

PURPOSE AND FORM OF REALIZATION OF THE BLENDED LEARNING SYSTEM DURING CHEMISTRY ACADEMIC COURSES

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Abstract

In the academic year 2003/2004, the Department of Chemistry Didactics began modification of courses: 'General Chemistry with the Elements of Physical Chemistry' for the first year of biophysics and 'Phase transitions in a Solid State', intended for fourth-year chemistry students. The main reasons for modification of these courses were the unsatisfactory final grades of students in both courses. Preliminary research shows that students have difficulties in understanding the above-mentioned lectures due to lack of elementary knowledge. There is also a great differentiation between the levels of the skills and knowledge of students. Considering the above-mentioned situation, we have proposed to use elements of distance learning for equalization of the level of knowledge, the so-called blended learning system (Bonk & Graham, 2004). The full paper presents the methodology of preparing and the application of blended learning classes at an academic level, the findings of questionnaire surveys on how students find the blended learning system and statistical analyses of exams.

Key words: *blended learning, distance learning, general chemistry, learning system.*

Introduction

The Bologna Declaration signed in 1999 by the countries of integrating Europe has initiated changes in higher education systems in many member states. In the case of Poland these changes coincided with the reform of the education system at lower levels. The reform has changed the structure of the Polish school introducing a six-year primary school, three-year lower secondary school and three-year upper secondary schools. The obligatory number of hours for teaching subjects pertaining to natural science in secondary schools has also been decreased. As regards chemistry, pupils must pass at least a three-hour course in the whole educational cycle; however it can be even 12 hours in the case of profiled classes. As regards higher education three-year Bachelor's studies and two-year supplementary Master's degree studies have been implemented (Until 2006 alternatively students could take up undivided five-year Master's degree studies).

At present studies are taken up by young people who have completed education according to the new system. We have also several years' experience in working with students who finished their first-degree studies and begin the second-degree studies. Worse teaching effects as regards courses given during first years of first-degree and second-degree studies have been observed. At the Department of Chemistry Didactics, Jagiellonian University, detailed research works to diagnose the existing situation have been carried out. The research has been performed for the following courses:

- 'General Chemistry with the Elements of Physical Chemistry' (GCh) – first year of first-degree studies, speciality – Biophysics.

- ‘Phase Transitions in a Solid State’ (PTSS) – first year of second-degree studies, speciality – Chemistry.

In the case of the course ‘GCh’ questionnaire survey was conducted (Broś, Kluz, & Migdał-Mikuli, 2008), which made it possible to find the main causes of that situation:

- differences in the total number of chemistry teaching hours in post-lower secondary schools,

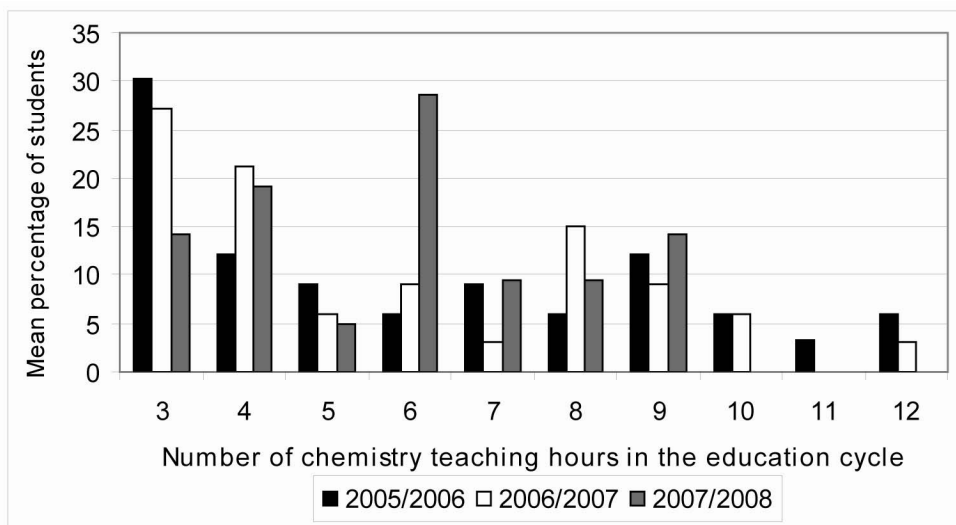


Figure 1. Number of chemistry teaching hours in the education cycle – survey conducted among biophysics students in the years 2005-2007.

as well as:

- no chemical experiments performed by young people,
- liquidated division of classes into smaller groups,
- shortening of upper secondary school education to 3 years (formerly 4 years).

Similar survey was also conducted among students attending ‘PTSS’ classes. This course is obligatory for four-year chemistry students (first year of second-degree studies) within the profile ‘Photochemistry and Spectroscopy’. The participants should have elementary knowledge of spectroscopic methods and related methods (Migdał-Mikuli & Bernard, 2006). The genesis of the problem is similar in this case. The participants of the course are students, graduates of first-degree studies, various lines and specialties; hence they are prepared differently to the perception of the subject matter of the lecture. Similar problems can be observed during many specialist courses.

Summing up it can be stated that the main reasons of the problems with perception of the subject matter during both of the above mentioned courses are:

- unsatisfactory preparation of students,
- high differentiation of the students’ level of knowledge and skills.

The existing situation makes it necessary for didacticians and academic teachers to propose a new education model (Migdał-Mikuli & Broś, 2005). To meet these needs the Department of Chemistry Didactics, Jagiellonian University, has proposed to modify the present classical education model. It has been proposed to include the elements of distance learning in the new model. The program of the above-mentioned courses has been adjusted to be taught using the blended learning method. The blended learning method assumes the classical teaching (face to face) to be aided with teaching using the computer technique (Picciano, 2006). For that purpose didactic materials have been elaborated which enable the visualization (Broś, Migdał-Mikuli, Kluz, & Bernard, 2006) of the subject matter of the lectures, and the program of exercise classes has been modified as well. In addition, multimedia materials have been prepared, intended for independent work of students who are going to take the

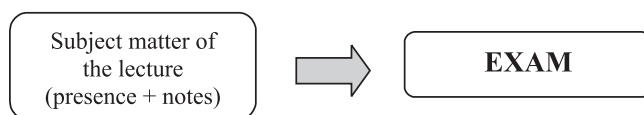
courses. Two manners of making these materials available to students have been proposed:

- in a form of application written to CD,
- realized with the use of the Moodle e-learning platform.

The materials for the students have been elaborated according to the following scheme:

- **‘What you should already know’** – the part of the material which should be known to students before the lecture or exercises.
- **‘The lecture part’** – the part of the material that is introduced during the lecture, presented with the use of various multimedia techniques.
- **The part ‘Check yourself’** – the part in which students can check the state of their knowledge using the enclosed texts.

a. Classical education:



b. The proposed blended learning system:

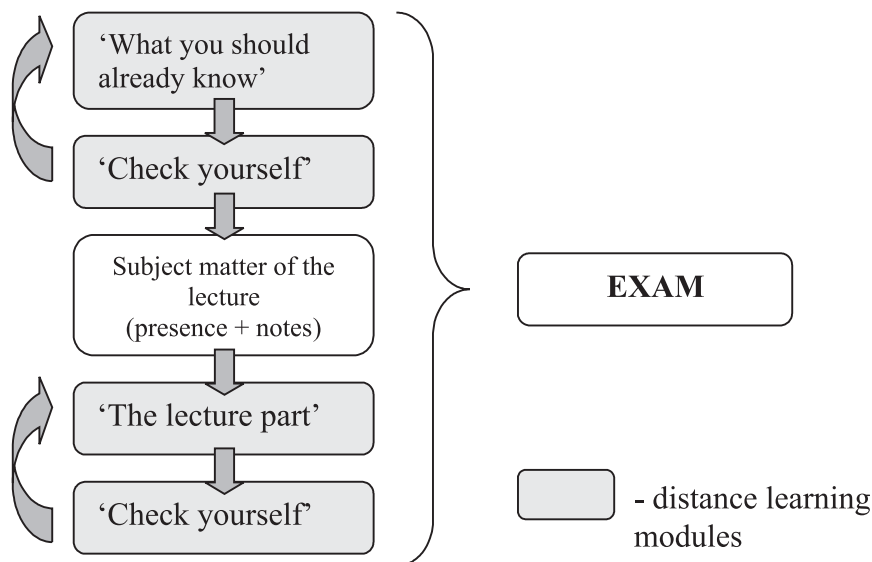


Figure 2. Graphical presentation of the education systems.

Such an education concept makes it easier for students to prepare themselves for a lecture, which results in better perception of the lectured matters. The modules ‘check yourself’ (Bernard, Broś, Migdał-Mikuli, Kluz, & Poźniczek, 2006) containing tests show students what they should know about definite problems. In this system the burden of making up arrears and equalizing students’ level of knowledge is shifted to a considerable extent to distance learning. The use of such a didactic aid does not dispense a teacher from reminding the essentials, however we can expect that a lecture will take a more efficient course and a lecturer will be able to spend more time on new parts of the material as well as on those which students find difficult. Such a form enables thorough preparation for an exam.

The questions we attempted to answer for the purpose of the study:

1. Will the introduction of the blended education system result in greater knowledge increments in students?
2. Will the students gladly accept the proposed education system together with all its modules?
3. In what form should the materials intended for independent students' work be made available?

The answers to these questions are necessary in order to estimate the effectiveness of the elaborated blended education system.

Methodology of Research

The works consisting in preparing the new program of the 'GCh' course and specifying the scope of knowledge checked during the final exam were undertaken in 2004. In 2005 estimation of the teaching effects was started, first during the course conducted according to the classical method and then during the gradual introduction of the elements of distance learning.

In the academic year:

- 2005/2006 – the course was conducted using the classical method,
- 2006/2007 – first elements of the distance learning were introduced,
- 2007/2008 – the new education system was introduced in its complete form.

The increment in students' knowledge was estimated on the basis of the following tests:

- diagnosis test – conducted during first classes in each year of studies, checking the secondary school chemistry knowledge,
- final exam – administered to students who had finished the course and taken the exam at the first term.

The increment in knowledge was estimated as a difference between the average percent result of the final exam obtained by students of a given year and the average percent result of the diagnosis test.

Another field of study was validation of the elaborated education model. For that purpose questionnaire survey was conducted. The survey made it possible for students to give their opinion on the usability of the proposed modules of the multimedia materials, and especially the modules intended for independent students' work.

The preferred form of making the materials available to students was also estimated on the basis of the conducted questionnaire survey.

Results of Research

Estimation of the effectiveness of teaching using the classical method and the blended method.

Tabele1. Results of the 'GCh' course: diagnostic tests, final exam and calculated knowledge increment obtained in the years 2005-2007.

Academic year	Mean percentage of the points obtained		
	2005/2006	2006/2007	2007/2008
Diagnosis test	59,3	62,7	57,1
Final exam	62,5	68,3	67,2
Knowledge increment	3,1	5,6	10,1

The results show that students participating in the course in the academic year 2007/2008 made the greatest progress in spite of the fact that they were worst prepared for the course.

Estimation of the usability of the course modules

The basic assumption of the system is independent students' work before taking classes. The offered materials are to make that work easier. The conducted questionnaire surveys have made it possible to estimate the usefulness of the materials included in this module, the degree to which they are utilized and the preferred form of making the materials available to students.

Table 2. Results of the survey conducted among biophysics students in the years 2006-2007.

Question No.		Percent of answers
1.	Do you find the module 'What you should already know' useful in preparing yourself for classes?	
	d. yes	49.0
	e. rather yes	39.2
	f. no	5.9
	g. it was not useful at all	0.0
2.	How often did you use the obtained materials?	
	a. I used them before each class.	47.1
	b. I often used them.	23.5
	c. I used them from time to time.	23.5
	d. I rarely used them.	5.9
3.	How, in your opinion, should these materials be made available? (multiple-choice question)	
	a. in a form of a CD or a DVD	82.4
	b. on the Moodle e-learning platform	29.4
	c. in a form of a course book (to be copied)	11.8
	d. in another form	0.0
4.	Did you have access to the Internet during the course?	
	a. yes	82.4
	b. no	17.6

Discussion

The results obtained make it possible to notice that as successive elements of the blended education system were implemented, the students' knowledge increment gradually increased. The estimated average percent increment in student's knowledge during the course conducted using the blended method, in relation to that conducted using the classical method, exceeds 10%. The obtained results are very satisfactory.

Another element was the estimation of the usability of the 'GCh' course modules, elaborated wholly for independent students' work.

The module 'What you should already know' has been considered useful in preparing for

classes by almost 90% of the students. Students willingly work with the use of the materials; about 70% of them systematically do so. These results confirm the fact that the elaboration of the course in the form of the presented modules, and especially the inclusion of the module enabling the completion of knowledge, necessary for the perception of new subject matters of the lectures, is the right choice.

From the point of view of the authors and those conducting a course, the form in which the materials are made available to students is extremely important (Burewicz & Miranowicz, 2005). The results of the survey show that more than 80% of students are willing to work with the use of electronic materials offered on CDs and somewhat less than 30% of students want to use the materials published in the Internet. The unwillingness to use the Internet sources does not result from lack of access to the Internet because as many as 82% of the students had constant access to the Internet during the course. The students explain their unwillingness to use the materials published in the net by too slow Internet connection and lack of mobility (students have access to the Internet mainly in student hostels, not at home).

Both the proposed forms of publishing the materials for students make it possible to enrich the text with multimedia files, for example animations, didactic films, interactive particle models, interactive test questions, etc. Unfortunately, when the materials are offered on CDs, it is difficult to follow directly the progress by means of statistical analysis of data collected during the online work.

It is a noteworthy fact that only 12% of students are willing to use classical printed materials. This shows that classical materials have been to a large extent supplanted by their interactive equivalents.

Summary and tasks for the future

The results obtained so far have shown that the proposed education system using the blended learning method makes it possible to improve the effects of teaching first-year students. Students willingly and systematically use the didactic materials prepared for them. The proposed modules of the course make it easier for students to make up arrears and to prepare more efficiently for the final exam.

We consider it necessary to continue the research during the 'GCh' course and to carry out analogous research for the 'PTSS' course. A pilot introduction of the elements of distance learning by means of the Moodle e-learning platform is also an important task.

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