Pedagogic Conditions and Methodological Aspects of Education Intensification on the Course "Theoretical Mechanics"

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Abstract. The article covers the questions about the pedagogic conditions and methods of education intensification on the "Theoretical Mechanics" course at university. After this course students must have not only theoretical knowledge but also skills in various engineering tasks. Thus all participants of education should be provided with information support. The article shows that this can be efficiently implemented only on the basis of electronic learning resources worked out, for example, in Moodle LMS with the help of application programs. Interactive forms and the elements of distance learning make student's work more active and efficient. In its turn, this intensifies the whole education.

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Introduction

At the present stage of modernization in Russian industry, real economy is badly in need of specialists who can solve technical problems of different complexity. Higher and secondary specialized educational institutions play an important role in training such specialists.

Russian professional pedagogy accumulated a significant experience in training specialists of various technical fields. There are developed methods of teaching technical subjects and many publications that can help teachers and students [1,2].

One of such educational subjects is theoretical mechanics. This is a fundamental natural science which forms a base for training bachelors and specialists in technical sciences. After this course student must have skills in solving various engineering problems. In its turn, this is necessary for the next courses: Strength of Materials; Theory of Machines and Mechanisms; Parts of Machines; Fluid Mechanics, etc.

When teacher selects educational material and organizes training, he should adhere to the following principles: scientific and fundamental character; professional orientation; versatility and possibility to obtain advanced training within the framework of multilevel technological education.

While reaching the goal and solving pedagogical problems teacher should competently apply educational methods. Besides, teacher should aspire to the productive result when he chooses educational methods. In competence approach, student is supposed not only to understand, remember and recall acquired knowledge but also to be able to use and operate with them in practice. In so doing, the productivity of education depends to a large extent on how active student is in his learning and creation, and also on the intensification of education, because person's zeal is an essential condition and the indicator of educational principle implementation.

In accordance with Federal State Educational Standards (FSES), the competence approach should be realized by the wide use of active and interactive lessons [3]. New educational techniques, distance learning [4, 5] and special software offer ample opportunities to intensify education.

Main part

In compliance with FSES VPO-03, 60% of total labor expenditures of future bachelors should be allocated for the independent work of students [3]. In fact, only 13% of students show the system independent work, and 78% work independently occasionally [6]. This can be explained, first of all, by the fact that students are not well-prepared for independent work at the present stage.

In higher school, students receive voluminous tasks for independent work (term projects, computation and graphical works, etc.) meant for a long period. Thus the intensification of education comes to the fore.

The structure of higher school educational technology based on intensification should contain the following blocks: goal; content; control means and forms; result assessment; correction and management of students' cognitive activity.

The pedagogic conditions for the implementation of higher school educational technology based on intensification include the information support for all the participants of learning:

- Curriculum;
- Working program based on modular training with a glance to obligatory minimum;
- Study guides for all the participants of learning according to the proposed technology;
- Reference lecture notes;
- Computation and graphical tasks for independent work;
- Methodological recommendations for these tasks;
- Means for test control;
- Computer resources provision.

Electronic learning resources and the elements of distance education help to create pedagogic conditions, to intensify education and to make students' independent work more active.

Moodle learning management system became very popular in reaching these goals. It is currently translated into dozens of languages and used in more than 200 countries. Moodle is an environment for distance learning. It gives teachers ample opportunities for creating high-quality interactive distance courses which include necessary educational, auxiliary and testing elements.

From the view point of provided opportunities, Moodle LMS can be favourably compared with well-known commercial systems, but it has the advantage of open source code. This allows "customizing" the system for a certain educational project and, if necessary, building new modules in it. Ample opportunities for communication are one of the strengths of Moodle LMS. The system supports sharing files of any format both between teacher and student and between students. Mailing service allows informing promptly all the participants of the course or certain groups about current events. Forum makes it possible to organize training discussions including group ones. One can attach files of any format to his message in forum. There is a function of message assessment – both for teachers and students. Chat allows organizing real-time training discussions of individual problems.

In Yelabuga Institute (affiliated with the Kazan Federal University), Moodle LMS is used by full-time and correspondence students for studying some subjects and by teachers for professional development. Besides, it helps students and schoolchildren to organize scientific research [7-10].

The authors worked out an electronic learning resource on the course "Theoretical Mechanics" based on Moodle LMS for training bachelors in area 051000.62 Professional training (by branches). The course is placed on the "Tulpar" ground in the Kazan Federal University [11] and contains all required educational materials on three subjects: "Statics", "Kinematics" and "Dynamics". Introduction includes the working program of the subject, schedule, exam questions and general methodological recommendations concerning the course. Here there are news forum and general forum.

Each studied subject includes the following elements: necessary theoretical material, didactic materials for practical lessons, some knowledge form independent work, references to recommended tutorials in university library, hyperlinks to external electronic information sources and tests for intermediate and final exams. Teacher forms the content of a certain test using his own bank of test tasks of various types.

It should be noted that the course is self-developing because such of his elements as "Wiki", "Data Base" and interactive glossary require their joint filling by all students under teacher's control.

The feedback is provided by assessed elements and also by forums and chats. "Message Exchange" and "Comments" are designed for individual communication between teacher and student: reviewing projects and discussing educational problems. An important feature of Moodle LMS is that the system creates and stores a portfolio for each student: all his works, marks, teacher's comments and forum messages. In general, this system used in teaching theoretical mechanics allows teacher to organize efficiently the independent work of students outside the class, to help students to orientate in diverse information sources, to get to know how efficiently some student studied materials, how much time it took him to learn one or another theme. All these data can be seen in a students' progress record formed automatically without additional labour expenditures. If needed, it can be easily converted for Microsoft Office software.

Curriculum for the course "Theoretical Mechanics" stipulates a final independent computation and graphical work. It is aimed at obtaining and developing skills of independent problem solving. The computation and graphical work includes the following tasks: to systematize and consolidate acquired knowledge on theoretical mechanics and previous subjects; to apply knowledge for solving engineering tasks; to develop computation skills; to learn rules and methods for design diagram building; to learn how to use special literature and reference books. The results of this work indicate the level of practical mastering the theoretical course.

While doing the work, students will inevitably need to use special literature, reference books and application programs. The ability to use competently and efficiently technical literature, current state standards and application programs allows student to apply the obtained knowledge efficiently not only for education but also in future, in industrial conditions.

Computer technologies and applications have a special role in intensifying computation and graphical works [12]. While doing the computation and graphical work, students use text editor Microsoft Office Word and graphical editor NanoCAD 2.5. NanoCAD is for design documentation execution in accordance with the construction standards. It provides the high speed and automation of execution due to the intelligent drawing technology and contains the functionality of NanoCAD for two-dimensional drawings. NanoCAD is the first Russian free system for automated design (SAD) and the platform for various branches. NanoCAD contains all necessary tools for basic design and has an intuitive interface. NanoCAD allows for creating and editing various 2D and 3D drawings, texts, drafting objects, image and printing settings for graphical technical documentation.

Basic knowledge in automated design systems, 2D drawings and inserting letters and digits is enough for the computation and graphical work. All necessary computations can be done manually in Microsoft Office Word. Then the data obtained is used for building design diagrams on selected scale. The communication facility of Moodle LMS allow teacher to get promptly students' works, review them, correct mistakes and send to improvement. All this promotes the intensification of education too.

Results and conclusions

The long-term experience in teaching theoretical mechanics shows that, in present conditions, it is possible to intensify education only with the help of modern computer technologies. They include electronic learning resources, allowing for distance education, and application programs for fast and high-quality computations in solving certain educational and applied problems, and in doing computation and graphical works. The authors think that Moodle LMS is the most suitable for the practical implementation of this approach. Its features, such as the high level of interactivity; the diversity of methods and forms; the opportunity to structure the content by modules; constantly active reference system; the opportunity to create an individual curriculum; the comfort and confidentiality of education, help to increase the interest to studied subjects, to develop skills and to stimulate students' independent work. Besides, teacher gets the opportunity to manage these processes promptly and efficiently. The role of teacher itself is changing. He refuses from the dominating role in training. To a large extent, he has a function of mentor and assistant for students or one of information sources.

So, for the successful solving of intensification problems in the course "Theoretical Mechanics", the appropriate pedagogic conditions should be created.

It can be implemented in the most efficient way on the basis of learning resources worked out, for example, in Moodle LMS with the help of application programs.

Interactive forms and distant education elements in teaching make student's independent work more active and efficient. In its turn, this intensifies the whole education.

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Generalized is experience in methodological support for creative training of engineers and scientists in Olympiad movement of students in theoretical mechanics. The authors analyzed traditions of training students in technical and natural specialties to solving innovative problems in design and operation of new technological equipment. Substantiated is necessity of intensive inclusion of Olympiad movement in independent work by study of theoretical mechanics and making it mass by providing students opportunities to shape their educational trajectory. Formulated are didactic pedagogic conditions, intensification, learning process, theoretical mechanics, LMS Moodle. The name of the journal. Life Science Journal. URL. http://www.lifesciencesite.com/lsj/life1112/077_26678life111214_405_408.pdf. Please use this ID to quote from or refer to the card. https://repository.kpfu.ru/eng/?p_id=86578&p_lang=2. Resource files.Â Timerbaev R.M., Shurygin V.Yu. Pedagogic Condition and Methodological Aspects of Education Intensification on the Course "Theoretical Mechanics" // Life Science Journal.- 2014.- V. 11, No 12, P.405-408. ru_RU.