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Distance educational technologies as means of increase of student’s motivation in the learning of general physics course

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Abstract. The Department of General physics and nuclear fusion, National Research University "Moscow Power Engineering Institute", developed a set of tests (over 1000 questions) for the current control of knowledge of students in the section "Electricity and magnetism" of the General physics course using the internet distance learning system "Prometheus" (fourth generation). Under this section of the proposed test tasks are divided into sections corresponding to the topics section. These tasks include quality issues, design tasks, tasks with a choice of answers (one of many, many of many), the job with the selection region in the figure, tasks with detailed answer. The variety of tasks allows the teacher not only to objectively assess the student acquired knowledge but also to develop his problem-solving skills, to learn to be fluent in theory. The results of testing conducted for several years, show the high interest of students in the repeated independent execution of tasks and correlate well with the results of intermediate certification (exams).

1. Introduction
The Department of General physics and nuclear fusion, National research University "MPEI", has developed and successfully uses a training-methodical complex for the course of General physics for students enrolled in educational programs in the field of power engineering. The complex consists of three textbooks with a total volume of approximately 80 PL. In addition to the training complex includes calculation tasks, tests, a typical control for all sections of the course, tickets to the laboratory works, tests.

Currently, the Department staff continues to develop and improve the complex. Active work on computer simulation of laboratory problems, prepared for publication updated laboratory workshops for all sections. Lecture notes is prepared in electronic form, which allows to conduct classes with students in the distance access mode (via distance learning technologies). Also the Department staff developed a set of tests (over 1000 questions) for the control of knowledge of students on all sections of General physics course using the distance learning system "Prometheus" fourth generation Internet.

2. Organization of distance testing
Within each section of the General physics course test tasks are divided into sections corresponding to the topics section, and include quality issues, design tasks, tasks with a choice of answers (one of many, many of many), the job with the selection region in the figure, tasks with detailed answer. The
variety of tasks allows the teacher not only to objectively assess the student acquired knowledge but also to develop his problem-solving skills, to learn to be fluent in theory.

Distance learning system "Prometheus" includes the designer of the tests, a special tool allowing to create and edit self-assessment tests and exam tests. Each test consists of sections (dedicated to each topic). Each section contains several questions. "Prometheus" allows the teacher to create several types of test questions. Each question has a type (table 1), the formulation and optional description for the right answer (note that the student will see in the report about trying the self-test or when you click on the button "Answer" in training mode).

**Table 1.** The types of questions generated in the "Prometheus", and their description

| Question type    | Description                                                                 |
|------------------|-----------------------------------------------------------------------------|
| One of the many  | The student can choose one answer from the offered                           |
| Many of many     | The student can choose several answers from the proposed                     |
| The input field  | The student is encouraged to input field in which to enter a response       |
| Compliance       | Students are encouraged to establish correspondence between pairs of values |
| The sequence     | Students are encouraged to organize elements of a sequence                   |
| Yes/No           | Students are encouraged to give positive or negative answer to the question  |
| Area in the figure | The student must select an area on the proposed figure                      |
| Detailed answer  | Students are encouraged to give a detailed response in writing. In this case, the participation of the tutor in the assessment of response |
| A few missed words | Students are invited to fill in the gaps                                   |
| Multiple input fields | Students are encouraged to collect multiple values                           |

Experiment on introduction of distance-test of students was conducted over 3 years among the students of the Institute of thermal and nuclear power engineering. The second semester of the study course of General physics was selected for testing. During this semester students learn section "Electricity and magnetism". All study materials second semester of the study course of General physics was divided into specific themes, grouped in 10 blocks. For each block the student was offered a test for self-examination. The following is a list of tests:

- Test # 1 "Coulomb's law and potential";
- Test # 2 "The Relationship of tension and potential";
- Test # 3 "The Theorem Of Gauss";
- Test # 4 "Dielectrics in electrostatic field";
• Test # 5 "Conductors in electrostatic field";
• Test # 6 "Electrical capacitors and the energy of the electrostatic field";
• Test # 7 "Methods of calculation of magnetic induction";
• Test # 8 "Ampere’s Force, the Lorentz’s force”;
• Test # 9 "Electromagnetic induction”;
• Test # 10 "Inductance, energy of magnetic field in matter”.

Each test contains 15 questions that are randomly selected by the testing system "Prometheus" from a large number of questions. A large number of designed questions of various types can significantly reduce the likelihood of recurrence of the issues in the tasks for different students. The time to perform each test is 40 minutes.

The permission for passing the test is given by the lecturer. The lecturer makes this announcement on his website and at the lecture test is available for the student in two modes: "self-examination” and "examination”. The student independently made the decision on the implementation of testing and was able to log in "Prometheus” as with a desktop computer (including your home), and mobile device.

Mode "self-test" allows the student an unlimited number of times within a certain time (several days) to the next test task after solving the previous one. Repeated the test allows the student to improve their result. When summarizing the results only counted the best score from all attempts. This mode contributes to the consolidation of the teaching material allows the student to identify gaps in training and helps the student to improve their knowledge.

The mode of examination available to the student only once. A student who wishes to re-test your knowledge, should contact the lecturer of the discipline for a new permission. Thus, the mode "test" fixes the achieved level of experience.

In the beginning of the semester, the system administrator has registered every student in the system "Prometheus”, after which the lecturer gave the students individual passwords to access the system. The schedule of tests was made in such a way that the testing phase in the "self-examination” was available during the study period respective topics in lectures and practical classes. After completing the classes a student could pass the test in the "examination”. Access students for testing in the modes "self-exam" and "exam” was regulated by the lecturer.

When performing test tasks in any mode, the student can skip the next question if difficult to find an answer to it, and to return to that question later. After the test the student can see how many questions he gave the right answers. Lecturer flow, unlike the student, has the opportunity to see all the answers to the questions. Accordingly, the lecturer can assess the level of knowledge of each student and to consider questions on which parts result in the greatest number of wrong answers. In addition, the teacher can see the results of all attempts of the student and assess improvement in student knowledge on each topic.

The result of executing each test system "Prometheus” is estimated on a 100-point scale. During automatic insertion of the result takes into account the weighting factor of each job in the total number of points. Table 2 shows compliance with the 100-point and 5-point scales of evaluation.

| 100-point scale | 5-point scale |
|-----------------|--------------|
| 90-100          | 5 (excellent)|
| 75-90           | 4 (good)     |
| 65-75           | 3 (sufficiently) |
| < 65            | 2 (bad)      |
After the completion of the semester of theoretical learning, when students prepare for the exam on the discipline, the lecturer again gave an opportunity to pass all the tests in the "exam" to consolidate the learning material.

3. The results of distance testing
It should be particularly noted that the participation of students in the testing was completely voluntary, the test results were not taken into account in the performance of examinations or during the examination.

The results of testing conducted for several years, show the high interest of students in the repeated independent execution of tasks and correlate well with the results of intermediate certification (exams).

Testing conducted in the fall semester of 2015, showed the following results (table 3).

| Показатель | 2015 | 2016 |
|------------|------|------|
| The number of students | 119 | 143 |
| The number of students who participated in testing | 57 | 66 |
| The number of students who received on the first attempt more than 80 points at least one test | 28 | 46 |
| The number of students who received the exam scores of 5 and 4 | 49 | 63 |
| The average score of test execution | 66,1 | 78,3 |
| Average score of exam results | 3,55 | 3,71 |

There was a detailed analysis of test results and their comparison with the results of the tests and the exam individually for each student. The conclusions made on the basis of the analysis show a significant increase in the quality of knowledge (and their assessment) those students who independently decided to deal with the tests. Especially good results shown by the students in the "self-examination" repeatedly performed tests to improve their scores.

Thus, the work carried out at the Department of General physics and nuclear fusion, allows us to talk about the impact of the use of distance technologies to increase the motivation of students to study the discipline.