

TRAINING IN COORDINATE METROLOGY – EXPERIENCES WITH A BLENDED LEARNING APPROACH

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Abstract:

Quality management decisions require precise and reliable measuring results. In manufacturing and assembling processes, production metrology plays a significant role in generating such results. For this reason, coordinate measuring machines (CMMs) are used more and more often due to their universality and flexibility. The quality of results generated by CMMs is highly dependent on the skills of the CMM operators. In order to minimize technicians' influence, they need to be provided with the necessary knowledge to carry out such tasks.

Efforts to introduce training at a national level led to the European project EUKOM, which developed a user-centred training course using new learning methods to meet the demands of CMM operators [1]. This project led to the foundation of the registered association CMTrain. Today, this association offers manufacturer-independent courses in coordinate metrology and it is continually improving learning methods and learning contents.

The courses combine face-to-face teaching, workshops and online learning in a blended learning environment. Using this concept, certified education and lifelong learning can be supported independent of the location of the students and available infrastructure.

Experiences gained with this training approach regarding users, tutors, training providers and developers as well as the application of new technical approaches such as mobile learning, new distribution channels for learning content and new possibilities for hands-on remote learning are discussed in this paper.

Keywords: Training, Coordinate Metrology, Blended Learning

1. TRAINING FOR COORDINATE METROLOGY

1.1 History of CMTrain

Based on the experience of several national training concepts for coordinate metrology [2] the EUKOM project was carried out, supported by the European Union. In the project

a well-funded and European-wide harmonized concept for teaching metrological competence and machine-independent basic knowledge for coordinate metrology was developed. The sustainability of project results was ensured by the foundation of Coordinate Metrology Training (CMTrain) [3]. This association was charged with further developing the EUKOM project results and now successfully offers training in the field of coordinate metrology on the market. CMTrain coordinates training activities and the further development of learning material.

1.2 Blended learning in CMTrain

The manufacturer-independent association CMTrain comprises a training programme at three hierarchical levels (Fig. 1). Level 1 is basic training, level 2 advanced training and level 3 training for specialists. Each training level includes hands-on experience using CMM manufacturer-specific measuring devices followed by further CMM-related training.

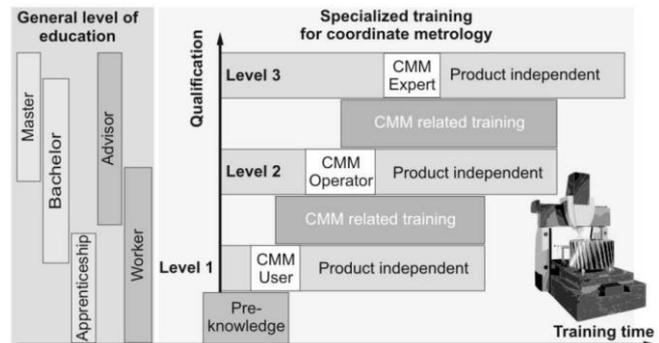


Fig. 1: The hierarchical training concept of CMTrain [4]

This training concept is used for training in industry and at private and state education establishments up to tertiary level.

The courses are offered as blended learning packages in various languages and include a final examination that is internationally recognized.

Each level of training consists of a combination of several forms of learning (Fig. 2). The learners and their tutors meet in person at a kick-off meeting e.g. at the regional providers' facilities. In the following e-learning phase, which lasts for

several weeks, the participants use a learning platform to gain the necessary theoretical background [5]. In this self-directed phase, participants have access to the learning material on a learning platform. The learners and tutors use communication tools, e.g. chat, forum, e-mail and other tools, which allow them to remain in contact with other learners and tutors. After this phase, a subsequent workshop on real CMMs allows small groups of four to five learners to gain very important practical experience. At the end of each level of training, there is an examination in theory and practice.

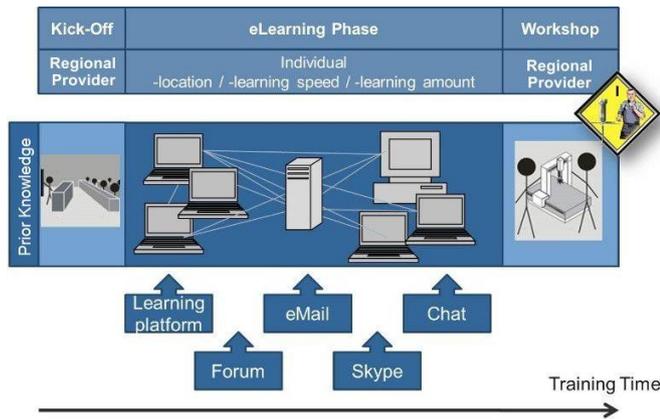


Fig. 2: The blended learning concept of CMTrain [6]

In several institutions, the access to real CMM for training is restricted or not available. In such a situation, other possibilities have to be chosen to offer practical experience. One possibility is to offer virtual workshops to support the learning success.

1.3 Field of application

The coordinate metrology courses offered by CMTrain are widely used in both industry and at private and state education establishments up to tertiary level. Industry not only accepts this training, it sometimes even demands it specifically in job offers. This shows that industry is highly satisfied with this training.

The interest shown by students to join the courses and take the exams voluntarily during their university studies will further spread the training so additional companies can profit from their knowledge. The students do this of their own accord, so this shows they realize the importance of this training in industry.

2. EXPERIENCES

Since CMTrain is international, cultural differences have to be taken into account when courses are offered. Workers in countries like Germany usually do these courses during

their working time. In Switzerland, however, many participants join the courses privately to maintain their own market value, build up knowledge and to improve at their job.

Some people prefer to learn in groups whereas others learn on their own or by way of internet communication. This especially affects countries where travel distances are much longer, such as South Africa.

2.1 Feedback from users

The blended learning approach (Fig. 2) is new to most participants. They first find it hard to manage their learning schedule. Once they get used to it, they see the benefit and the responsibility emerging from this freedom.

The communication between participants is highly dependent on the groups. Some participants meet to learn, others use the forum or learn by themselves. An interesting phenomenon is, if some of participants start using the forum, others are usually encouraged to use it too.

Participants benefit even more if they can discuss with people from the shop floor, sales, designers, manufacturers and decision-makers. A good mixture of participants in the group can enhance this effect.

Even after the course, discussions between alumni are possible. This leads to improvements in expertise and social networking.

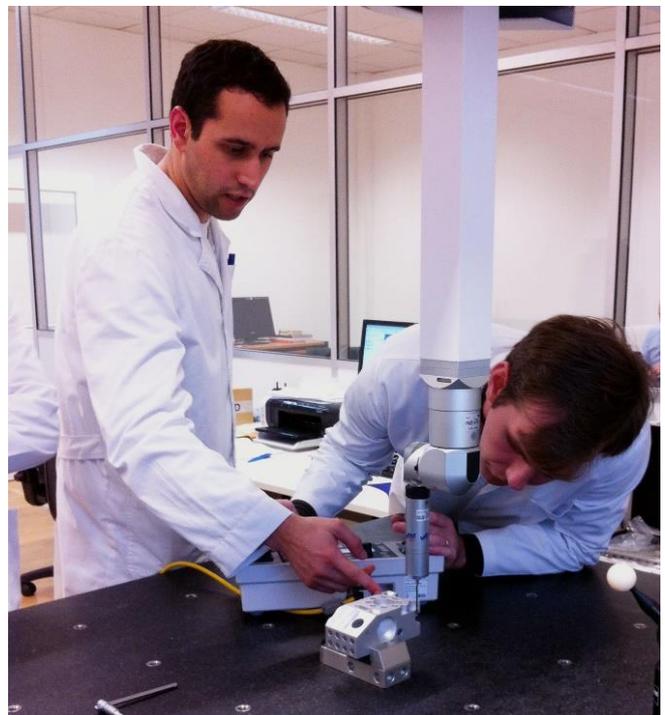


Fig. 3: CMTrain workshop at Technological Centre for Metal Working Industry (CATIM) in Portugal

2.2 Experience of tutors

Tutors need to maintain contact to their participants. It is very important to motivate people to learn. Many participants like to postpone their learning so it is important to keep an eye on this.

Compared to face-to-face teaching, questions from participants can be answered in a more flexible way. This means a tutor can answer questions for example in the evening, independent of working place. It is very rewarding for learners to receive answers in their learning time, which can be outside of normal working hours.

It is very fruitful for tutors to have contact to other tutors. This enables an exchange of knowledge and suggestions for didactic improvements. The train-the-trainer concept covers this to a certain extent but additional meetings improve this exchange further. Tutors make use of casual meetings, for example during fairs. Fixed meetings might be a good source of additional ideas.

2.3 Experience of course providers

For course providers, a CMTrain course offers not only earnings, it additionally helps to build up competencies and networking in industrial fields. The language independency of courses gives course providers the possibility to use the learning material according to their language needs. For example, Switzerland has many bilingual regions.

The advisory group of CMTrain delivers new inputs in industrial topics and didactics.

2.4 Experience of developers

As the platform is accessed online, the developers can instantly make updates of the learning material available. Even during a course, feedback from participants can be integrated.

3. NEW TECHNICAL POSSIBILITIES

Technology is evolving rapidly, not only in the field of metrology but also in how people use and consume media. Therefore, it is important to take improvements and changes into account.

3.1 Mobile learning

For some participants it is hard to sit in front of their desks after work. They want to go outside or learn in a more comfortable environment. New tablet computers like the iPad (Fig. 4) make it possible to read the learning material but still use the rich media included in the content. Furthermore, the use of smartphones makes it even more tempting to learn while on the go. However, these devices call for an optimized

interface that is different to the interface on a traditional computer due to size and touch input.

3.2 New distribution channels

The Moodle learning platform, used for CMTrain and many other educational programmes, works for most participants. In industry, however, this is not a platform participants are used to.

Since 2008, Apple has pushed its App Store and the number of 70 billion downloaded apps will likely be exceeded by the end of the year 2013. This shows how many people can be reached using a well-known system. Furthermore, people already know how to use these platforms.



Fig. 4: CMTrain course prototype on iPad mini

Additionally, being present in such an environment leads to free marketing because people will find the content by browsing the App Store. Other platforms to spread the media could also be used such as iTunes U, Google Play, traditional e-book services and many others.

3.3 Hands-on remote learning

Virtual devices can simulate real machines to a certain level of detail. Virtual machines are suitable for workshops if the workshop would be too dangerous or too expensive using real machines.

Developing virtual machines calls for a lot of effort in general and applies even when simpler experiments or simulations have to be emulated.

Workshops with real devices using a virtual interface (Fig. 5), for example over the internet, may be an alternative

to virtual devices. The situation enables more realistic feedback to the participants.

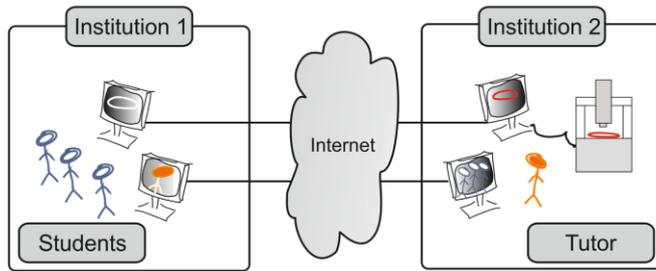


Fig. 5: Technical approach that integrates virtual workshops on real machines accessed via the internet. [5]

The new approach of using a real machine for training is to access the machine directly and control it over the internet in real time, providing the participants a workshop with a remote laboratory. This demands reliable feedback over the internet to be able to control the machine in a safe way. To prevent damage to the machine and to protect the user, safety aspects have to be taken into account. To handle the large amount of data, as is the case e.g. for optical CMM, special compression procedures have to be used [7].

4. OUTLOOK

Experiences gained with the blended learning approach obtained positive feedback, showing that the concept works at industrial and university levels. For this reason, it is very important to spread the idea of CMTrain internationally to give access to this concept for everyone.

The new technologies make improvements on a didactic level possible. Therefore, it is essential that these new features should be implemented to optimize learning opportunities and the learning effect.

Anyone interested in being a tutor on behalf of a corporate member or companies and institutes who wants to be a part of the bright future of CMTrain is welcome to contact the CMTrain association on cm-train.org.



Fig. 6: Logo of the CMTrain association [3]

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