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COMPARISON OF TWO LABORATORY-ORIENTED SUBJECTS IN TERMS OF FACE-TO-FACE AND ON-LINE FORM OF EDUCATION

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Abstract

The article is focused on presenting the method of online teaching of two subjects: CAQ and Metrology and Quality of Technological Processes, which are implemented in the summer semester on Bachelor's study degree. The teaching was to be implemented in such a way that there was interaction with the students, and, at the same time, we also had to prepare the protocols later elaborated by students. The article will compare the face-to-face method of teaching, its methods as well as the evaluation of the two subjects, with the online method of teaching. Two subjects focused on the control and measurement of dimensions will be compared, but with different ways of implementing the exercises during the online process. Both subjects used laboratories to process them. The result is a relatively comparable success in both subjects.

Keywords

On-line teaching, metrological subjects, on-line teaching of software

INTRODUCTION

The pandemic has brought about a major change in the traditional face-to-face teaching in schools. Standard education has been forced to move into the digital environment. Each of the teachers was looking for his/her own way. Due to the pandemic, the measures changed very quickly. Therefore, the teachers' time dedicated to teaching increased because they had to adjust all the content of the curriculum to the online study method [1]. Teachers had to familiarize themselves with the possibilities of digital platforms and learn how to use them. Currently, there are already many available communication tools and platforms, electronic resources, and existing support for the pedagogical process. Online teaching assumes an Internet connection and a suitable communication device (PC, laptop, tablet, phone, etc.).

Due to online communication with students, the STU Management recommended using other communication tools, such as Google GSuite [2] and Microsoft Teams [3, 4]. The article deals with the comparison of the applied methods of the distance form of exercises at the Bachelor's degree with the results achieved before the introduction of online testing.

MATERIALS AND METHODOLOGY OF EXPERIMENT

The online teaching process should be divided into four parts:
1. Determination of measurable educational goals/outcomes.
2. Processing and delivery of educational materials according to the goals: books, Internet links, videos, e-books, exercise books, etc.
3. Designing the tasks and activities based on the above-mentioned materials. It can be the quizzes aimed at understanding the subject matter, chapter summaries, short compositions, or simple tasks.
4. Associated methods of assessment, feedback and marking with the learning activity so that students know a) what their goal is, b) how they are doing, and c) when they have met the learning goal [5].

In general, when taking an online degree program, you might encounter the resources like: - e-books, Journals, videos, recorded lectures, quizzes, discussion forums, live QaA sessions and interviews [6]. Online learning is a comprehensive term that includes a number of instructional environments and approaches. Types of online learning are Asynchronous online courses, Synchronous online courses, Hybrid courses, Providing continuity, Distributing materials, Creating content, Fostering collaboration, Assessing students and Selecting tools [7].

Classroom options were used for the pedagogical process of the subjects, integrating various modules. Classroom is part of the complete GSuite program of Google Inc. In Classroom, it is possible to assign a student to a specific class. Tasks for processing were gradually added to the class. The necessary materials were gradually inserted into the Classroom (video demonstrations, study links, presentations of individual exercises, etc.).

CAQ Subject

The CAQ subject is focused on the measurement and evaluation of dimensions and tolerances of shape and position. The student gain knowledge about the geometric parameters of machine parts, about manufacturing deviations, about their measurement methodology, and about the possibilities of computer support for measurement and quality. During the exercises, the student practically verify the acquired knowledge and learn to work with the Calypso measurement software. Measurement is performed on a CMM. Coordinate measuring machines enable complex dimensional inspection of products. The high quality of their technical design ensures accurate measurement. To operate this machine, knowledge of software is required. Using the software, it is possible to prepare a measurement program. Fig. 1 shows the elements necessary to obtain the measurement protocol.

Technical drawing Model CMM

Fig. 1 *Necessary elements for processing the protocol*

Students used the CALYPSO ZEISS software to prepare a control program. To work with the mentioned software, it was necessary to use the software that enables remote computer control during distance learning. For this purpose, the TeamViewer software was used. On each PC, it was necessary to generate credentials that were specific for that PC. Each student received log-in data for a specific PC in which the CALYPSO ZEISS licensed software was installed. Fig. 2 shows an overview of the remote PC control process.

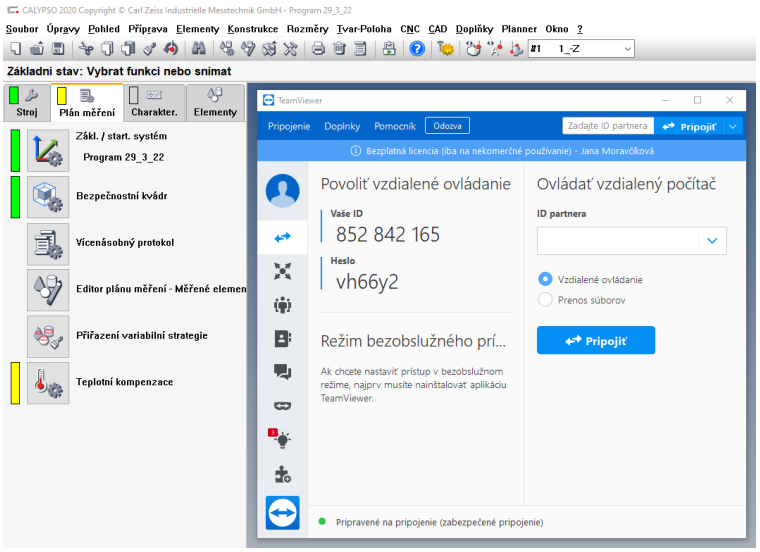

Fig. 2 *Setting up remote PC control using TeamViewer*

As part of the transition to online teaching, it was necessary to provide exercises from the CAQ subject with software teaching. The condition for passing the course was the development of a measurement plan and the implementation of a measurement simulation in Calypso. For simple understanding of the control of the CALYPSO program, a sequence of individual steps in the development of a measurement plan was developed. Fig. 3 shows the procedure of only the main steps for creating a measurement plan. The individual parts of the scheme contain further divisions, which the students take over and apply in the measurement plan during the exercises.

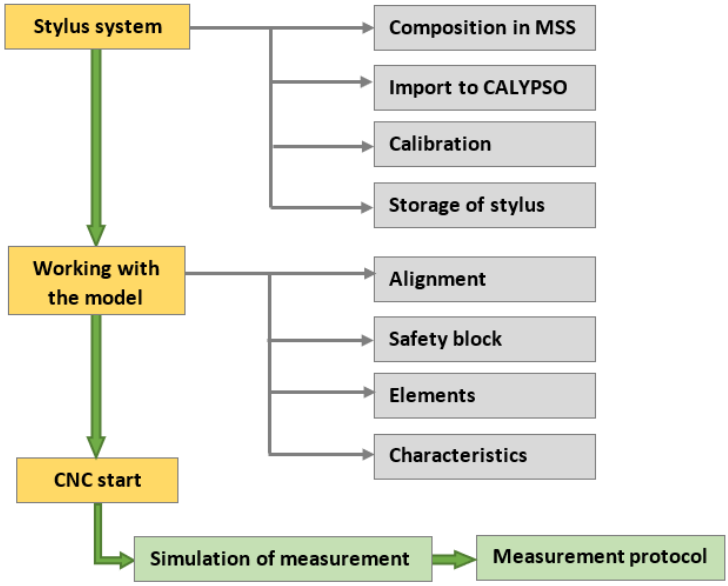

Fig. 3 *Scheme of the main steps for developing a measurement plan*

Teaching software requires gradual verification of thee acquired knowledge, and partial tasks are therefore assigned to students through Classroom. In the Classroom, creation of the measurement plan during face-to-face teaching is carried out in the laboratory where the CMM is installed. Students have the opportunity to try composition of the machine, assembly of the sensing systems, clamping of the calibration spheres and the measured part, etc. directly at CMM. During the semester, practical demonstrations and verifications of the created measurement plan on the machine were also carried out. Fig. 4 shows a preview of the simulation of the processed measurement plan.

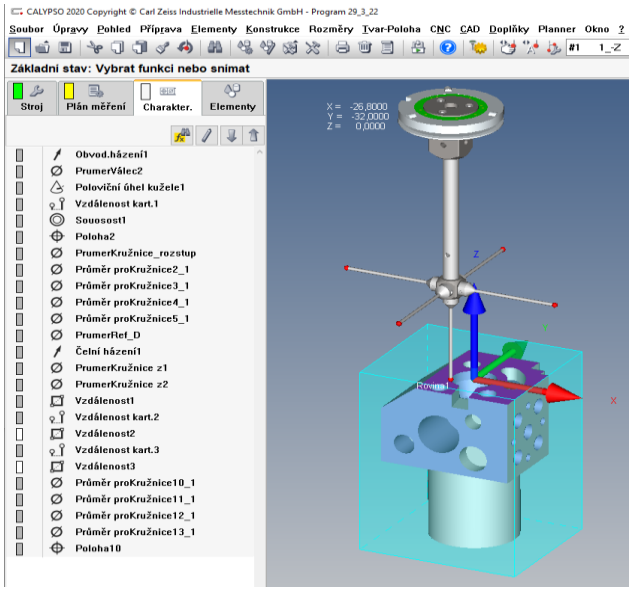

Fig. 4 *A preview of the simulation of the processed measurement plan*

During on-line teaching, students do not have the opportunity to take measurements on a machine. All the necessary elements are solved using PowerPoint and the measurement on the machine is performed through video demonstrations.

Fig.5 shows the evolution of the exercises of the CAQ subject, depending on the academic year, when this subject was taught.

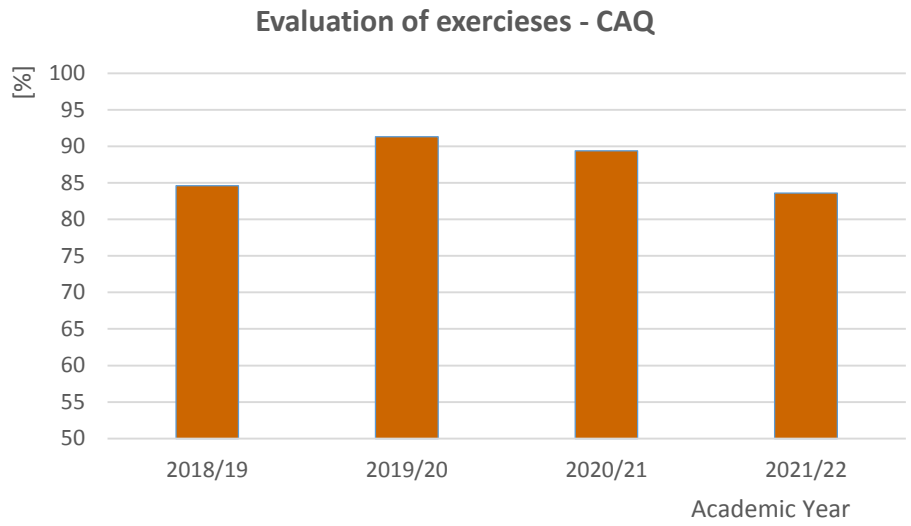

Fig. 5 *Comparison of exercise evaluation of subject CAQ*

Subject of Metrology and Quality of Technological Processes (MQTP)

The MQTP subject is also focused on the measurement and evaluation of dimensions and tolerances of shape and position. The student will acquire the knowledge on the geometric parameters of machine parts, on production deviations and the methodology of their measurement. During the exercises, the student will practically verify the acquired knowledge, and will learn how to work with gauges and measuring devices. According to the assignment, the student performs practical measurements in the MTF STU engineering metrology laboratories. The student will acquire practical skills in the field of measurement.

It was not possible to carry out the measurements in person during online education. The exercises were carried out using Google GSuite. Since the measurements could not be performed, they were presented during the semester using video demonstrations. Then, in the classroom, the students were provided with the measured values of the measurements, which they then used in further processing. Each measurement was processed and transmitted in the form of a protocol. The protocols were evaluated, and the students had the opportunity to enter the discussion based on the teacher's comments.

The Fig. 6 shows a preview of the geometrical parameter measurements presentation within the MQTP subject. Fig. 7 shows the evolution of the exercises of the MQTP subject depending on the academic year, when this subject was taught.

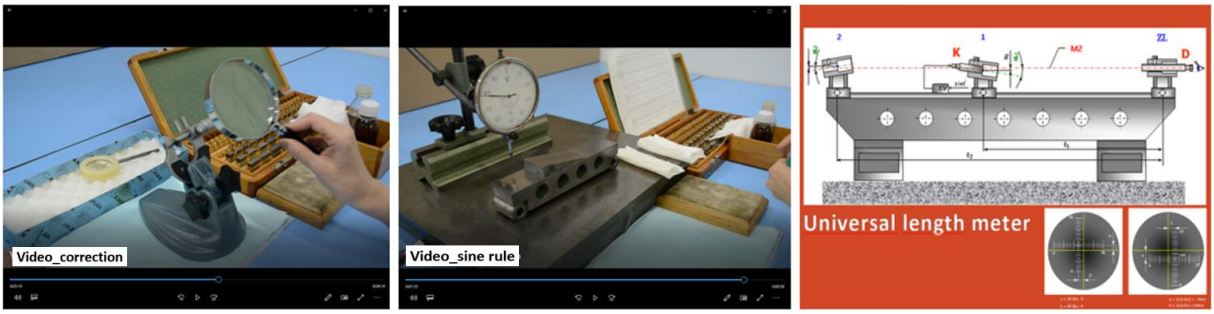

Fig. 6 *Presentation of measurements of geometrical parameters in the MQTP subject*

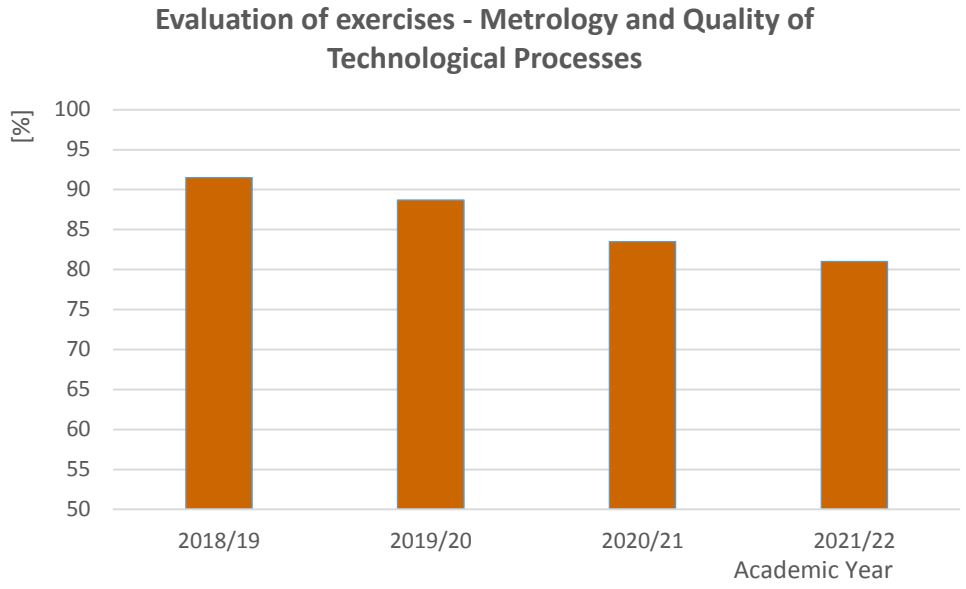

Fig. 7 *Comparison of exercise evaluation of the MQTP subject*

CONCLUSION

From the point of view of the Institute of Production Technologies, Faculty of Materials Science and Technology, STU in Trnava, it can be stated that:

- In accordance with theoretical assumptions, e-learning is a good tool for teaching software but the method is not optimal for teaching a laboratory subject.
- Teaching measurement within e-learning is possible, students' knowledge can be well tested even within this form of teaching.
- However, students lack the practical skill.
- It is not possible to try practical measurement and use measuring devices.
- Student success in online learning is roughly comparable to the face-to-face learning.
- To verify students' knowledge of laboratory subjects, it is advisable to supplement the exercises with review questions and a test at the end of the measurement.

Acknowledgement

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