



# DBL Example: Measurement quality assurance



# 01.

# Design Criteria of the DBL Activity



#### Lecture context

Subject Manufacturing Technologies Degree • Industrial Technologies Engineering Duration • 3h Modality • In a computer room Students • 10-13 students Working groups • Groups of 3 people



# Intended Learning Outcomes (ILOs)

- Learning how to perform a calibration procedure.
- Learning how to estimate the measuring uncertainty.
- Learning how to perform a repeatability and reproducibility (R&R) study for measuring systems.
- Proposing solutions for improving the measuring uncertainty.
- Proposing solutions for improving the repeatability and the reproducibility.



## 02.

# **Activity Design**



# Course scripting

Establishing ILOs

Prepare material:

measuring
instruments and
workpieces

Write the activity
statement



# **Activity statement**

The teacher proposes students the following scenario: the group of students are the workers of a workshop where they manufacture parts. The customer has asked them to verify that the parts comply with the design tolerances, and they have to decide if the measuring instruments that they have are capable of verifying those tolerances. To do that, first they will have to calibrate the instrument, then, calculate its measuring uncertainty, and, finally, perform a R&R study. Once they analyze the resulting dataset, they will have to propose solutions to improve the measuring procedure.



#### **Lesson Flow**

#### Presenting the DBL activity:

- Activity statement
- Work to be done by the students
- Description of the measuring system and the workpieces
- Description of the results expected

### Developing the activity

- The students work autonomously: they perform the measurements and write the data in an Excel sheet
- In the Excel sheet they work with the data to obtain results
- The teacher provides guidance when needed

# Analysing results and proposing solutions

- The students analyse the dataset obtained, and they extract results.
- In view of the results, the students propose solutions for improving the measuring quality.



Measured workpieces

#### **Lesson Flow**

Dataset generated by the students during the R&R study:

List of workers

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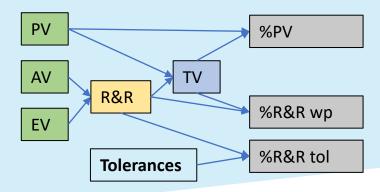
Measureents of the same workpiece



#### **Lesson Flow**

#### Analysis of results of the R&R study:

- Repeated measurements of the same workpiece → Measuring system repeteability (EV)
- Measurements by several workers → Reproducibility (AV)
- Measurement of sevrral workpieces → Workpieces variation (PV)
- Total measured variation (TV)



University of Zaragoza

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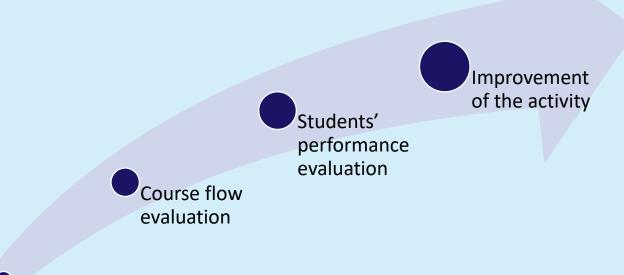


# 03.

Evaluation and optimization of the learning process



# Evaluation and optimization of the learning process



Course scripting evaluation

