IMPLEMENTING THE PRINCIPLES OF BLENDED LEARNING IN THE TEACHING OF METROLOGICAL SUBJECTS AT UNIVERSITY LEVEL

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Abstract: *This article provides information on the practical applications of Blended Learning principles in teaching metrological subjects at the Faculty of Materials Science and Technology in Trnava of the Slovak University of Technology (FMST SUT). The subjects concerned are Computer Aided Quality, Metrology and Quality of Technological Processes and Measuring and Inspection of Product Parameters.*

Keywords: E-LEARNING, BLENDED LEARNING, FACE-TO-FACE TEACHING, AIS – ACADEMIC INFORMATION SYSTEM

1. Introduction

New forms of teaching by way of online education are no longer an exception at most universities. Similarly, the trend for expanding the use of online education also exists in Slovakia.

This is a new type of knowledge society, where both theoretical and experimental knowledge is generated, obtained via the online teaching provided by an e-learning system. These forms contribute to and open up new areas for the direct use of knowledge, and are thus becoming to an even greater extent a popular form not only for students and teachers, but also for professionals in general. Students at the FMST in Trnava were able to experience the implementation of these new forms of teaching.

The particular subjects concerned were "metrological" ones: Computer Aided Quality, Metrology and Quality of Technological Processes and Measuring and Inspection of Product Parameters. The time allocated for these subjects is two hours of lectures and two hours of practical classes per week.

The following article describes the use of e-learning methods and blended learning in academic practice.

2. The e-learning environment

The concept of e-learning (electronic learning), or learning management system, is a teaching process carried out in so-called multimedia scenarios.

The latter integrate multimedia and (tele) communication technologies, thus enabling communication on a virtual platform, as well as playing back various files and materials, carrying out different tests, holding online conferences etc. It is a type of (online) software based on a web application. This teaching and education environment thus offers the user a great level of freedom in terms of place, time, staff and tools. (Fabian, 2007).

The use of e-learning for independent education is so versatile that many institutions are using it as part of their internal education systems. As well as this, the Organisation for Economic Cooperation and Development (OECD) gives two reasons for using e-learning in its brochure entitled "e-learning, the partnership challenge".

The first reason is the use of e-learning in educative activities which cannot be mastered without the use of technology (i.e. the dematerialisation of teaching from a time and place perspective, following the motto "anytime" and "anywhere", an interactive approach to sources by anyone who wishes to study as a distance learner, etc.).

The second reason is relations within education, which can be improved using information technology (i.e. the opportunity to choose your own style of work and learning, as well as the possibility of checking and monitoring your own learning process on your own, etc.).

From this point of view, e-learning is a new vision for education policy, which is trying to move on from an old-fashioned method of giving knowledge to a new – modern – method of interactive learning and education. (Horn, 2014, Singh, 2003)

3. The blended-learning environment

As mentioned above, e-learning is a way of managing teaching materials in a transparent manner. E-learning can even replace the process of traditional classroom teaching (so-called face-to-face teaching) to which we are accustomed.

We then call such a form of teaching (online or offline) virtual education. Compared to traditional face-to-face education, this form of teaching and learning is supported only by e-learning. (Fig. 1)

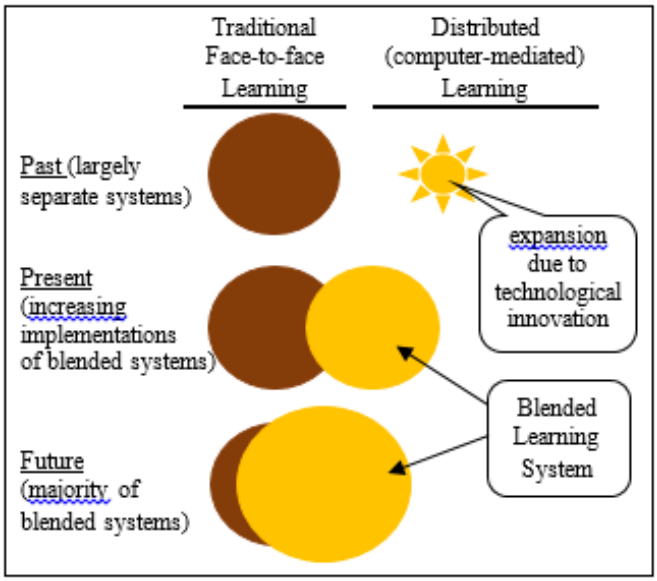

Fig. 1 *Blended learning (Bonk, 2016)*

Within this virtual form of teaching, the teacher provides his/her students with all documents, feedback, knowledge etc. in an electronic format adapted to e-learning needs.

E-learning even enables the teacher to divide students into various work groups, give those marks, set times for handing in work and other materials, launch an online conference etc. (Blended Learning, 2013, Yuen, 2010)

One of the further possibilities – or forms – of teaching is a so-called combined (integrated) form of teaching and learning, combining (integrating) a traditional form of teaching (face-to-face) and an online form of education, where the teacher gives feedback to his/her students both in the classroom and in the e-learning portal.

We then call this form of teaching "blended learning". From a methodological, media-didactic and media-pedagogical point of view, Blended Learning is not only about giving information, but also knowledge; we can thus talk of a so-called integrated form of processing and giving knowledge (Decsi, 2011).

4. The application of blended learning in the teaching of metrological subjects

Blended learning, that is the combination of a traditional form of teaching and online education, is applied in the teaching of metrological subjects at the FMST SUT in Trnava. The use of e-learning has been met with positive feedback from students. The lecturer was using AIS – the Academic Information System used at the FMST SUT in Trnava.

Lectures are held in face-to-face form. They mainly take the form of a monologue by the lecturer, supported by a relevant presentation of study materials. The lecturer's monologue includes dialogue (discussion) with student where necessary. The study materials presented are in the form of brief text notes. They mostly include images to illustrate and explain the subject being dealt with. The images often show practical examples of the application of the processes being studied. The presentations are made in PowerPoint, and where appropriate, the text and images are animated to enhance student attention. The lectures are available to students in electronic form via the AIS system. Students appreciated the fact that the lectures on these subjects are available in this system seven days a week and twenty-four hours a day. They can thus study and prepare for their lessons at their own tempo.

Practical classes are also face-to-face; here, students carry out practical measurements of products' geometrical parameters, work with measuring systems (management and measurement software of computer-supported measuring equipment).

Study materials are available to students in the AIS. These are mainly textbooks in electronic form, in Slovak and in English. As well as textbooks and the above-mentioned lectures, the AIS also has electronic material for practical exercises available to students as required.

Students often work on various essays in electronic form. The AIS system enables a schedule of topics to be created, where the lecturer can enter topics for the students' essays and dissertations. The lecturer can also open up a space to submit them: an electronic storage place for essays. This is not only of pedagogical importance, but also of economic and ecological significance. The students do not use up paper and printer ink pointlessly. The problem of archiving students' work is also solved: instead of taking up physical space in a real archive, the electronic essays take up only very little space in the AIS system.

The students' knowledge is tested using a combined (integrated) form. Part of the exam is in traditional, written form. In this part, the students are tested on measurement tables, for example, and various calculations. The second part of the exam is carried out using information technology in the AIS system. Each student has a test generated for them with closed questions. The questions are chosen at random from databases divided up according to individual specialised topics in the examined subject. There is a pre-determined number of questions chosen at random in each topic. Each exam is therefore unique: no student has the same test as another student. The questions are aimed at testing basic concepts, definitions and theoretical knowledge in the given subject area. For each question, the student can select one correct answer out of four possible choices.

The exam is set for a limited time, defined in advance, and the screen shows at all times the time remaining. The exam ends when the set time is up, or when the test is closed (sent) in the AIS. While the exam is ongoing, the student can change his/her answers at any time. If he/she is unsure of the answer to any question, he/she can leave it out. He/she can do so by not selecting any answer, or by choosing "no answer to this question". One of the great advantages of this form of exam is how quickly the test results can be had, since the number of points obtained and the percentage success rate of the computer test is displayed on the screen immediately after its submission (sending).

Another huge advantage of such testing lies in the feedback: the lecturer can follow statistically the success rate of answers to individual questions. It is thus possible to analyse both the weak and strong points in students' knowledge and then to suggest and introduce corrective measures to improve the teaching process. The tests are automatically archived in the AIS. Since it is an electronic archive, it is not only of pedagogical importance, but also of economic and ecological significance (as mentioned in the case of students' essays and dissertations).

5. Examples of electronic materials

Figures 2, 3 and 4 shows the examples of the electronic lectures to which the students have access in the AIS.

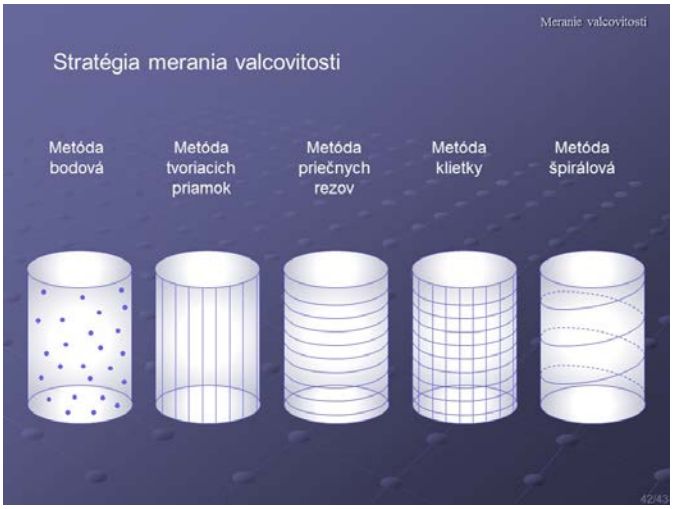

Fig. 2 *Electronic lectures – Strategy for measuring of cylindricity*

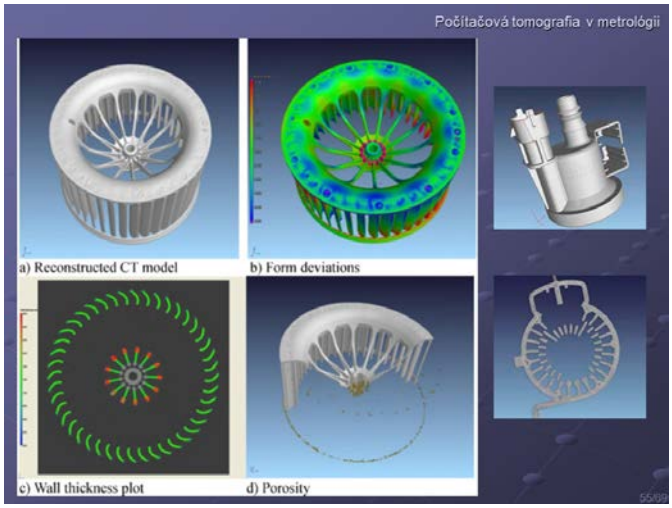

Fig. 3 *Electronic lectures - Computed tomography in metrology*

Fig. 4 *Electronic lectures - Calibration Artifacts*

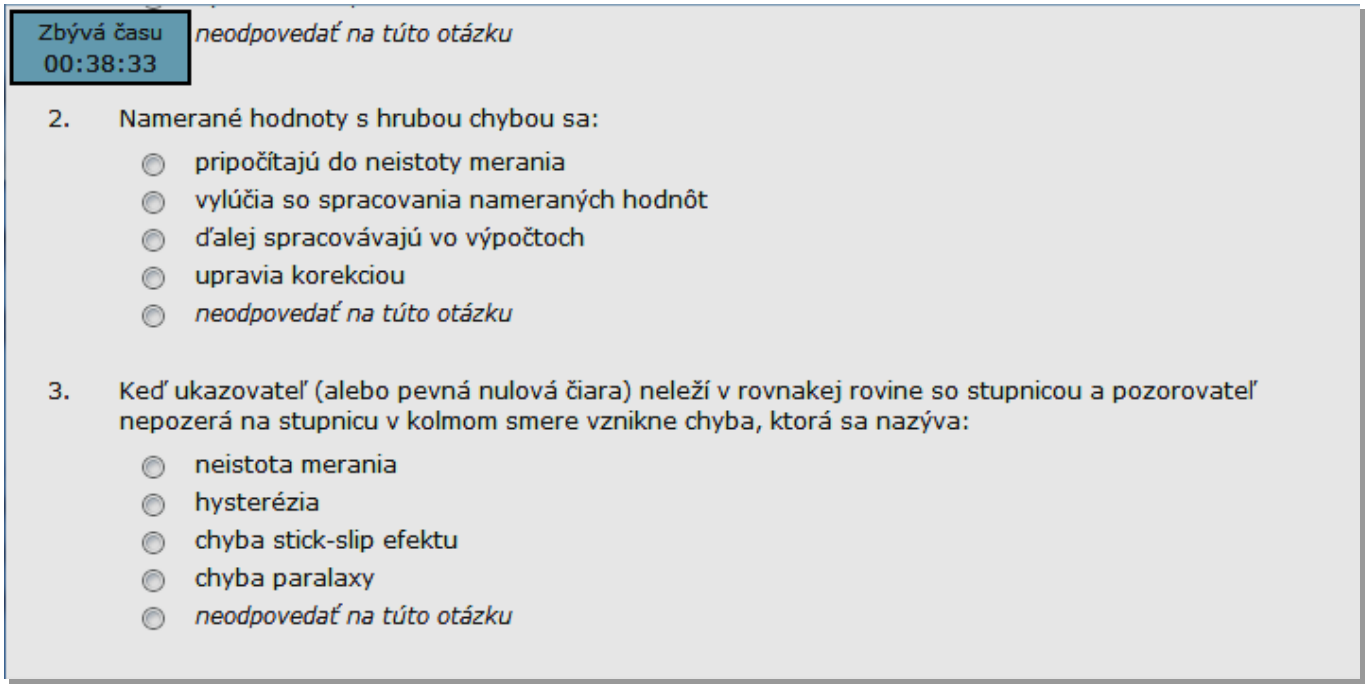

Fig. 5 *Example of a test in the AIS system*

For example, in fig. 2 the strategies for measuring of cylindricity are displayed:

- Spot method
- Method of generating lines
- Method of lateral cuts
- Cage method
- Spiral method

Figure 3 shows the use of computed tomography in metrology and fig. 4 represents the calibration artifacts. Figure 5 shows part of a test in the AIS system. The top left-hand corner shows the time remaining until the end of the test. Below are the possible answers to question 2:
"Values measured with a gross error"
- Are modified by correction
- Are further processed in the calculations
- Are excluded from the processing of values measured (correct answer)
- Are added to the uncertainties of measuring
- No answer to this question

The following answers are possible for question 3:
"When the indicator (or a straight zero line) does not lie on the same level as the scale, and the observer is not looking at the scale perpendicularly, an error results which is called:"
- Measurement uncertainty
- Hysteresis
- Error of parallax (correct answer)
- Error of stick-slip effect
- No answer to this question

6. Conclusion

The use of Blended Learning, that is a combined form of teaching, where a traditional teaching method (face-to-face) is combined with an online method, shows every sign of being a very way forward. It is an efficient tool for procuring information and knowledge. At the FMST SUT in Trnava, this new approach to education is also being applied to metrological subjects.

Benefits can be felt in the pedagogical, economical and ecological domains. In the future, an online form of communication between lecturer and student will need to be further built and expanded. At present, the department is trying to set up a project to enable the creation of online video communication via the Internet. The aim is to show live demonstrations of measurements from laboratories directly on the students' laptops and tablets.

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References

Fabian, P., Veen, W., Mühren, A. Finding a balance in blended learning with extralarge student groups. In 5th International Conference on Emerging e-Learning Technologies and Applications. 6 – 8. September, 2007, Košice, pp. 311 - 316

Horn, M. B., Staker, H., Christensen, C. M. Blended: Using Disruptive Innovation to Improve Schools. San Francisco, Publisher: Jossey-Bass, 2015, ISBN 9781118955178 (ebk)

Singh, H. Building Effective Blended Learning Programs. In: Educational Technology, 2003,Volume 43, Number 6, pp. 51-54

Bonk, C. J. & Graham, C. R. (Eds.) Handbook of blended learning: Global Perspectives, local designs. San Francisco, CA: Pfeiffer Publishing [cit. 22.9.2016] Available at: http://www.click4it.org/images/a/a8/Graham.pdf

Blended Learning. The Glossary of Education Reform, 2013 [cit. 2016-10-03] Available at: http://edglossary.org/blended-learning/

Yuen, A.H.K. Blended learning in Higher Education: An Exploration of Teaching Approaches. Proceedings of the 18th International Conference on Computers in Education, November 29 - December 3, 2010, Putrajaya, Malaysia, p. 623-630

Decsi, K. Lovrantová, K: Metóda a didaktika Blended Learning a e-learning vo vyučovaní technických predmetov v akademickom prostredí na Slovensku. Prípadová štúdia. (Method and didactics of Blended Learning and e-learning in teaching metrological subjects at universities in Slovakia. Case study) MVEK Prešov 2011, p. 381-387, ISBN 978-80-555-0482-7

Akademický informačný systém (Academic Information System)[cit. 22.9.2016] Available at: https://is.stuba.sk