

# Use of e-learning in teaching fundamentals of materials science

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## Education and research trends

### ABSTRACT

**Purpose:** The main aim of this article is to present the usage of educational platform Moodle in teaching Fundamentals of Materials Science 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; Mixed mode

## 1. Introduction

There are many definitions of e-learning, one of them says: e-learning is the means of introducing education, which can be used in many different education modes (for example in traditional and distance education) and philosophies of education (for example behaviorism and constructivism). E-learning is based on using different net distributed technical tools. The development of computer technology, broadband access to the internet and increasingly common computers in a household, make this means of communication become widely used in education. What increases especially quickly is the number of trainings meant for the workers of big companies, public administration, and higher education. It is also becoming more popular in middle and

secondary schools. The development is highly financed by different European Union programmes supporting e-learning. Its main goal is to adjust education and teaching systems in European Union to economy based on information technology and knowledge [1-6].

E-learning may be realised in many ways. Available methods and techniques may be grouped in five categories:

- time accessibility,
- practical techniques,
- student - teacher cooperation,
- relations to traditional learning,
- level of formalization.

The radio and television broadcast and instructions, aided with computer, (e.g. interactive courses, manuals for self-instruction of

programs, simulations etc) and sent via internet as a gathering of information (www sites, educational films and instructions, electronic libraries, P2P programs etc), or across tools of communication (mailing programs, text and voice communicators, discussion forums, platforms of a group work, audio and videoconferences etc) can be assigned to the practical techniques.

Student - teacher cooperation can be realized in courses with presence of teacher (in asynchronous or synchronous modes), courses without participation of teacher, but basing on multimedia information and instructions and in independent learning, based on different kinds of accessible information in electronic form, in particular with content of www sites as well as with conversations with other persons (discussion forums, e-mails, communicators etc.). It can be regarded as a supplement for traditional learning, e.g. virtual campus or as a replacement of traditional learning - of all or only for concrete object.

There are two levels of formalization: formal learning - strictly related to programs of learning of the university (related with system ECTS) and informal learning - not related with programs of learning of the university, but actively developed and valued supplement of the traditional learning [7-16].

## 2. Experimental procedure

### 2.1. Moodle platform

E-learning Platform at the Institute of Engineering Materials and Biomaterials was created in October, 2004 as a modern distance education tool and contains: didactic materials used for lectures and materials science classes as well as instructions for laboratory classes in the Institute, available for students. It is also used for interactive communication among students and the Institute employees [3, 4].

Institute E-learning Platform was also used to test teaching efficacy of mixed mode method with reference to Fundamentals of Materials Science for the first-year students (Fig. 1) of the Faculty of Mechanical Engineering of Silesian University of Technology in Gliwice.



Fig. 1. E-learning platform with available interactive courses for online group

### 2.2. Research methodology

Research was carried out on the group of 270 students, having a constant access to the internet, who were divided into two equal groups: traditional and online one. In each group students enrolled to one of the nine sections, each of nine teachers ran classes for one traditional and one online section. The traditional group had two types of classes: in even weeks - laboratory classes, when students got acquainted with apparatuses and made measurements in accordance with the instructions referring to the table exercises. In uneven weeks - table exercises, when teachers checked theoretical preparation of the students and commented on the results of the measurements, or they dealt with particular tasks. The online group in even weeks had identical classes. Instead of table exercises they took part in an online course available on the Institute educational platform. The course was divided into ten theme parts, and each part contained the following e-learning tools:

- exercise instructions,
- presentations consisting of theoretical part referring to each and every exercise, drawings, animations,
- individual and automatic evaluation test,
- exercises to do and send in within a set time,
- voting, checking student's preparation for a chat,
- discussion forum,
- chat.

Students could use the platform resources at any time convenient to them. The only thing they had to do was to log in using their own password. The prepared course was available solely to the group of online students. The time of chat was unequivocally named by the teacher and the learners. Voting took place sporadically just before the beginning of a chat. Students were informed, individually, about the results of the test referring to each exercise, as well as about the evaluation including comments on the exercises that had been sent in. Test results, as well as evaluation of the exercise did not influence the fact whether the student was given a credit or not in the subject. The credit depended on the total assessment resulting from the final test given to both groups simultaneously, testing the same skills and knowledge.

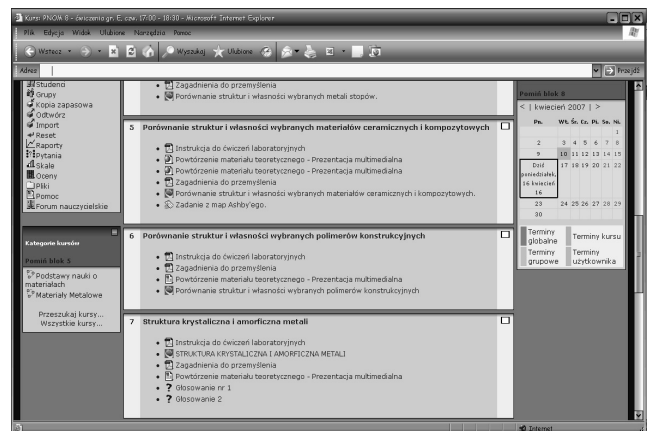


Fig. 2. Teacher's view of examples of the e-learning tools in the interactive course

### 3. Results and discussion

Table 1 shows the obtained results, basing on performed Final Exam. Each participant could get 23 points. The results turned out to be very similar for both groups, which means that distance education supported teaching is as effective as traditional methods.

Table 1. Statistic description of the final exam results

Statistic description	Traditional group	Online group	Total result
Average	11.90	11.99	11.94
Middle result	12	12	12
The highest result	21	21	19
The lowest result	4	5	4
Standard deviation	3.04	3.30	3.16

There were quite significant differences between particular sections. They are presented in Table 2.

Test and exercises which were done during the course and evaluation did not influence the results of next tests, but there is a significant convergence between them and the results of the final exam. Similarly to traditional learning, systematic work improves the results. Table 3 shows a percentage comparison.

The quality assessment of the answers shows that traditional students group was better at open questions, whereas the other was better at the closed ones (Table 4). It results from the fact that the first group didn't attend table exercises, whereas the others hardly answered the open questions in a written form. The participants of the online course answered the questions in the survey 'Have the didactic materials offered by platform

Table 2. Comparison of the results of the particular sections

Student section	A	B	C	D	E	F	G	H	I
Online group, point	10.16	12.93	12.75	11.36	10	12.43	11.4	12.6	13.62
Traditional group, point	11.33	11.26	12.86	12.27	10.25	11.36	10	12.13	13.67
Difference, point	-1.17	1.67	-0.11	-0.91	-0.25	1.07	1.4	0.47	-0.05

Table 3. Comparison of the results of the tests during the semester to the results of the final test in online group sections

Student section	E	A	G	D	F	H	C	B	I
Final exam results, point	10	10,2	11,4	11,4	12,4	12,6	12,8	12,9	13,6
Tests and exercise results, %	60%	68%	59%	75%	80%	84%	82%	78%	78%
Final exam results, %	38%	39%	44%	44%	48%	48%	49%	50%	52%

(instructions, presentations, tests, voting, tasks) supported your learning process?' in the following ways (Fig. 3).

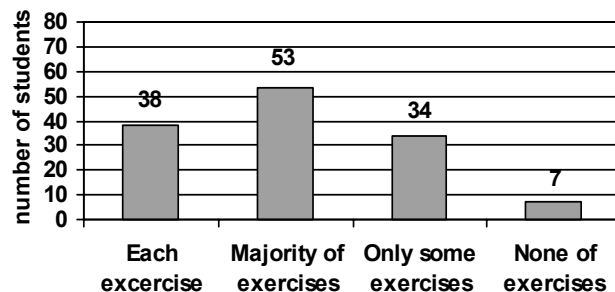


Fig. 3. Have the didactic materials offered by platform supported your learning process?

They also thought that this education method is more interesting, which may result from the fact that it was the first time they worked using this method (Fig. 4).

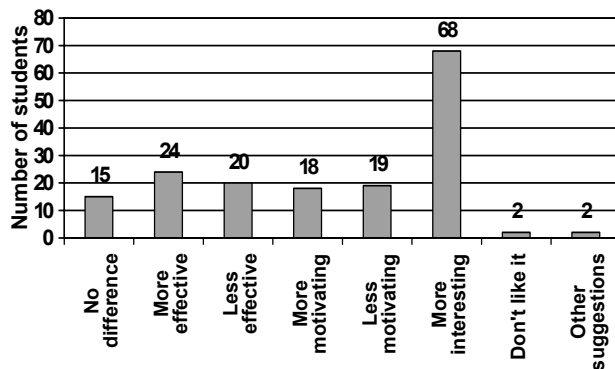


Fig. 4. How do you find effectiveness of online learning in comparison with traditional methods?

Table 4.

Easiness of the tasks in the traditional group, online and the whole tested population (test tasks and \*-open tasks)

Number of a task	1*	2	3	4*	5*	6*	7*	8*	9	10	11*	12*	13	14*	15*	16
Points	1	3	2	1	1	1	2	1	2	2	1	1	2	1	1	2
Easiness for every student	0.85	0.30	0.51	0.89	0.81	0.78	0.39	0.50	0.33	0.53	0.46	0.95	0.32	0.49	0.86	0.13
Easiness for online group	0.88	0.25	0.50	0.90	0.83	0.80	0.39	0.54	0.38	0.49	0.53	0.92	0.32	0.56	0.85	0.13
Easiness for traditional group	0.82	0.36	0.52	0.87	0.80	0.76	0.40	0.47	0.28	0.57	0.39	0.97	0.32	0.42	0.87	0.13

Basing on the questionnaire performed on analysed student group for the question: Which of the offered didactic resources was most useful? Students evaluated this question in the range of 1 to 4, where grade 1 was the most usable recourse; the figure 5 represents students evaluation of given question.

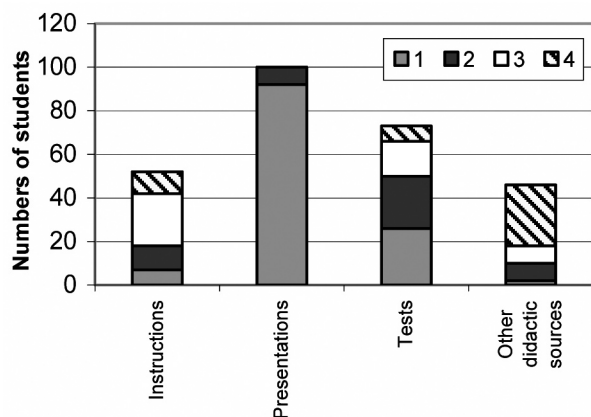


Fig. 5. Students' evaluation of the question: which of the offered didactic resources was most useful?

## 4. Conclusions

The research results allow to draw certain conclusions. The course presented in this article confirms that e-learning enables the introduction of the new education formula, which may include advantages of traditional teaching and distance education as far as Materials Science is concerned. What needs to be worked on is the differentiation of testing forms to check if the students learn issues properly. There is no technological possibility for us to have telephone conference and videoconference, because majority of students are not properly equipped to do so. In this branch the progress is extremely quick so hopefully this opportunity will be possible quite soon. The method of blended learning doesn't involve any changes as far as the role of the teacher is concerned; the only things that change are: ways and methods of communication and instructing students. Students consider this form of learning far more interesting. Thorough analysis may be carried out only after the next few courses prepared for other subjects.

E-learning systems are being rapidly developed and it's only a matter of time, when such systems become an integral part of all Higher Education teaching and learning in the future.

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