

## **Application of Internet Technologies in Teaching Higher Mathematics at Universities**

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## **INTRODUCTION**

Today, a wide spectrum of mathematics teaching methods has been developed [1 – 3]. However almost all of them refer to a range of teaching methods that are widely applied in primary and secondary schools. At university, mathematics teaching is still provided by means of traditional methods and technologies, the success being almost entirely dependent on the teacher's personality and students' knowledge.

The essence of teaching lies in the ability of a teacher to stipulate and control students' cognitive activity that is defined by the learning outcomes of a certain educational program. One of the basic principles of mathematics teaching is its fundamental character that is determined by the following statements:

1. mathematical concepts and problem solution methods must be of certain level of abstraction to guarantee their wide application;
2. applied mathematical concepts must include accurate definitions; basic statements must be proved;
3. all materials must be presented in a logical order, while the structure of the course must comply with the complementary disciplines.

## **1 INTERNET TECHNOLOGIES IN EDUCATION**

Modernization of educational system is an essential constituent of the society modernization. Modernization of educational system implies the use of up-to-date information technologies aimed at achieving psychological learning goals and outcomes. Information technologies are those technologies, which are built upon special technical means (computer, audio, movie, and video). When computers became an integrated part of teaching process, the term "new teaching information technology" was coined [4]. The internet is one of the most important providers of information and communication technologies (ICT). The application of such a powerful instrument allows solving a great number of educational problems, precisely, when it comes to distance learning.

Nowadays, internet technologies are one of the most efficient components of math education in HEIs in the USA, West Europe and Japan. The issue of introducing internet technologies to the educational process for math learning in Russian HEIs becomes more and more relevant. Finding proper responds to this issue will not just foster the improvement of students' math knowledge quality and the quality of specialists' training, but will also foster the integration of Russian education into the global educational system.

The analysis of best practices of world-known educators and psychologists has led to summarizing the benefits and drawbacks of IT application to the educational process at university; has given an opportunity to define key requirements towards future professionals, i.e. comprehension of basic methods, perception of essence, ability to search for and apply information. This has arisen the necessity to develop scientific basis for applying emerging information technologies to the educational process and for creating specific guidelines on using computers for teaching Higher Mathematics.

It has resulted in altering the logical sequencing of teaching material presentation. Detailed citation of facts has been replaced by recapitulated presentation of the contents. The patterns and characteristics are now learned by means of the software. Thus, students become to some extent involved in simulation of processes and their features. The computer solution method for solving applied and classical problems should only be one part of a comprehensive modern math education approach used

at technical universities. Today there is a wide variety of software application packages. However utilization of these packages can be efficient not so much when the algorithm for program development is clear, as when the classical mathematical principles and methods serving as basis for these programs are understood.

Based on the analysis of all the existing educational web-resources in mathematics, the following three groups are distinguished:

1. websites which provide math theory explanation, examples of problem solution, and tests;
2. web resources that have a collection of lectures or practical tasks presented in video format;
3. "calculators" that allow students to gain instant solutions and explanations for math problem.

In addition, online resources are becoming increasingly popular as they allow students to interact with learning environment without a teacher being physically present. As a rule, the material is delivered through creative and play-based activities when a user (student) is granted awards and rating scores for his/her achievements and has a possibility to compete with other website users switching to a new layer.

According to the research [5], reciprocal teaching and feedback are the most essential constituents of educational process and are considered the keystones of success. Therefore, interactive technologies are widely applied in secondary schools, workshops, seminars, and in-company trainings. The book by Thomas, E.J., Brunsting, J.R., and Warrick, P.L. [6] can be a good example of math courseware since it offers a wide range of competences and skills that must be shaped upon the course completion. Besides, the book provides teachers with the recommendations on developing the required students' competences in mathematics. However, it is worth noting that there is still a lack of guidelines for math teachers.

Tomsk Polytechnic University actively applies information and communication technologies (ICT) in distance learning programs and developing student web-based support. The website for distance learning provides teachers and students with a common information space which allows faculty members to share teaching materials without any delay, while students have an opportunity to download and study the materials shared by teachers.

Given the application of the newly developed math courseware, a great number of students now have an opportunity to deepen their knowledge in mathematics and mathematics-based disciplines. Faculty members of the Department of Higher Mathematics (Tomsk Polytechnic University) have gained vast experience in implementing distance learning technologies.

## **2 RESULTS AND DISCUSSION**

In 2015, the Department of Higher Mathematics carried out a survey aimed at revealing the opinions of students and teachers about implementing e-learning courses in Mathematics programs.

The survey involved 86 students and 35 faculty members.

In general, faculty members hold a positive view of using e-learning in for teaching Mathematics. Precisely, 95% of respondents (to a greater or lesser degree) agreed that they were confident in using e-learning tools in the disciplines they taught; 83 % reported that e-learning is an alternative way to make students feel excited about

their learning; 89 % of the respondents (to a greater or lesser degree) agreed that students are willing to be involved in e-learning; 93% of the respondents reported finding e-learning effective for student's independent work; and 81 % of the respondents noted that e-learning courses have positive influence on students' academic progress.

In addition, faculty members specified benefits and limitations of applying e-learning tools for Mathematics teaching compared to the traditional mode of study.

Benefits:

- e-learning provides an opportunity to plan, set goals, organize, and evaluate student's independent work;
- immediate results and feedback allow instructors to uncover student's difficulties with a subject;
- online simulator helps students memorize formulas and key notions of a subject;
- e-learning tools provide the potential to develop personalized learning resources in accordance with student's knowledge level;
- interactivity (joint projects, games) engages students in educational process pushing them to learn mathematics.

Limitations:

- math e-learning course development is a rather time-consuming endeavour.

Most faculty members believe that mathematics teaching should involve both traditional learning and innovative teaching technologies. The use of internet technologies requires math instructors to acquire additional skills and competences, for example, in the sphere of psychology and information technologies.

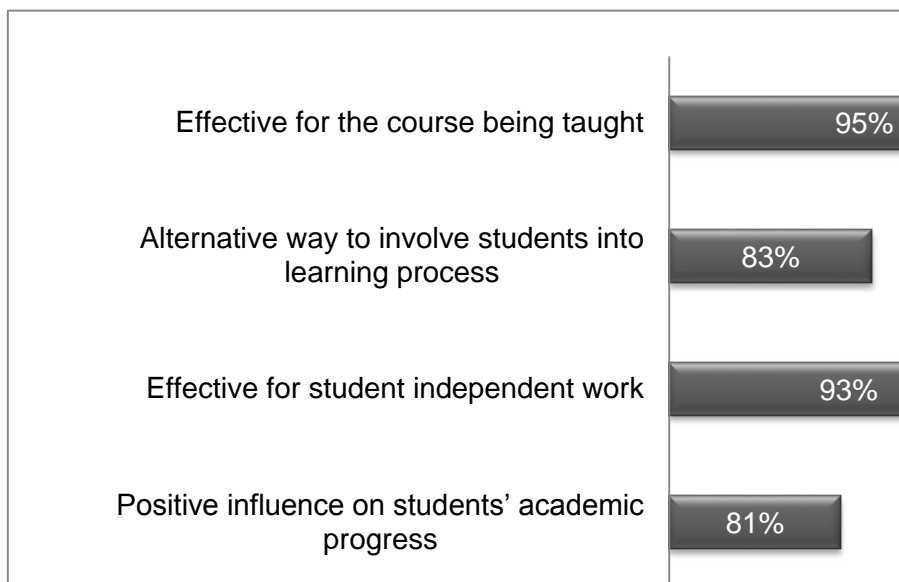


Fig. 1. Faculty opinions on e-learning use in teaching process

Nearly all survey respondents (85%) agreed that students are excited about using e-learning tools in teaching, while 9 % of respondents reported about negative attitude of students towards e-learning.

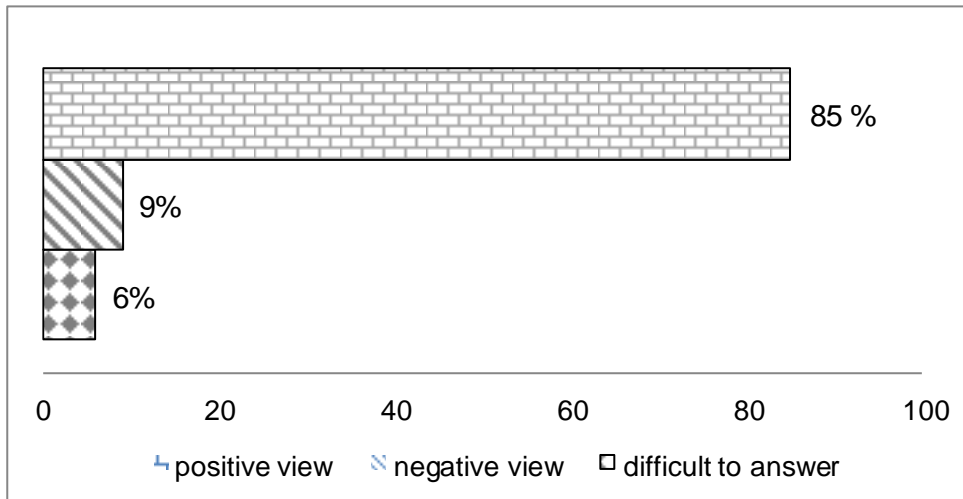


Fig. 2. Faculty opinions on students' attitude towards e-learning

Students also view e-learning positively with respect to learning Mathematics. The majority of participants (84 %) finds e-learning rather effective, while 8 % of respondents believe that e-learning is useless for teaching Mathematics, and 8 % of students find it difficult to answer the question.

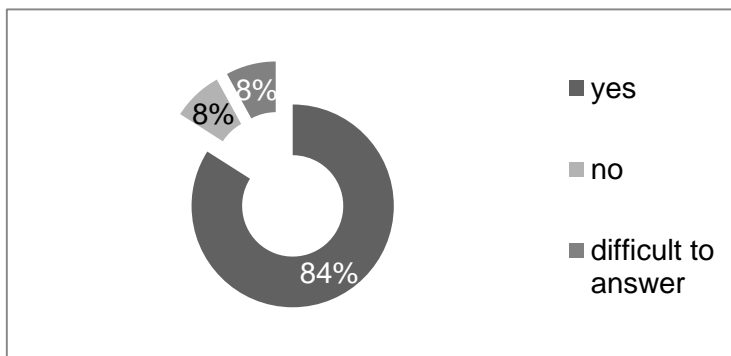


Fig. 3. Student opinion on e-learning use in teaching Mathematics

At the same time, most students noted that electronic tests helped them learn the subject in a deeper way (82 %), with 10 % of respondents saying “no” and 8 % having difficulty responding.

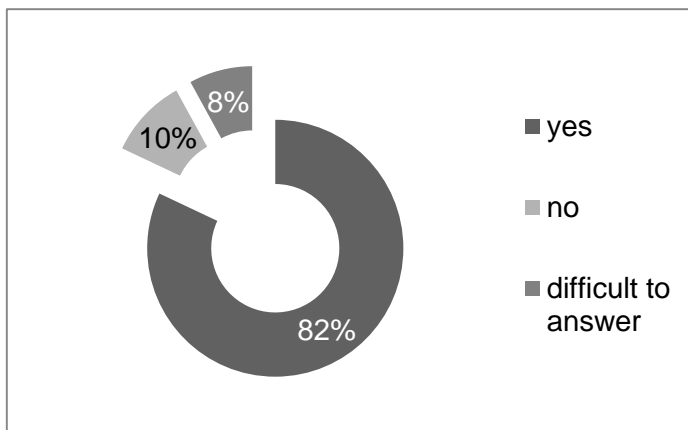
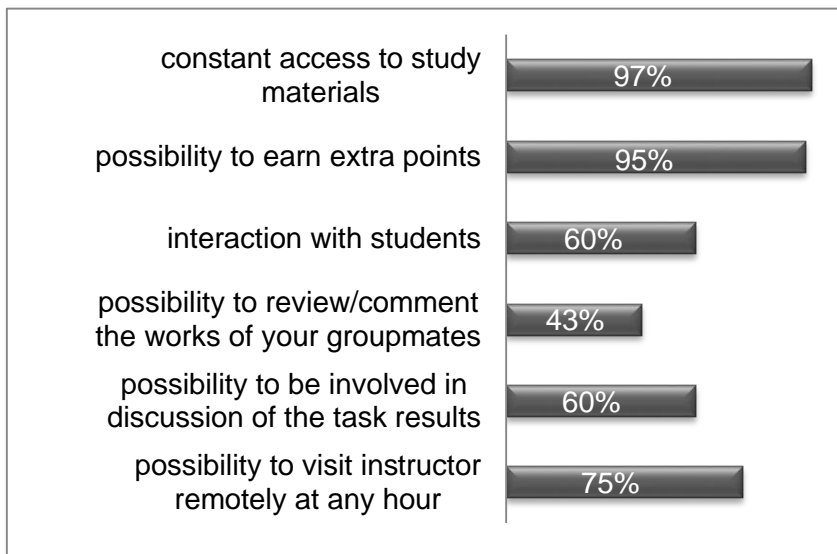


Fig. 4. Student opinion on e-learning test benefits in terms of Mathematics learning

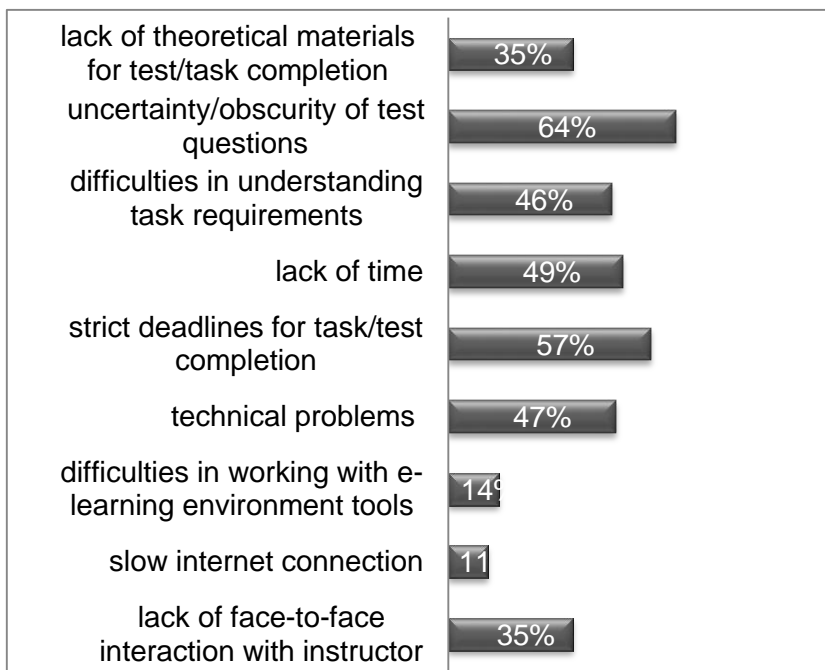
Besides, the conducted survey revealed student opinion on usefulness of e-learning in education.



*Fig. 5.* Student opinion on usefulness of e-learning in education

As it is obvious, the reasons why students consider e-learning useful are as follows: constant access to study materials and classes (97%), possibility to earn extra points (95%) and contact instructor remotely at any hour (75%). The less useful features of e-learning are the following: possibility to be involved in discussing task results (60%), possibility to review/comment groupmates' work (43%).

The difficulties students face while completing the tasks are listed below.



*Fig. 6.* E-learning difficulties encountered by students.

Almost all difficulties enumerated in the questionnaire (to a greater or lesser degree) were encountered by students during the educational process. Most troubles were caused by uncertainty/obscure of test questions (64%) and strict deadlines for task completion (57%). Moreover, students had difficulties due to the lack of time that they could spend on e-learning (49%) and various technical problems (lack of website access, website glitch, authorization error, etc.) (47%).

To gain another perspective on the use of e-learning within the course of Mathematics, students were asked to indicate how much time they spent on their university studies (per week). Most students spent 1-4 hours per week using PC. 14 % of students spent more than 4 hours, while 10 % - less than an hour.

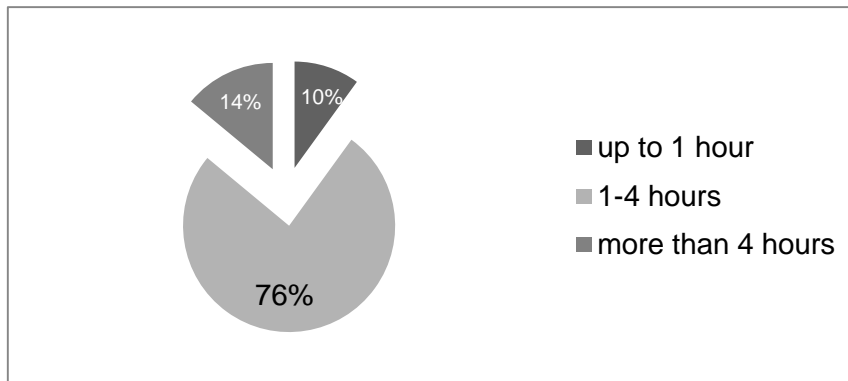


Fig. 7. Time that students spent in the e-learning environment

In addition, students noted the benefits and limitations of using e-learning for Mathematics learning compared to the traditional mode of study.

The indicated benefits are:

- additional data and materials on the subject;
- flexibility, i.e. students can fit study time into their schedules better;
- opportunity to repeat the studied material;
- opportunity to interact with instructors at any time;
- unbiased students' knowledge evaluation.

Limitations:

- fixed timing for tests;
- lack of face-to-face interaction with instructors.

## CONCLUSIONS

Use of internet technologies in teaching Higher Mathematics at universities allows enhancing efficiency in subject mastering, broadening course content, as well as expanding teaching and learning modes. It also increases students' motivation to learn and provides them with opportunity to study independently and acquire absolutely new knowledge that will most likely be of practical importance at their future workplace. Faculty members are given unlimited opportunities for self-development, which, in their turn, shift teaching process to a much more efficient level [7 – 9].

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