Practical experience of using LMS Moodle in personnel training for machine-building enterprises

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Abstract. The article describes the experience of conducting classes and monitoring knowledge on the LMS Moodle online platform for full-time students at the university when studying one of the technical disciplines. The conditions for organizing test control of students' knowledge on theoretical topics and practical tasks, which give an objective picture of students' knowledge, are outlined. The analysis of the results of the knowledge control for various types of tasks was carried out. As a consequence the conclusion was made about the possibility of conducting certain types of classes in a distance learning format. Assessment of the learning results was carried out according to Bloom's taxonomy. The analysis and conclusions made by the authors will be useful to teachers of secondary and higher educational institutions using distance learning, organizing test control and independent work of students on online platforms with a mixed form of student learning.

1. Introduction

Pedagogical practice adopts the taxonomy of learning outcomes, developed in the middle of the 20th century by professor of Chicago University, B. Bloom [1]. According to his concept, the development of student's thinking can be divided into six levels, the first three of which - knowledge (first level), understanding (second level), application (third level) - can be attributed to mastering the basic part of the course being studied.

Technical disciplines which last two or three semesters and, contain, in addition to lectures, seminars, laboratory work, and course projects, require the creation of a large educational content [2]. At the same time, a teacher may face an insufficient number of classroom hours. In addition to the traditional educational process, an online course hosted on the LMS Moodle platform [3], [4] allows a teacher to design the study of the course taking into account the complexity of topics and tasks. Some of them can be taken out for independent study on an online platform with subsequent knowledge control in the test form. It will give a chance for more detailed consideration of topics and issues that cause difficulties for students to understand in classroom time.
LMS Moodle is successfully integrated with various programs designed for the implementation of basic educational programs [5]. It should be noted that testing is an objective method of knowledge control subject to certain conditions and is successfully implemented in the LMS Moodle environment [6]. Obviously, on the online platform, the teacher can also create individual learning paths [7], introducing variable tasks of increased complexity or creative tasks into the educational process for students who successfully cope with the basic part of the course and are motivated to participate in olympiads, competitions, conferences and scientific work (according to Bloom’s taxonomy correspond to the highest levels of learning outcomes: Analysis-Synthesis).

Thus, when developing a scenario for studying a course, a teacher divides the educational content of the discipline into the basic (mandatory) part of the course and the additional (elective) part (table 1).

| Course content                                          | Classroom lessons | Online platform |
|--------------------------------------------------------|-------------------|-----------------|
| Basic part of the course                               | +                 | +               |
| (learning levels: Knowledge-Understanding-Application)  |                   |                 |
| Additional part of the course                          | –                 | +               |
| (learning levels: Analysis-Synthesis)                  |                   |                 |

Variable tasks in the field of technical disciplines include such tasks of increased complexity as, for example, solving problems of optimization and parameterization of structures [8], [9], the choice of rational materials [10], structural synthesis of mechanisms [11]. Since work on tasks of increased complexity is almost always carried out individually and outside the classroom, there is no doubt that synchronous and asynchronous teacher-student interaction on the Moodle online platform [12] will help the teacher to more effectively organize the preparation of a student with the highest level of learning outcomes.

The question of choosing tasks for independent study of a basic resource on an online platform at the first stage is decided by the teacher intuitively and / or is based on the experience of teaching the discipline [13]. However, the correctness of the choice must be confirmed experimentally, through testing and objective control of the knowledge with further analysis of the statistics of the results obtained.

2. Problem statement, technical support and research
The objective of the research is to identify the types of tasks that can be completed in whole or in part on the online platform, for students studying technical disciplines.

The test groups - full-time students of the Faculty of Mechanical Engineering, studying discipline "Basics of Design" in groups A and B (group names are conventional) (table 2).

Technical support:

- computer class of the university, equipped with a projector for conducting classes and stationary computers connected to the Internet;
- online course in the discipline "Basics of Design" on the LMS Moodle platform;
- home computers of students.

| Types of activities                | Group A                  | Group B                                      |
|-----------------------------------|--------------------------|----------------------------------------------|
| Lectures and practical classes    | in the classroom         | in the classroom and on the online platform |
| Course project (checking tasks and consultations) | in the classroom | on the online platform |
Testing on the online platform in a computer class under the supervision of a teacher on an online platform on home computers without the supervision of a teacher

Access to the test is limited by start and end times, so that students in each group can only take the test at the same time.

The method of knowledge control - test questions on the theory of the "Multiple choice" type and tests with practical tasks with manual input of the answer, posted on the LMS Moodle platform with automatic verification of answers by the system. Based on the results of the tests performed, it can be concluded that students have received basic knowledge of the first and second levels on the Bloom scale when mastering theoretical topics and the first or third levels on the Bloom scale for performing practical tasks.

Theoretical material on topic "Gears and reducers" and practical tasks on topic "Problem solving" were selected as tasks for "Research 1". Lectures and practical classes were held in the classroom on these topics for students of group A and group B. They had 2-3 weeks to consolidate the studied material and prepare for the test control. Group A students performed tests in the computer lab under the supervision of a teacher, while students in Group B performed the same tests on home computers. Access to tests was opened at the same time for each group, questions and tasks appeared randomly from the bank of test questions. In test "Gears and reducers" the number of questions given by the system to each student was 20, the time limit was 25 minutes, the number of questions in the bank of test questions was 153. Practical tasks on topic "Problem solving" are compiled in the form of a test with manual input of the answer, the number of problems issued by the system to each student was 10, the time limit was 20 minutes, the number of problems in the bank of test questions was 200.

Students of group B took part in "Study 2". Students were asked to independently study topic "Symbols of rolling bearings", presented as a presentation on the LMS Moodle platform, and to complete a practical task on this topic. The theoretical material on this topic can be attributed to a low level of complexity. It is important that access to the study of the material was opened at the appointed time and was limited to 60 minutes, after which students immediately and simultaneously performed practical tasks in LMS Moodle, issued by the system automatically from the test bank. The number of assignments to be given was 10, the time limit was 10 minutes, the number of questions in the test bank on this topic was 80. It should be noted that the compiled test was not previously performed in any other groups, which excluded the possibility of students to receive information about test questions and possible responses from other students.

Note that the LMS Moodle system stores test results (questions and answers, points), which helps the teacher analyze the results and make comparative assessment.

3. Results and discussion

In group B, the number of students who completed the test on topic "Gears and reducers" with a result above 80% of correct answers turned out to be significantly higher than in group A (figure 1).

![Figure 1](image-url). Results of the test on topic "Gears and reduction gears": a - group A; b - group B.
In group A, not a single student completed the test with a score higher than 94%, while in group B there were 8 such students. Such results can be explained by the lack of control from the teacher during the test in group B. Probably, the students had time to use literature, despite the large volume of theoretical issues covered and the limited time to complete the test.

Thus, despite the higher results in group B, it is impossible to conclude about a higher quality of basic knowledge of the first and second levels according to the Bloom scale among students of this group in comparison with group A. This means that control of knowledge over the assimilation of theoretic material must in the audience.

Performing test "Problem solving" refers to the practical part of the discipline and requires students to master the third level of basic knowledge (application). It is interesting to note that the students of group B coped with the problem solving worse than the students of group A (figure 2).

Thus, you can say with a high probability that the lack of control from the teacher and the ability to use the literature did not affect the results of this test. This means that the control of knowledge on solving problems can be carried out in out-of-class mode, if the access to the test is opened simultaneously for the whole group and the time is limited.

Independent study of topic "Symbols of rolling bearings" and the subsequent immediately after it the implementation of practical tasks in the form of the test shows that out of 29 students who had studied the topic and participated in the test, 21 students correctly completed 8-10 tasks out of 10 (table 3).

Thus, most of the students in the group successfully coped with the independent study of the topic and the implementation of the practical task, having received basic knowledge of the first or third levels on the Bloom scale. Note that for students who completed tasks with a score of less than 50% of correct answers, the time spent on practical tasks was the maximum allowable value - 10 minutes. Therefore, with a high probability, it can be assumed that these students did not have enough time to master the
theoretical part of the topic and / or time to complete practical tasks, especially given the fact that out of 5 students in this subgroup, four are foreign students who do not speak Russian well enough. language.

4. Conclusions
It is appropriate to control knowledge in the theoretical part of the discipline in the classroom, under the supervision of a teacher. In this case, the marks obtained as a result of testing objectively reflect the quality of the knowledge gained. The successful completion of the test on theoretical questions without the use of auxiliary literature and other sources indicates that the student has received knowledge with memorization of theoretical material and its understanding, that is, the achievement of the first and second levels according to Bloom's taxonomy.

The study of theoretical material related to a low level of complexity can be brought to independent study by students on an online platform. In this case, a teacher can present the material in the form of a presentation lesson, including audio accompaniment. If the subsequent control of knowledge on such topics can be performed in the form of practical tasks, then such control, carried out in a test format on an online platform with a large number of tasks, gives an objective picture of the student's level of knowledge. It happens if the tasks are completed simultaneously by the whole group and the time is limited.

Practical tasks drawn up in the form of a test with manual input of an answer with a large number of tasks in the tests bank and carried out simultaneously for the whole group with a time limit for the test excludes the possibility “to guess” or “to copy” the answer. Therefore, control over the implementation of practical tasks, which include the solution of problems, can also be carried out out-of-class on an online platform under the same conditions - simultaneous implementation and time limit. As the studies show, the assessment of the level of knowledge for these types of tasks is objective. Note that the successful completion of practical tasks, which include problem solving, is the achievement of the first, second and third level by the student according to Bloom's taxonomy.

The results obtained in the course of the study allow the authors to believe that the conclusions made during the study in one of the technical disciplines - "Design Basics" - can be interpolated to other technical disciplines, the study of which includes theoretical and practical types of classes.

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