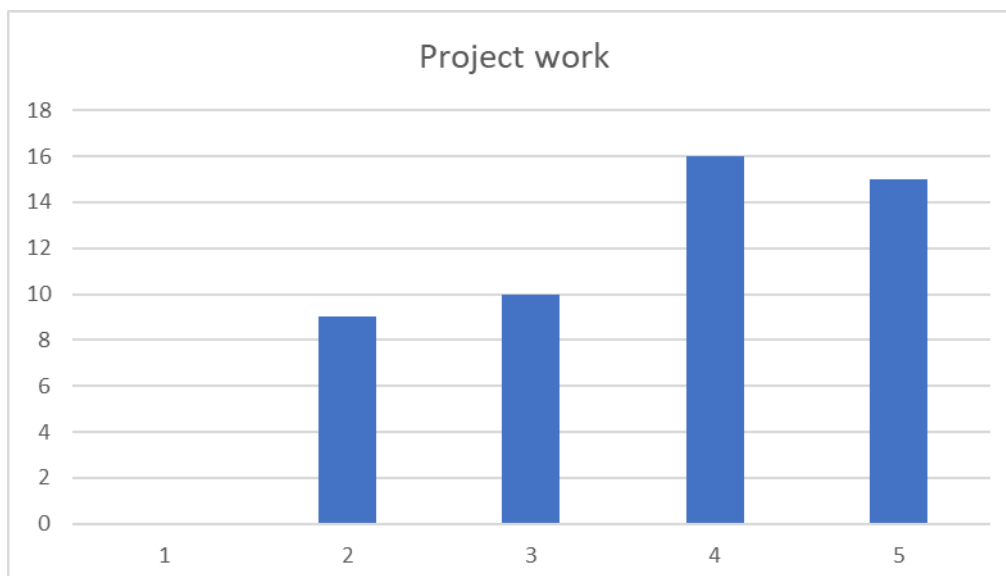
The next question is related to **"Which channels do you prefer to manage or to receive courses."** To which, 55% answered Blended learning (eLearning with



workshop), 38% Lectures (face to face) and finally 7% answered that they preferred eLearning.

Below, graphs with percentages related to the preference of different learning/teaching methods are shown, and the value of 1 is relative to the least important and 5 the most important.





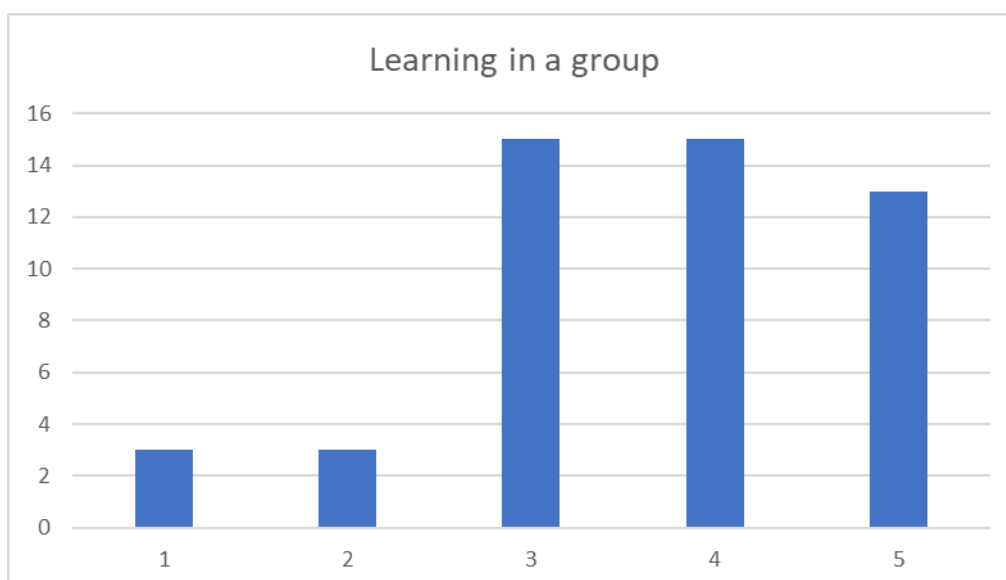
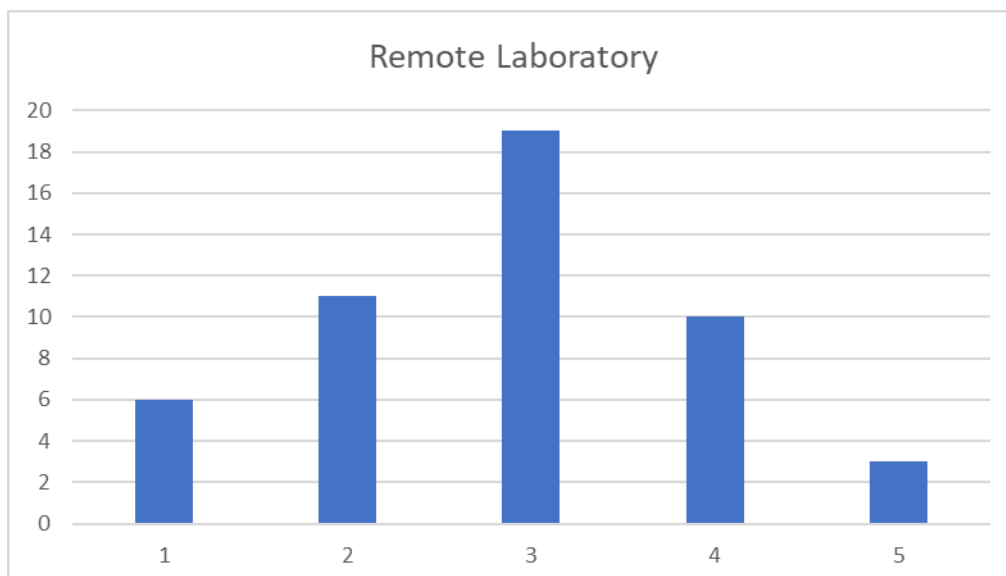
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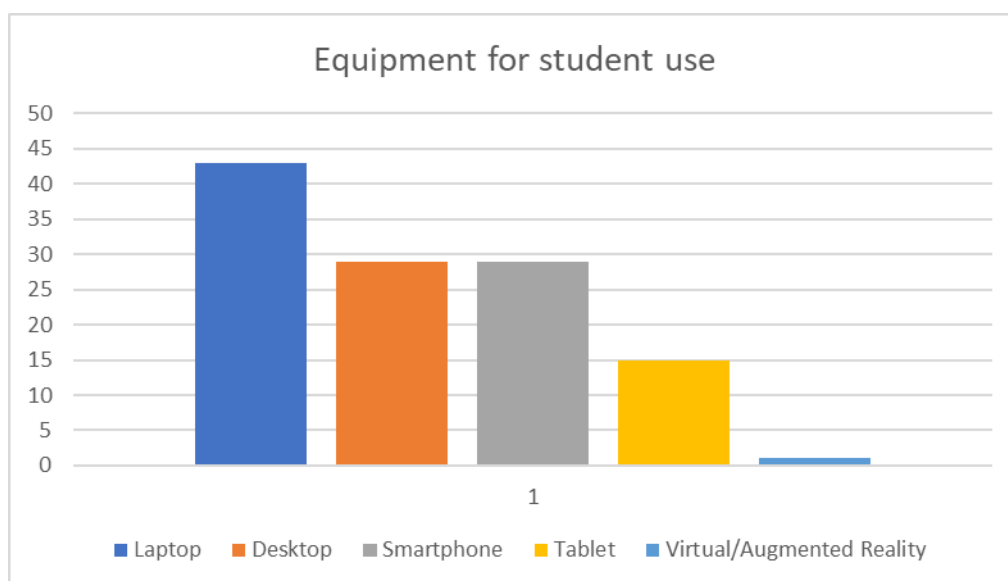
Following the questionnaire, they were also asked, "**How would you like to interact with your tutor/student?**". The vast majority, with a percentage of 46%, say that they prefer In person, followed by Synchronous way (e.g. Chat, phone call), with 31% and, finally, Asynchronous way with 23%.

Also, with some relevance to the survey, were asked whether "Do you think that is important to evaluate the pre-knowledge before training starts?". The majority said YES, with 58%, 9% said NO and 13% did not know.

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<p>REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL ESTABLISHING "ERASMUS+": THE UNION PROGRAMME FOR EDUCATION, TRAINING, YOUTH AND SPORT AND REPEALING DECISIONS No 1719/2006/EC, No 1720/2006/EC AND No 1298/2008/EC</p>		

Following the previous question, the respondents were asked "Which level of assessment do you consider to be important?". 15% responded before the training, 28% after the training (written exam), 21% after the training practical exam with equipment and 36% during the training.

Finally, a graph on the considerate preferences "If you are on distance learning, which equipment you consider that your student will use:"



## Conclusions

These results are very indicative of how the learning approach/methods, and learning aims, must be crossed with the aim of the project as well with the public target needs and expectations. The consortium will focus in a BLearning pedagogical approach, where the workshop and project work methods are very appreciated by students. These workshops schemas must take in the account the available spaces and equipment inside of teaching entities showed in the answers.

The role of the teacher/tutor still is very important for the students, for the lecture and mainly for the practical sessions. The users also showed their preferences for interactive learning approach, which must be adapted to different digital platforms (desktop, tablet, mobile, etc.), virtual/augmented reality was chosen by a small percentage of responders but they answers indicates that it could be a new trend.

## Annex I

# Survey educators/students

### Survey Introduction

Train4DiM project (<http://train4dim.pk.edu.pl>) aims at finding and developing appropriate education methods adapted to the specifics of individual stages of the production process (design, manufacturing, quality control), which is extremely important issue that may be crucial to properly exploit the potential of the fourth industrial revolution. Because of it, we intend to develop complex training material for digital manufacturing including content for design, manufacturing and quality control, showing dependencies and relations between these production stages.

Project consortium consists of 3 universities (Cracow University of Technology, Poland; Interstaatliche Hochschule fur Technik Buchs (part of the University of Applied Sciences of Eastern Switzerland - OST), Switzerland and University of Padua, Italy) and 2 non-profit organisations (CATIM, Portugal and CMTrain, Germany). As all participating organizations have coordinate metrology background main focus of the project will be on coordinate metrology and portable measuring systems.

Please, take a few minutes to let us know your experience by taking this survey.

#### 1. What is your role at your institution?

Educator/Teacher

Student

Administrator

Other

#### 2. Teaching level

Apprenticeship

Bachelor's degree

Master's degree

#### 3. Location

Country: [Click or tap here to enter text.](#)

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Region: Click or tap here to enter text.

City: Click or tap here to enter text.

#### 4. If you are a student, where do you study?

- School/university
- Home
- Work
- On the way
- Other place

#### 5. Which would be your favorite eLearning medium?

- Text with images
- Video
- Audio
- Interactive content

#### 6. Has a Digital manufacturing initiative been integrated as an additional subject into your school/University?

- Yes  No  I don't know

If you answer "Yes", please tell us how?  
Click or tap here to enter text.

#### 7. If you have a Digital Manufacturing training course in your school/institution, what percentage are the following areas part of that courses (needs to add up to 100%)

- Math basics Choose an item.
- Product Design Click or tap here to enter text.
- Information technology
- Metrology Click or tap here to enter text.
- Additive Manufacturing Click or tap here to enter text.
- Other Manufacturing Technologies Click or tap here to enter text.

#### 8. Is there a dedicated digital manufacturing lab, or facility, in your school/institution?

- Yes  No  I don't know

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If so, what kind of equipment/tools are available for students?

[Click or tap here to enter text.](#)

## 9. Is there a dedicated metrology lab, or facility, in your school/institution?

Yes

No

I don't know

If so, what kind of equipment/tools are available for students?

[Click or tap here to enter text.](#)

## 10. From the technologies/tools (below list) which are the most important for near future?

CAD/CAE software  Additive manufacturing  Cyber-physical systems (Industry 4.0)  GPS (Geometric Product Specification)  Data formats   
Nanotechnology  Big Data  Metrology equipment

If you want to enumerate additional technologies/subjects, please include here:

[Click or tap here to enter text.](#)

## 11. Which channels do you prefer to manage or to receive courses:

Lectures (face to face)

eLearning

Blended learning (eLearning with workshop)

## 12. Please rate your preference of the following methods how to learn/teach?

Lecture [1 - 2 - 3 - 4 - 5]  
Workshop [1 - 2 - 3 - 4 - 5]  
Project work [1 - 2 - 3 - 4 - 5]  
Self-Learning [1 - 2 - 3 - 4 - 5]  
Remote laboratory [1 - 2 - 3 - 4 - 5]  
Learning in a group [1 - 2 - 3 - 4 - 5]

## 13. How would you like to interact with your tutor/student?

In person

Synchronous way (e.g. Chat, phone call)

Asynchronous way (e.g. Email, Forum)

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**14. Do you think that is important to evaluate the pre-knowledge before training starts?**

Yes

No

I don't know

**15. Which level of assessment you consider to be important?**

Before the training

During the training

After the training (written exam)

After the training practical exam with equipment

**16. If you are on distance learning, which equipment you consider that your student will use :**

Desktop PC

Laptop

Smartphone

Tablet

Virtual/augmented Reality

If you want identify additional equipment's, that you consider useful for training please include here:

Click or tap here to enter text.

Name Click or tap here to enter text.

Email Click or tap here to enter text.

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