New digital technologies of training in the transport education

A F Smyk, T M Tkacheva and Yu A Portnov
Moscow Automobile and Road State Technical University (MADI), 64, Leningradsky ave., Moscow, 125319, Russia
E-mail: afsmyk@mail.ru

Abstract. The article analyzes the use of new digital technologies in transport education considering the Moscow Automobile and Road Construction State Technical University (MADI) as an example. The results Massive Open Online Courses (MOOC) and other electronic systems in the training of engineers using on specialty «Land transport and Technological Vehicles» are given. Positive opportunities of online courses using arise in the organization of student extracurricular activities and the implementation of a differentiated approach in training. Different content of online courses in the areas of training makes it difficult to use MOOC in the practice of general engineering education. The authors suggest using the Modular Object-Oriented Dynamic Learning Environment (Moodle) which is a free web application that provides to create websites for online learning. The experience of using the online resource «Information system MADI» («IS-MADI: Physics») to study Physics, created by MADI's teachers, is also considered. This experience makes to conclude that using of the Internet resource «IS-MADI: Physics» awakes interest of students to learn Physics. In a whole students begin to understand that knowledge of Natural Science disciplines gives them powerful tool to create and to exploit modern cars and roads, they begin understand importance of Physics.

1. Introduction
During various historical stages the economic development of Russia was inextricably linked with the transport system formation. In turn this system stimulated the development of primary vocational and higher engineering education. The current stage of innovative economy development and technological modernization is associated with digitalization, which means the widespread introduction of digital technology in all areas of activity.

In transport education in the training of motor engineers in the direction of “Land Transport and Technological Vehicles”, three forms of training are implemented: full-time, part-time education and distance learning. For all of these educational forms there are different models of the educational process organization as well as of training materials presenting. The experience of the Moscow Automobile and Road Construction State Technical University (MADI) in the use of new digital technologies for training of engineers motorists during the study of natural sciences in junior courses is considered as an example.

2. Problem statement
2.1. Models of electronic educational resources
Comparison of curricula of mechanical engineers training in the Moscow Automobile and Road Construction Institute (1933) and specialists on the specialty of "Land Transport and Technological
Vehicles” in the Moscow Automobile and Road Construction State Technical University (2013) showed that these curricula keep from the XIX century the tradition of Russian engineering education to give students fundamental physical and mathematical training [1]. A large number of hours are still allotted to the study of physics and mathematics. These hours are divided between class work and the student’s self-work. During intramural educational process student’s self-work takes up 50 % of all time, during part-time and extramural educational process it takes up to 80 % of all study time. Despite the advantages of the independent nature of educational activities, there is a problem of organizing and controlling this activity, which can be solved with the help of an information-educational environment.

The creation of an educational environment emphasizes the importance of learning, ensures the assimilation of comprehensive knowledge, skills, formation and development of competencies. The educational environment helps to implement all the functions of training, assimilation of all elements of the content of education. An important subsystem of the developing educational environment is the educational and technical environment of professional and personal self-development of students [2].

Modern young people are often referred to as “digital aborigines,” and it is not difficult for them to obtain any information from the Internet. But information itself is not knowledge. It is the teacher’s task to turn this information into knowledge. There is no unified approach to this path, every time the teacher is faced with the task of choosing different models of electronic educational resources, taking into account the tasks of training specialists of a certain specialty.

Today the educational space is filled with various open educational resources (online courses), there is a format of MOOC (Massive Open Online Courses), which allows to carry out network interaction of participants of the educational process. In our country there is a steady growing interest in MOOC, in the implementation of students “training in this format. The best universities of the Russian Federation offer on the platform “Open Education” their online courses of basic disciplines studied in Russian Universities [3]. Any student user can take an online course of interest from the leading Universities of the Russian Federation completely free of charge, as well as in the case of successful completion of training he can receive set-off by using these results in his university within the framework of his own educational program.

For extramural studies, MOOC seems to be the most effective. The experience of using MOOCs in training specialists on the specialty “Land Transport and Technological Vehicles” at the Siberian Federal University has shown that there are inconsistencies in the curricula of different Universities, and there is a difference in the volume of study of disciplines, which makes it difficult to integrate MOOCs with traditional forms of education [4]. Therefore, it is possible to use the results of MOOCs to set off individual modules of the academic discipline.

3. Materials and methods

3.1. IS-MADI: Physics

Another way to train physics was chosen at the Department of Physics MADI: it includes using well-known digital educational technologies and creating one’s own web resource. At the MADI Department of Physics, the transition to digital forms of education is carried out using electronic presentations, including videos and materials from the Internet, electronic textbooks and teaching materials, the certified information system “IS-MADI: Physics” [5], and computer testing – input, current, and final. Students use electronic materials to carry out mini-projects, as well as to prepare reports for student conferences. Internet resource “IS-MADI: Physics” was created and developed by teachers of this Department to solve the problem of training automotive engineers in Physics and other disciplines of Natural Science.

An important part of this resource is the section “Library”, which is available for students throughout the work with the information system. This section consists of textbooks, texts and presentations of lectures, environment descriptions of laboratory works, and guidelines for solving problems. A survey was conducted among the 2nd year students of the Faculty of Road Transport (specialty "Automotive engineering in transport technologies"). They systematically use 'IS-MADI:
Physics” during two semesters. The aim of this survey was to determine the effectiveness of the Library section using by students. It turned out that 64% of respondents constantly use lecture texts, 42% use methodological recommendations for solving problems, 48% use lecture presentations.

In the learning module there is a "Bank of tasks", which contains about 2500 questions and tasks to test the knowledge gained in the study of each topic, structured by levels of difficulty that students pass sequentially. "IS-MADI: Physics" was created as a game with several levels, each of which can be reached only after passing through the previous stage. At the first level assimilation by students of the basic concepts and definitions of the studied section of Physics training course is checked. At the second level it is required to solve a quantity of simple tasks with the choice of the answer. In case of successful execution of a task the system transfers the student to the following level, but if the number of the wrong answers or a limit of time is exceeded, the system returns this student on the first level. At the third level the student is offered to solve a number of problems of basic level of complexity.

The answer must be entered from the keyboard, taking into account the specified accuracy. If the number of incorrect answers or a limit of time is exceeded the system returns this student to the first step again. The quantity of questions, the number of the offered possible answers, time limits, quantity of admissible errors at each stage is set by the teacher based on the curriculum and the number of training hours. The important advantage of an information system is that it helps junior students to organize their self-work in an optimal way.

Practice of pedagogical work shows that first-year students satisfactorily perform their self-work when it is specific and tied to a certain point in time. The use of "IS MADI: Physics” makes it possible to clearly define the necessary minimum sections for development and the time frame for their implementation. At the same time students are given the opportunity to pass sections of the information system any number of times at a convenient time for them and in any place where there is access to the Internet, using a personal computer or smartphone.

![Figure 1. Moodle training page](image-url)
answer chosen by the student during testing or quiz, students can go to another page, return to the previous page or be redirected in a completely different way. Another important tool of the Moodle system is the ability to host all kinds of electronic content: hyperlinks to electronic resources, e-books, video and audio files.

To carry out an active interaction with students in the Moodle system, the "Video Conference", "Forum" and "Chat" modules are provided. The "Video Conference" module allows student to create links to web conferences. Using this module, student can specify the name and description of the event in the calendar, as well as groups and recording parameters of the online session. The Forum module allows participants to communicate in asynchronous mode. There are several types of forums, such as a standard forum where everyone can start a new discussion at any time and a “Question and Answer” forum where students must first reply to a message before they can see the answers of other students. The Chat module allows participants to have the opportunity of synchronous written communication in real time. Chat can be either a one-time event or repeated at the same time every day or every week.

4. Results and Discussion

The results of the «IS-MADI: Physics» used by first-year students (set 2018/2019 academic year) in the discipline "Ground vehicles," in total 110 people, are given (Fig. 2). First-year students solved problems in eight sections of Physics: Kinematics, Dynamics, and Conservation Laws in Mechanics, Electrostatics, DC Laws, Magnetism, Molecular Kinetic Theory and Thermodynamics. 90–92 % of the first year students received set-off in physics, as the result of work in the semester.

Approximately the same feature is observed in Fig. 3. The results of the use of the Internet resource «IS-MADI: Physics» by second-year students (set 2017/2018 academic year) in the same discipline "Ground vehicles," in total 98 people, are given (Fig. 3). They solved problems in six sections of Physics: Oscillation, Waves, Wave Optics, Quantum Optics, Thermal Phenomena, Atomic and Nuclear Physics/ It is shown? That the most difficult sections of Physics are Quantum Optics, Atomic, and Nuclear Physics. But in spite of difficulties 88–90 % of students pass exam successfully.

The use of the Internet resource "IS-MADI: Physics" makes it possible to draw a conclusion not only about the abilities and knowledge of students of the first and second academic year of the technical university, but also gives a cut of school training in Physics in the whole country, as MADI is attended by young men and girls from different cities of Russia.

Figure 2. Results of “Information System MADI: Physics” used by students of the first year in the Autumn of the 2017 (2017-2018 academic year).
1 – No solving problems; 2 – Problems of the 1st level of complexity solved; 3 – Problems of the 2nd level of complexity solved; 4 – Problems of the 3rd level of complexity solved 5 – Problems of the 4th level of complexity solved
Figure 3. Results of “Information System MADI: Physics” used by students of the second year in the Spring of the 2018 (2017–2018 academic year).

1 – No solving problems; 2 – Problems of the 1st level of complexity solved; 3 – Problems of the 2nd level of complexity solved; 4 – Problems of the 3rd level of complexity solved; 5 – Problems of the 4th level of complexity solved.

To increase the effectiveness of electronic forms of training, an interactive information educational environment is required. This thesis implies the use of training and monitoring programs. The compilation of such programs will ensure their successful application if these electronic forms take into account the individual abilities and capabilities of students, the teacher’s ability to arrange training tasks according to degree of difficulty, absence of difficult tasks with large time costs, allowance to have a few percent of possible errors, and an opportunity to find answers to assignments and detailed explanations. All of these factors allow us to hope that students will be able to work independently. If at the same time there is a two-way communication with the teacher (it can also be electronic: e-mail, Skype or other instant messengers), then the probability of passing the exam or other control task will be close to 100%.

It is possible to compare the merits of MOOCs and the information system “IS-MADI: Physics”. Both tools are proposed to note the possibility of using interactive tasks with automated assessment of the result. In the information system “IS-MADI: Physics” mentioned above, such tasks and their assessment are included in the program. The course of the assignment is recorded by the program, and the teacher can track how many attempts to solve the task the student completed, how many of them were successful. At the end of the task, the program is evaluated as a percentage.

Examination with proctoring (as MOOC uses), that is exactly what we created in the information system "IS-MADI: physics": the task has limited the time of its execution to the specified time interval, the number of possible errors at each level of task execution and instant electronic assessment. Of course, during the task, the student is offered a countdown. However, in real time, students in this case are not monitored by the teacher, and verification of the identity of the person who sits at the computer and performs the task is also not provided. However, this information system "IS-MADI: Physics" is convenient for both students and teachers: an unlimited number of students can perform the same task at the same time. Despite the simultaneous use of this system, due to a large database of tasks (more than 2500) each student will have its own set of tasks.

5. Conclusions
In conclusion, we can draw the following statements:

1. Digital forms of training (on-line training) increase the effectiveness of training due to the speed, individualization of the educational process and the objectivity of student assessments.
2. The transition to digital forms of education is inevitable in connection with the widespread, more accessible and accelerating spread of electronic forms of interaction.
3. To increase the effectiveness of electronic forms of training, it is necessary to create an interactive information educational environment.
4. Accessibility, relative ease of use, very fast control and the ability to immediately receive encouragement for a well-completed assignment contributes to the growth of motivation to learn.

References
[1] Smyk A and Zimanov L 2017 Training of automotive engineers in the mirror of education reforms in the Russian Federation Bull. of transp. 3 12
[2] Tkacheva T 2013 Educational environment as a factor of improving the quality of education: MADI The Tidings of the Baltic State Fishing Fleet Academy: Psychological and pedagogical sciences Theory and methods of professional education 23 86
[3] Babaeva M and Smyk A 2018 Distance education: a historical path to MOOK Higher Education in Russia 4 156
[4] Moskalev A, Serukova I and Dolgopolova M 2019 The use of mass open online courses in teaching physics to bachelors of general engineering areas of training Bull. of Krasnoyarsk state pedagog. Univer. 1 26
[5] Smyk A, Spiridonov A, Bachtina E, Belkova Y and Spiridonova L 2016 Information system for effective study of physics Phys. Educat. in univer. 22 97
[6] MADI PKI Distance Learning System Retrieved from: https://cdo.madi.ru