EVALUATION OF ELABORATED STUDY MATERIALS IN PHYSICS AT RIGA TECHNICAL UNIVERSITY

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ABSTRACT
Elaborated multimedia study materials in physics at Riga Technical University are under investigation. The wide range of study materials including topics of lectures, animated presentations of lectures, and animated problem solutions, animated instructions for real laboratory works, short (6-7 min) teaching movies, and multiple-answer tests for self-control are developed. In addition, physical thesaurus and overview of physics study materials in the Internet are elaborated.
All study materials are organized by using Blackboard Learning System ML™. This system allows not only to develop all kinds of study materials and tests, but also to organize and control student's work with all study materials and other activities in frames of the learning system.
We have analyzed the usage of elaborated materials and compared it with students' examination grades for testing of the effectiveness of electronic study materials in comparison with traditional ones. The investigation of first year students' progress in physics shows, that the determinative is the number of lecturer-guided classes and not the usage of e-learning study materials. The results of our analysis show that multimedia study materials are used as complementary study materials for non-assisted studies of physics (in the evenings of working days and weekends). The certain correlation between number of accesses of learning content and students' grades in the examinations also exists.

KEYWORDS
Physics teaching, electronic study materials.

INTRODUCTION

The process of learning always is related with the acquisition of knowledge and skills from different sources. It can be realized either in the traditional way by the assistance of teachers or instructors during classes or in up to date way, which becomes more and more popular – by the usage of different electronical study materials. The advantage of the traditional study methods is the continuous feedback between students and teacher, the drawback – fixed timetable of classes and frequent different background of students if one class. It is possible to choose the time of study and amount of devoted time for each selected topic of study by the usage of electronical study materials in different learning systems.

Mover multimedia as a way of presenting learning material provides valuable and diverse resources more than a traditional text-book. Rich multimedia presentations have been successfully used for supporting learning on desktop computers for years. Only recently due to improved Internet connections it becomes widely available outside university. There has been also a substantial research carried out on educational value of multimedia. A number of theories have been created to assist analysis of multimedia and to create guidelines for improving media based learning scenarios. Cognitive load theory (Sweller, 1999) and cognitive theory of multimedia learning (Mayer, 2001)

turned out to be quite successful for analysis of multimedia instructional material. By emphasizing the role of the human cognitive system and its resource limitations (e.g., limitations in processing channels, working memory, and attention) theories allow to seek and find most relevant instructional material creation approaches. Researchers seem to agree that when multimedia is combined with proper instructional approaches it yields effective learning. The drawback of this method of study – the lack of continuous feedback, students can not obtain answers on the questions arising during the usage of electronic study materials. Also, if the electronical study materials are used outside of classes, teachers can not check the quality of obtained skills and knowledge. Therefore, in our opinion the most perspective and useful is blended learning method when students can attend classes and get all necessary information (for repetition, refreshing of background or getting more knowledge) online, by using specially prepared electronical study materials.

In this research authors try to analyze the impact of both the number of classes and the usage of electronical study materials on the level of acquired knowledge in physics. We try also to find the relation between the intensity of usage of electronic study materials and students' progress in physics.

DESCRIPTION OF ELABORATED STUDY MATERIALS

The top level organization of the materials in the virtual learning environment is according to their type: topics of lectures, video presentations, presentations of the problem solution in step-by-step manner, materials for the preparation and execution of the laboratory works (including descriptive text and a video presentation), educational movies, tests, dictionary of used physical terms, overview of Internet resources for the each topic.

The detailed description of elaborated study materials is given in (Blums, 2006).
In each such section materials are grouped according to the time schedule. There are 32 parts in each section corresponding to 32 study weeks (or 2 semesters for physics in Curriculum). This is especially important for self-control reasons - for materials of each study week three tests are elaborated: (1) one for theory, (2) one for practical skills in the problem solution and (3) one for the corresponding laboratory work.

All study materials are organized in the virtual learning system - Blackboard Learning System ML™. This system allows registration of all users, control of their activities in framework of this system, management of access to created documents, provides a communication between users and instructors, offers management of tests and other activities necessary for successful mastering of physics.

THE METHOD

As already mentioned before, it is very difficult to evaluate the quality of skills gained from electronical study materials, therefore as the first parameter of students' activity we use the number of accesses (NA) of the Blackboard. We acquire the information of the students' NA over the 24 hours and week as well as compare the final grades in physics with the NA.

To evaluate the impact of classes we analyze the grades of students for the last two study years (2006/2007 and 2007/2008). This investigation compares the grades (10 point system; 1 – the lowest, 10 - the highest one) obtained by students on entry test, showing the knowledge entering the Riga Technical University (RTU) then with the grades after the first and the second semester. Analysis was done for two study groups – the first group includes students with 6 credit Physics and contains 903 students, and the second one were the students with 8 credits Physics and contains 344 students. The changes in the amount of students in both groups are taken into account, too. All results were normalized to 100 %.

RESULTS

STUDENTS' ACTIVITY OVER 24 HOURS AND THE WEEK

In Figure 1 we can clearly see, that the students' activity increases at the evenings, after classes (4 p.m. and later). In our opinion this is a good evidence for the fact that electronical study materials, even prepared for non-assisted study of physics, do not replace the traditional method of study by the attendance of classes, but are used as a complementary source of information.

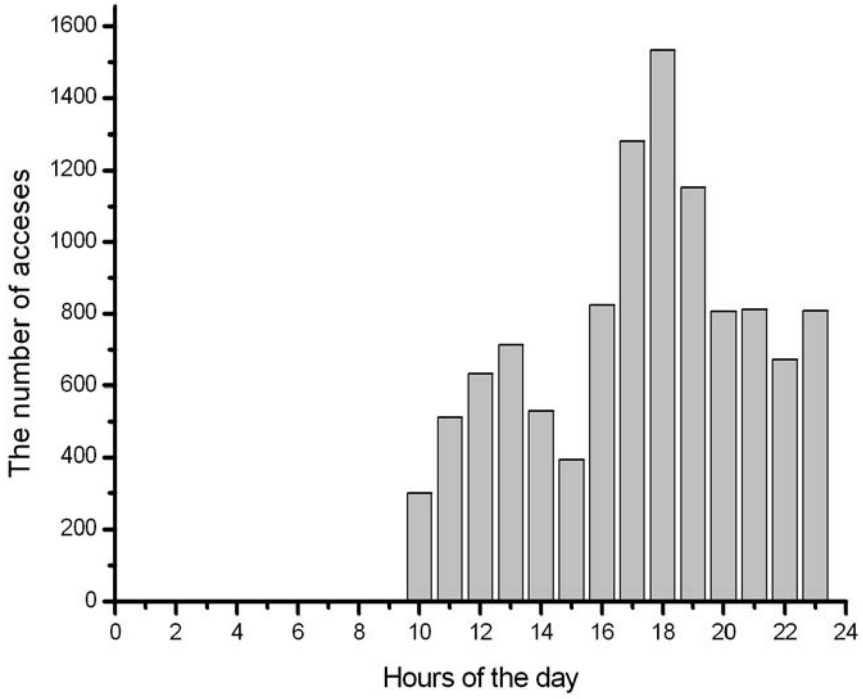

Figure 1. The distribution of the number of acceses of electronic study materials over the 24 hours.

Figure 2 shows how study materials are used over the week. We see that the lowest level of activity is on Saturday, but increases before the week days, especially actively on Sundays – electronic study materials are used for the preparation to the laboratories.

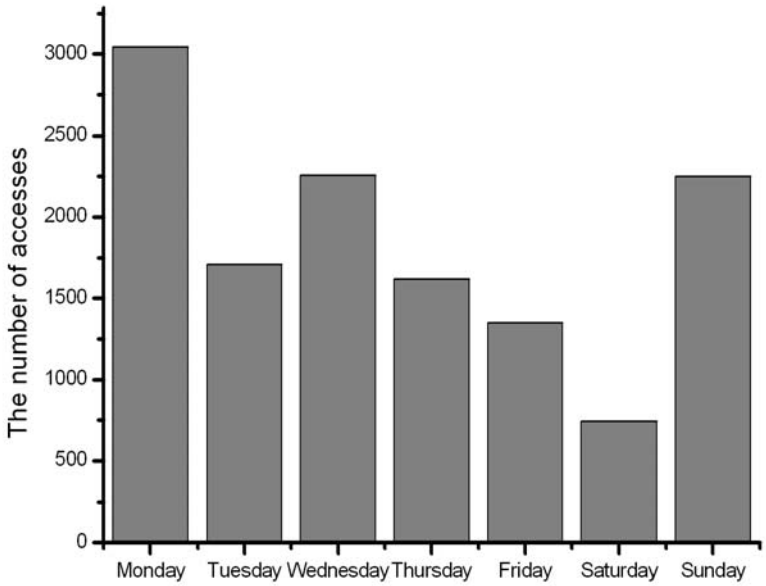

Figure 2. The distribution of the number of acceses of electronic study materials over the week.

The analysis of the relation between students' NA of the Blackboard and the final grade in the examination shows, that there is no full correlation between its (see Figure 3.). We can see that the activities in usage of the electronic study materials are not the determinative of final grade. For such analysis the background of students must be taken into account because for students with lower background more time is needed to get the same final grade. Therefore, we can not maintain, that the higher grades are due to the more intensive exploiting of electronic study materials and vice versa.

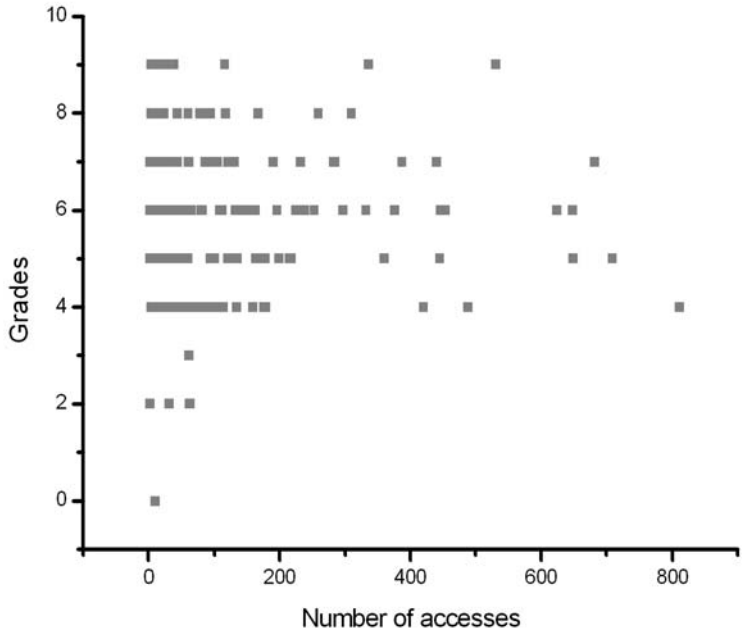

Figure 3. Final grades in the physics examination as a function of the number of accesses of the Blackboard.

THE IMPACT OF THE NUMBER OF CLASSES

The first students' group under investigation includes students from two faculties of the RTU (Fig. 4 – Faculty of Electronics and Telecommunication, Fig. 5 – the Faculty of Building and Civil Engineering). Students were examined by different professors. Entry test for both faculties gives the similar results; see curve 1, Fig. 4 and Fig. 5. We can see that the greatest part of grades are between 5 (moderate) and 6 (almost good), and the number of students with higher and lower results is less. In comparison with results after the first semester (see Fig. 4 and 5, curve 2) the same qualitative shape and small quantitative difference is observed. In both cases the main part of students has the lowest grade 4 (almost moderate). The number of students with higher grade diminishes with grade. The results after the second semester shows a small amendment, but the main part of students obtained no higher mark 6.

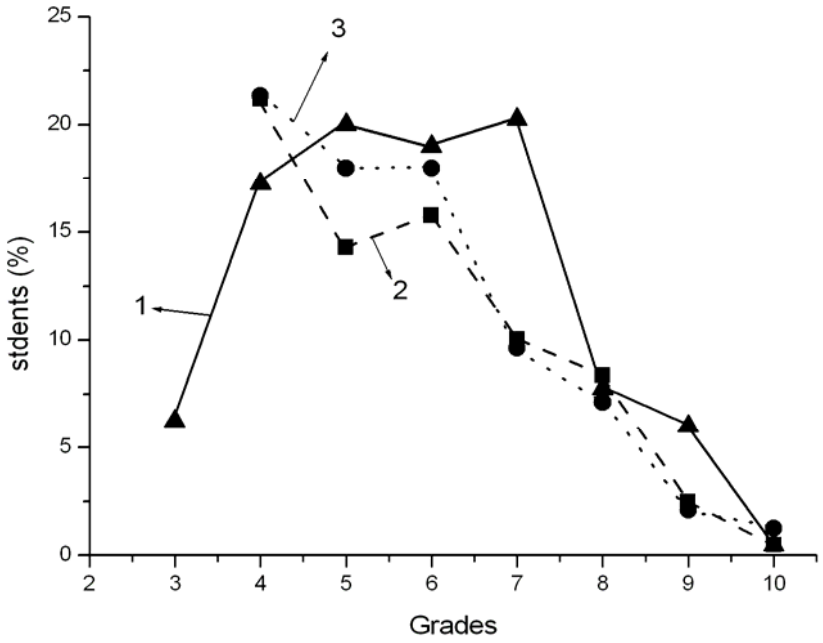

Figure 4. The distribution of students' grades (the Faculty of Electronics and Telecommunication) for grades of the entry test (curve 1), the first semester examination (curve 2), and the second semester examination (curve 3) for 6 credits Physics.

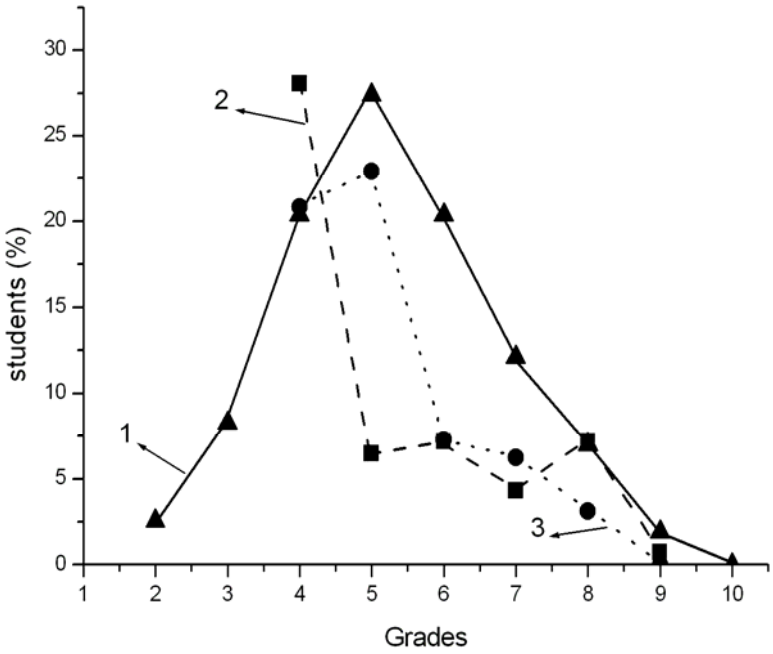

Figure 5. The distribution of students' grades (the Faculty of Building and Civil Engineering) for the entry test (curve 1), the first semester examination (curve 2), and the second semester examination (curve 3) for 6 credits Physics.

From these results we can conclude that the efficiency of studies for 6 credit Physics course in the first semester is rather lower than in the middle school and only in the second semester they are getting adjusted to the new style study of process .

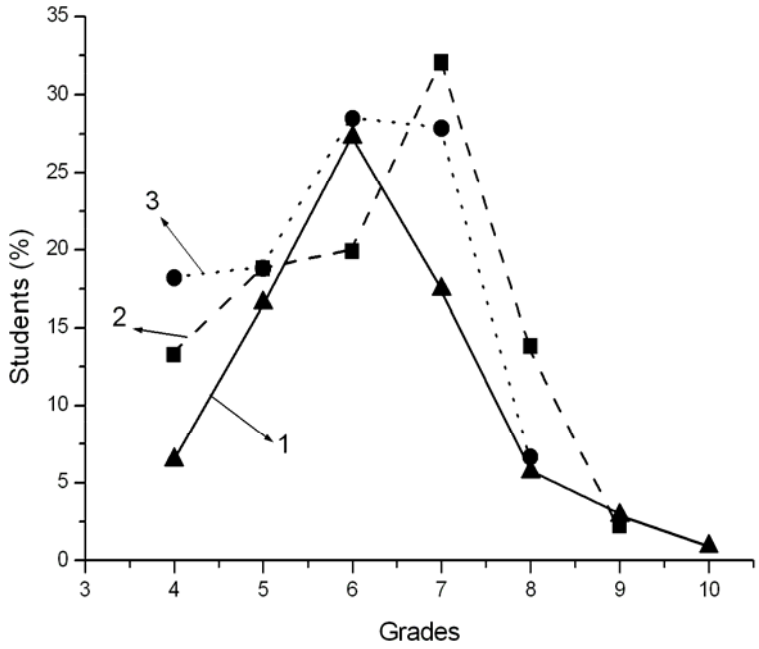

Figure 6. The distribution of students' grades for the entry test (curve 1), the first semester examination (curve 2), and the second semester examination (curve 3) for 8 credits Physics.

The results for the second students' group (see Fig. 6) with large number of contact lessons (8) substantially differs from the results for the previous group. In this group students of two faculties – Faculty of Transport and Mechanical Engineering and Faculty of Material Sciences and Applied Chemistry are included. Fig. 6 shows both quantitative and qualitative difference from results of Fig. 4 and 5. The grades of the entering test show the same shape but the results of the first and the second semester exam are higher.

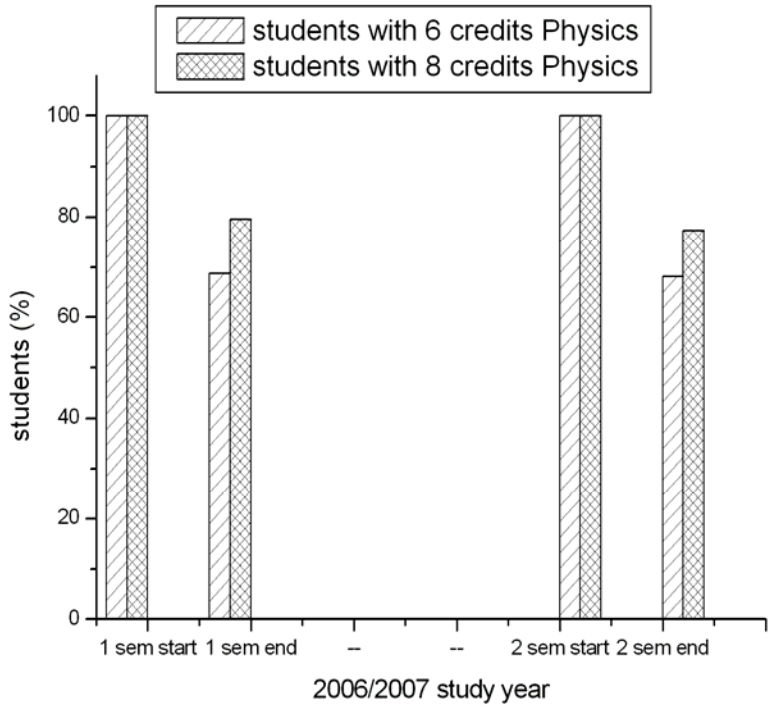

Figure 7. The changes of the amount of students in 6 and 8 credits Physics courses along 2006/2007 study year.

In Fig. 7 changes of the amount of students in both groups under study is shown. There is compared the number of students at the beginning and the end of the study process. The graphs show that the dropout rate of the students in the group with 6 credit Physics is close to 10 % higher than for students with 8 credit one. This is a good proof for enlarging of contact lessons what gives to the lecturer a possibility to work additionally with poor students, namely – to realize specialized methods for students with different level of knowledge and skills.

The analysis of the preliminary results of examination grades of this study year 2007/2008 shows qualitatively the same situation with nonsufficient deviation about 10-12%.
Therefore we can maintain, that the number of classes is the determinative for the successive physics mastering.

The obtained results are powerful for step-by-step changing of the style of teaching process from the middle school to the university and that part of the unassisted work for students has to be enlarged gradually.

CONCLUSIONS

We tried to analyze the usage of elaborated materials and to compare it with students' examination grades for the evaluation of the effectiveness of electronic study materials in comparison with traditional ones. The investigation of first year student's progress in physics shows, that the determinative is the number of lecturer-guided classes and not the usage of e-learning study materials. It has been shown, that for the same initial level physics knowledge students after 8 credits Physics with additional time for lecturer-guided problem solving have better results in the exam after each semester. The dropout rate of the students for this group is lower, too.

The results of our analysis show that multimedia study materials are used as complementary study materials for non-assisted study of physics (at the evenings of working days and weekends). There is also a certain correlation between the number of accesses of learning content and students grades in the examinations.

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