Journal of Achievements in Materials and Manufacturing Engineering
VOLUME 29
ISSUE 1
July
2008

E-learning on the example of materials science

L.A. Dobrzański*, F. Brom
Division of Materials Processing Technology, Management and Computer Techniques in Materials Science, Institute of Engineering Materials and Biomaterials, Silesian University of Technology, ul. Konarskiego 18a, 44-100 Gliwice, Poland
* Corresponding author: E-mail address: leszek.dobrzanski@polsl.pl

Received 19.03.2008; published in revised form 01.07.2008

Education and research trends

ABSTRACT

Purpose: The main aim of this article is to present the use of the Moodle educational platform in teaching Fundamentals of Materials Science and Metal Materials in the Institute of Engineering Materials and Biomaterials at Silesian University of Technology in Gliwice, and to analyse the efficacy of e-learning as the means of introducing education within a traditional model.
Design/methodology/approach: This article contains the description of learning within the mixed mode, which is education embracing a face to face method and distance learning method for the first-year students. The comparison of the efficacy of mixed mode learning versus traditional learning will be presented.
Findings: The efficient method of assisting remotely the e-learning students acquiring skills and knowledge at a varying pace has been developed, providing them with the personalised support.
Research limitations/implications: Larger population of students should be tested so as to give measurable results, which would imply what needs to be worked on and what changes to introduce in order to improve the e-learning process.
Originality/value: The course presented in this article confirms that e-learning enables the introduction of the new education formula, which may embrace advantages of traditional teaching and distance education as far as Materials Science is concerned.
Keywords: E-learning; Computer supported education; Moodle; Blended learning; Diversifying power of a task

1. Introduction

E-learning, according to M. Nichols, may be defined as the teaching method, which may be used in different educational models (for instance in traditional or distance teaching), but also in various teaching philosophies (for instance behaviourism or constructivism) [1].

The development of computer technology and access to the broadband Internet and increasingly common ownership of the computers in households, make it possible to become more and more common as the means of communication in education. E-learning is most commonly used for trainings of the workers of big companies, public administration and higher education. Lately, it has been more often used in education both on the level of junior secondary school and secondary school, as well as an academic one.

Such an intense development of this teaching method is only possible due to the financial support of the European Union. The main aim of the Union programs is the adjustment of education and teaching systems used in European Union to the economy based on knowledge and computer technologies.

The cooperation of a student and a teacher takes place either during the direct meeting or by means of synchronic or asynchronic links, or even without personal contact, when a student's work is based on multimedia courses available through the university or other information found in a global net.

Distant learning in comparison to a traditional one may be treated as an additional method, giving extra information or as a replacement of all the existing traditional courses or only of the

particular chosen subject. It is especially important in Polish reality, because the number of adults improving their qualifications is one of the lowest among the member countries of OECD. The report of the European Commission and Council for Education, entitled "Modernization of the education and training systems: an important input into Europe's well-being and social coexistence" published in 2006, shows that the degree of literacy of people aged 16-65 in our country is high and the education of working people has little connection with the profession they do.

The preparation of a new training offer for grown-ups, the one that is not only convenient but also cheap, may turn out to be a very effective stimuli of the competence development for the economy based on knowledge [2-7].

2. Experimental procedure

2.1. Moodle platform

E-learning Platform of the Institute of Engineering Materials and Biomaterials was established in October, 2004 as a modern distant teaching tool and contains teaching materials for lectures and materials science subjects as well as instructions for laboratory exercises carried out in the Institute available for students and for interactive communication with students and Institute staff (Fig. 1) [8-9].

E-learning Platform of the Institute was also used to test teaching efficacy of the mixed mode method in Fundamentals of Materials Science for year one students of Mechanical Engineering and Technological institute of the Silesian University of Technology.

2.2. Research methodology

Research was carried out for two terms. Within the first term, the results of teaching were measured in the Fundamentals of Materials Science subject of taught in a mixed mode method to a group of 270 students. Within the second term the measurements were repeated taking into consideration the results achieved by 200 students taking part in the classes connected with the subject of Metal Materials. In both cases students were divided into two equal groups: traditional and mixed. In each of the groups students signed for one of the sections of 15 students. Both subjects were taught by the same teachers, each of them was teaching in one traditional group and one that was mixed.

The traditional group had two types of classes: in even weeks laboratory exercises, where students got acquainted with the equipment and made measurements following the instructions and board exercises. In odd weeks, teachers checked whether students were prepared theoretically and discussed the results of measurements, or possibly solved odd exercises. The mixed group, in even weeks, had identical classes with the traditional group, but instead of board exercises they participated in the Internet course online, included in the institute educational platform.

The traditional group had two types of classes: in even weeks laboratory exercises, where students got acquainted with the equipment and made measurements following the instructions and board exercises. In odd weeks, teachers checked whether students were prepared theoretically and discussed the results of measurements, or possibly solved odd exercises. The mixed group, in even weeks, had identical classes with the traditional group, but instead of board exercises they participated in the Internet course online, included in the institute educational platform.

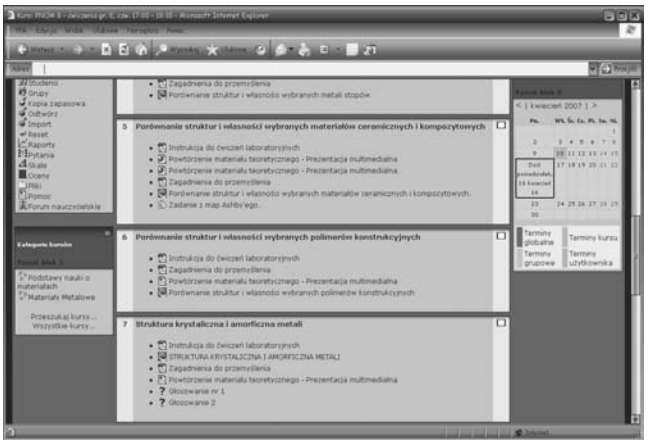

Fig. 1. An example of materials for students on "Alloy tool steels"

Separate courses were prepared for both subjects. They included the following tools: exercise instructions, presentations, self-evaluation tests, tasks, voting, discussion forum, chat.

Mixed group students could use the platform resources any time they wanted. They simply had to log in using the given password. The time of the chat was set by the teacher and the students. Voting sporadically took place before the chat. Students were individually informed about the results of tests checking their knowledge with reference to each exercise, as well as about their marks and comments referring to a task. The results of test or marks acquired from the tasks did not influence getting the credit from the subject. The credit was given on the basis of the final test taken by both groups at the same time and checking the same knowledge and skills [10-13].

3. Results of the research

In Table 1 there are the results of the final test in the Fundamentals of Materials Science (PNOM) and Metal Materials (MM). In the first case each participant could gain maximum 23 points, and in the second one 36. The results turned out to be very similar for both groups, which may mean, that supporting traditional teaching with the distant teaching is equally efficient as the traditional methods. In the first final test a statistic student got 52% points, whereas in the second one 66.6%. Such a big difference seem to result from the following: the weakest students give up their studies after the first term, and also the subject Metal Materials is a kind of continuation of the Fundamentals of Materials

Table 1.
Statistic description of the final test results

Group	Traditional -	Mixed -	Traditional-	Mixed MM
Average	11.90	11.99	23.94	24.02
Average result in %	51.17%	52.13%	66.50%	66.72%
Median	12	12	25	25
The highest result	21	21	33	32
The lowest result	4	5	10	12
Standard deviation	3.04	3.30	4.75	4.02

Table 2.
Comparison of the results from the different sections

Section	A	B	C	D	E	F	G	H	I
Mixed group - PNOM	10.16	12.93	12.75	11.36	10	12.43	11.4	12.6	13.62
Traditional group - PNOM	11.33	11.26	12.86	12.27	10.25	11.36	10	12.13	13.67
Mixed group - MM	23.25	26.09	24.04	22.89	25.09	21.42	24.00	25.66	-
Traditional group - MM	24.33	24.00	24.53	24.84	26.83	21.87	17.89	26.25	-

Science, which results in a natural increase of knowledge and skills in this area. The differences between the average results were quite considerable in particular sections. They are presented in Table 2.

After the quantitative analysis of the tasks, we can draw the conclusion that in the first term simplicity coefficients for open tasks in the traditional group of students were considerably higher than the same factor in the mixed group. In the multiple-choice tasks the results were reverse, that means higher simplicity coefficients in individual tasks appeared in the mixed group. It results from the fact that the traditional group students did not solve tests on table exercises, whereas e-learning students very seldom gave written answers to open questions. After introducing changes in the way of checking students' degree of preparation for the classes in both groups, the differences decreased vividly. Apart from the information about statistical characteristics of a single task (omission fraction, simplicity coefficient), a correlation between task results and test results was determined, that is diversifying power of a test task. It determines the capability of a task to differentiate students according to their general achievements in a given syllabus. Diversifying power of a task was calculated according to the formula:

$$r_{is} = \frac{n\sum ix - (\sum i)(\sum x)}{\sqrt{[n\sum i^2 - (\sum i)^2][n\sum x^2 - (\sum x)^2]}}$$

where: r_{is} – diversifying power of a task, i- the task result of a student U (U=1,2,3…,n), x – the test result of a student U (U=1,2,3…,n), n – the number of tested students [16].

In the final test in the subject "Metal Materials" nine tasks in the traditional group and six tasks in the mixed group were solved correctly, mainly by the best students (r_{is}>0.4), and those tasks may be classified into the group which is characterized by satisfactory diversifying power. Minimum diversifying power of the task (r_{is}>0.2) was characterized by fifteen and twelve tasks in the examined groups appropriately. The other several tasks slightly diversified students' abilities, although in those cases diversifying power was positive as well. A higher value of standard deviation proves that there was a bigger diversity of students in the traditional group as far as mastering syllabus material in this subject is concerned (Table 1).

After each term the on-line course participants answered the questions included in evaluation questionnaires. The first one was aiming to improve the technical aspect of the course and the conclusions were drawn to elaborate the introduction of the course on Metal Materials. The other questionnaire, summing up the experiment, was quite a lengthy one and it is difficult to comment on it entirely in this very article. The most significant conclusion was that immense majority of students (88%) would be willing to choose the mixed group once again (Fig. 2.).

They prepared for classes most often using resources included in the education platform and the academic book (Fig. 3). It corresponds with the Polish research results PISA 2006, which among the strongest points of junior secondary school and secondary school pupils mentioned: reading with understanding, knowledge of science and ability to explain natural phenomena in a scientific way. Polish pupils, more often than their peers in OECD countries, watch regularly TV scientific programmes, read scientific articles in newspapers and magazines, browse through scientific websites. The Internet is also a very important source of scientific information for students. In the experiment, the students

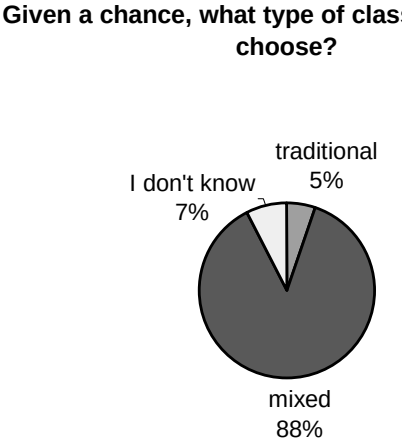

Fig. 2. Results of the questionnaire on the kind of classes

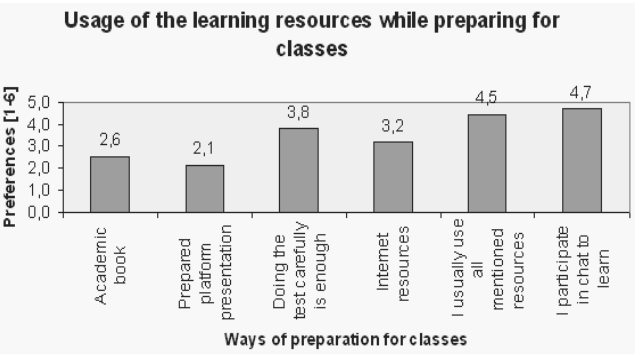

Fig. 3. Ways of preparation for classes (1 – most often, ..., 6 –.least often)

asked "what sources they use to search for scientific information", put the Internet definitely at the first place, and reading rooms and libraries at the further ones. This answer was chosen both by students in the mixed and traditional groups. Holding classes in the mixed way considerably influenced the way of communication between students and teachers. Electronic mail is preferred by over 40% of students in the mixed group, and only 16% in the traditional group. According to the students, academic teachers also accept this way of communication. Only 4% of students believe that teachers' attitude to this form of communication is negative [14-21].

4. Conclusions

The results of the research allow to draw the number of conclusions. Research results for two courses presented in this article confirm that an e-learning method enables the usage of the new teaching formula, which may embrace the advantages of traditional teaching and distant teaching of the Materials Science. As to a technical aspect, there is no possibility to have conference conversations or videoconference, because majority of students are not equipped enough to do it. The progress in this field is so fast that it will become possible quite soon. The post-graduate studies or any other form of training for adults using the mixed mode learning method become a tempting reality at the Mechanical Engineering and Technological Institute of the Silesian University of Technology.

Acknowledgements

Investigations were partially financed within the framework of the Polish State Committee for Scientific Research grant No N50720932/4094.

References

[1] M. Nichols, A Theory for eLearning, Journal of Educational Technology & Society 6/2 (2003) 1-10.
[2] L.A. Dobrzański, R. Honysz, Z. Brytan, Application of interactive course management system in distance learning of material science, Journal of Achievements in Materials and Manufacturing Engineering 17 (2006) 429-432.
[3] L.A. Dobrzański, R. Honysz, Development of the virtual light microscope for a material science virtual laboratory, Journal of Achievements in Materials and Manufacturing Engineering 20 (2007) 571-574.
[4] T.Walasek, J. Piątkowski, D. Morawska-Walasek, Information technologies supporting students' mobility, Journal of Achievements in Materials and Manufacturing Engineering 25/1 (2007) 429-432.
[5] W. Torbacki, E-learning for manufacturing enterprises and universities based on ISOF Academy, Journal of Achievements in Materials and Manufacturing Engineering 22/1 (2007) 93-96.
[6] J. Świder, P. Michalski, G Wszołek, Laboratory support for the didactic process of engineering processes automation at the Faculty of Mechanical Engineering, Journal of Achievements in Materials and Manufacturing Engineering 15 (2006) 1999-2006.
[7] M. Gumińska, J. Madejski, Scaleable model of e-learning platform, Journal of Achievements in Materials and Manufacturing Engineering 21/1 (2007) 95-98.
[8] E-learning Platform of Institute of Engineering Materials and Biomaterials – http://www.platforma.imiib.polsl.pl/.
[9] J. Cole, Using Moodle: Teaching with the Popular Open Source Course Management System, O'Reilly Media, London, 2005.
[10] B. Galwas, Virtual Polytechnics – conception and goals, Warsaw University of Technology, Centre for Remote Education, Mewa 6 (2003) 77-81 (in Polish).
[11] J. Bednarek, Multimedia in education, PWN, Warsaw, 2006 (in Polish).
[12] A.K. Stanisławska, Looking for optimal educating model trough the Internet. Methods of remote courses design, Mewa 5 (2002) 44-47 (in Polish).
[13] H. Tuzun, Methodology of on line education, e-Mentor 2 (2004) 9-10, http://www.e-mentor.edu.pl.
[14] St. Pałka, Pedagogical Methodology. Research Practise, Gdańsk Pedagogical Publication, Gdansk, 2006 (in Polish).
[15] St. Juszczyk, Methodological bases of empirical researches in computer since, Impuls, Cracow, 1998 (in Polish).
[16] B. Niemierko, Measurement of Education Results, WSiP, Warsaw, 1999 (in Polish).
[17] T. Bender, Discussion-Based Online Teaching to Enhance Student Learning: Theory, Practice and Assessment, Stylus Publishing, New York, 2003.
[18] L.A. Dobrzański, F. Brom, Z. Brytan, Usage of e-learning in teaching fundamentals of materials science, Journal of Achievements in Materials and Manufacturing Engineering 24/2 (2007) 215-218.
[19] L.A. Dobrzański, F. Brom, The advantages of the e-learning method in higher educational system on the example of the subjects on material science at Technical Silesian University in Gliwice, Proceedings of Conference "Moderni informacni a komunikacni technologie ve vzdelavani" Infotech 2007, Ołomuniec, 2007, 281-286 (in Polish).
[20] Programme for International Student Assessment (PISA) 2006 results from: http://www.pisa.oecd.org/.
[21] The Research Results 2006 in Poland from: www.men.gov.pl/…/polski_raport_PISA_2006 (in Polish).