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DBL example activity: Measurement quality assurance

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Course description

The activity is part of the course Manufacturing Technologies, that is a compulsory course that takes part in the third year of the Bachellor degree of Industrial Technologies Engineering, at the University of Zaragoza.

The activity takes place in a computer room, with a maximum of 13 students per activity. The students work in groups of three people.

The material needed is prepared by the professor, and it is: a measuring system (vernier caliper) per group, and calibrated blocks and workpieces to be measured. The students will also use Excel, which is already installed in the computers.

Prerequisites: In the previous theory lessons, the students have already learnt about measurement quality assurance.

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.

Learning outcomes:

- 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.

Student's activities

First, the teacher presents the activity statement and introduces the work to be done by the students. The teacher describes the measuring system to be used, and the results expected.

The students work in groups of three people. First, they perform the calibration procedure measuring calibrated blocks. Then, they calculate the measurement uncertainty, measurimg the workpiece. Finally, they perform the R&R study, measuring several workpieces, several times and by several workers (students). All the obtained data is copied in an Excel sheet, creating a dataset. Once all the measurements are taken, the students analyse the dataset using statistical methods. They extract conclusions about the suitability of the measuring instrument, and they propose solutions for improving it.

During the process, the teacher acts as a guide and supervise the students work, helping them when necessary.

Evaluation

During the evaluation phase, the teacher asseses if the learning outcomes were achieved by the students. Firstly, this is done by observation in class. In addition, each group of students, at the end of the class, will give the teacher the spreadsheet obtained and a document with the conclussions extracted and the solutions proposed.

Course designing

This course uses the following active learning component:

- Practice: the students perform the mesurements to obtain the dataset.
- Dataset treatment
- Discussion: students will have to propose solutions to improve the measuring quality in view of the results.

Checklist

- Does the problem revolve around the same topic? Yes, all is about measurement quality assurance
- Is the topic appealing to the students? Yes.
- Is the approach of the problem close to a real-life situation? Yes, it's directly pulled from it.
- Do the students have to do any previous work before the lesson? They need to attend to the theory lessons.
- Do the students have the previous knowledge required to solve the problem? Yes, it has been worked in the theory lessons.
- Does the problem statement or report given to the student contain all the necessary information to solve the exercise? Yes, they'll just have to take measures and follow the course activity.
- Is the dataset given to the students with the problem statement? No, the teacher gives the problem statement and the students collect themselves the dataset.
- Does the course script contain all the information required to follow the lesson? Yes
- Does the course script consider the previous knowledge that the students may have? Yes
- Is the course script easy to follow without misinterpretation? Yes
- Are all the tools and equipment required for the lesson described in the course script? Yes