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MULTI-LEVEL TESTS AS A MEANS OF SOLVING TYPICAL TASKS AND EVALUATING COMPLEX KNOWLEDGE

The improvement of higher educational system in Ukraine is one of the up-to-date task. Ukrainian students have to follow all European system requirements; they must have skills to be hired in Ukraine as well as in other countries of the world. Thus, Ukrainian education is being adopted to the world trade market. Unfortunately, in present days the real level of special knowledge is sufficiently low, because of the number of reasons: unsatisfactory economic conditions in Ukraine (many of industrial plants had been bankrupted because of political and economic reasons), the student's unavailability to improve the knowledge; an absence of motivation of studying; the faults of choosing the qualification and so on. According to our theoretical and practical experiences one of the way to amend this situation is to evaluate student's skills following his level of present knowledge. Therefore, the system of distance studying and the huge part of individual student's work make us use new approaches and methods to satisfy all needs of educational process and then the labour market. The special attention must be paid to the technical subjects because of their complicated structure with some parts of practical and theoretical materials, and a number of different disciplines related to the technological processes (such as Physics, Chemistry, Material Science and others). The lectures as well as the practitioners have to find the best method to support this general aim.
Key words: higher education, technical specialty, multilevel test, student's control, modern lecturer.

Introduction

The article deals with the new method of technical specialties' student's testing. It provides a wide varieties of levels, that allows students to be tested impartially. Also it helps the tutors and lecturers to improve the system of teaching. The usual test consists of three levels with 5-6 tasks in each. It is impossible to step to the next level if the student doesn't pass the previous one. The first level is the easiest one and the last is the hardest. Many answers to the test make the creation of the new tests quicker. The test was being used for 3 years, thus the results of it were incredible: the students were motivated to improve their professional skills and knowledge as well as the tutors (lecturers). That new method was created to control the students of technical specialties, that's why the test contained a lot of pictures, graphs, and videos. It made the student find different ways to solve the tasks and answer the questions. This testing system eliminates the possibilities to use the Internet-recourses while doing the test. The only one problem appeared to the tests' designer was the absence of technical equipment for all of the students (the system of internet connections in the countryside, different versions of software, etc.).

The aim of the study is to show for the university lecturers how to improve the system of students' testing to allow them amend the professional skills and in future an ability to find work in different branches of industries not only in Ukraine, but also in the countries of Europe, and in the world in a whole.

Theoretical framework and methodology

In the process of investigation, the authors took into account the latest works of the prominent Ukrainian scientists in technical and pedagogical science for the theoretical background. Some researchers of this issue have dedicated their scientific work to this topic (pedagogy: oral methods, method of written control, current control method, didactic test, etc.): S. S. Vitvyts′ka, A. O. Esaulov, A. P. Kondratyuk, P. H. Luzan, L. P. Oderiy, A. A. Sbruyeva, M. M. Fitsula, V. V. Chmel′, A. Y.

Yahodzins′kyy and others. Besides, many different types of test control were being widely discussed in the terms of studying. We didn't use theoretical foreign works, but a lot of videos were taken from world-famous scientific and popular programs "How it's made?" (Discovery Science), "Myth busters" (Discovery Channel), etc., where the students can be informed about following processing methods: casting methods, coatings, laser methods, plasticity methods, powder methods, surface phenomena. Moreover, the students must be good at such methods of material investigation as: characterization, electron microscopy, finite element analysis, first principles, fracture mechanics/fracture, behaviour/fatigue, hardness, micromechanics, modelling/simulations, phase diagrams, simulations, stress/strain measurements, thermal analysis, X-ray analysis, etc. But, nevertheless, the main method of knowledge checking is testing.

An American psychologist Henry L. Roediger III (Washington University) emphasized that the role of testing was significant in comparison with classical ways of learning and memorising the material: "Taking a test on material can have a greater positive effect on future retention of that material than spending an equivalent amount of time restudying the material. Knowledge learned through cramming is less durable over time." The results of distance studying have three main mechanisms of checking: case-technology, television-satellite technology, and net technology (M. Shvets', N. Samoliuk, 2013). Our work was based on the net technology use. There are 10 the most-widespread techniques of checking: summarization, highlighting, keyword mnemonic, practice testing, imagery use for text learning, rereading, distributed practice, elaborative interrogation, self-explanation and interleaved practice. The most effective study techniques across a range of learning conditions were practice testing and distributed practice, the researchers report. Practice testing with feedback, in our opinion, is the most efficient testing system for modern Ukrainian students.

Results

The use of the latest method of testing students' knowledge, which allows to evaluate the work of a student of technical specialties objectively and quickly had been analysed. The basis of the tests is the principle of multilevel checking, which provides an individual approach to each student, and also allows the lecturer to model the further work correctly. The method of teaching experiment, rating method, methods of control and self-control (test method) were used in the development of the proposed methodology. As a result of the long-term (for three years) research, the method of controlling knowledge of students was used to demonstrate the results that provided objective evaluation, the real level of knowledge acquisition, the impossibility of writing off and using any Internet resources during the course of testing, increasing student motivation to study specialized disciplines, etc. Material science is a very complicated subject, that demands to obtain a knowledge in the field of Mathematics, Physics, and Chemistry. And multi-level tests tend to improve knowledge of Material Science for well-educated students. Only 1/3 of the studying group can pass this test. The prospect of developing this technique is expanding the subject of tasks for test control, improving the technical basis of university audiences (laboratories, lecture hall, etc.), increasing the professional complementarity of teachers. Improving students' knowledge will make them more competitive in the new European space, increase mobility and allow them to successfully develop their own state in the future.

Multi-level tests allow:

- exclude the assessment of students who do not even have the elementary notions of discipline;
- to assess the depth of knowledge acquired by the student during the course;
- to consider and master the technologies of real typical parts, including right when preparing for tests.

As a way of individual work students were given the task of finding video among the proposed ones, in which certain technological processes occur. This method forced the student to review the useful technological processes of manufacturing parts, knots, mechanisms in search of the desired.

Discussion

The current state of teaching disciplines in higher education institutions of the I-IV levels of accreditation requires the professorial teaching staff to possess such diverse methods of checking knowledge that would allow them to test objectively, quickly and consistently the practical and theoretical knowledge acquired by the student.

This process is constantly complicated by the transfer of the vector of lecture hall studying to the self- educational studying of students. If a school teacher has enough time to use different methods of checking knowledge, then the university lecturer has a limited time (the reason is an auditorium load reduce): “Modern didactics distinguishes the following methods for controlling knowledge of pupils' abilities: oral control, written control, behind the doorway of practical tasks, didactic tests, observation, graphic-sign and computerised control” (Bezhinov, 2016, p.173).

In the arsenal of a modern lecturer, the most promising type of test is a computer one that can be applied to the students of various forms of learning (full-time, part-time, extra-mural, distance, etc.): “In today's theory and practice of test control there are more than 20 varieties of tests: depending on the purpose, nature and functions of control, character, forms of response” (Yakymets N., Myronchuk N., 2014, p.160.).

The test control has both advantages (speed, full coverage of the studied material, etc.), and disadvantages (sudden right choice, the lack of development of logical speech, inattention to the psychological characteristics of each student, etc.): “The best one can be considered to be having a relatively few tasks, but gives you an opportunity to profoundly sensing knowledge and skills. Proceeding from this, when compiling the tests, it is necessary to select the optimal number of tasks, which makes it possible to relatively accurately determine the level of knowledge formation” (Yakymets’ N., Myronchuk N., 2014, p.161).

Modern means of communication and the development of higher education in Ukraine require higher education lecturers of sufficient professional competence. Distant education acquires an enormous scale, so the Internet computer network has become widely used at all levels of the educational process, and especially when checking students' knowledge of full-time, part-time and distance learning.

The change of the vector of development of the Ukrainian economy towards agrarian education has led to a reduction of auditorium classes for students of technical specialties, which led to increasing in the load on self-student training. Thus, the training of future specialists in engineering specialties (particularly the discipline "Technology of Production and Processing of the Materials") requires a different approach: an electronic version of lectures, electronic or online counselling and testing.

In preparing the tests, the lecturer adheres to the following requirements that would facilitate the most objective assessment of the student's knowledge and skills, which includes the following main stages:

- an ease of access to the test (Internet, Google, e-mail, Skype, etc.);
- availability of tests for students of different levels of training;
- the ability to view video and audio files, graphic images for checking knowledge about technological processes of semi-finished and finished production;
- level of technical support for communication in the scheme “student-lecturer”;
- motivation of a student and a lecturer for preparation and performance of a test.

The fulfilment of the test tasks in the discipline of "Technology of Production and Processing of the Materials" is the final stage in the study of students in this discipline, which explains the most important stages of the transformation of the material into a component.

The proposed test for checking students' knowledge is characterised, first of all, by multilevel: the student cannot move to the next (higher) level until the initial level is successfully passed; this makes the student consistently and thoroughly study the discipline. A differentiated approach in the formulation of multilevel test tasks allows us to assess the depth of the acquired knowledge and to exclude the possibility of "accidental" obtaining of a high score.

At the first level the questions of the general nature of the stages of the technology of obtaining typical blanks from typical materials are asked. In the first block of tests, the understanding of the concepts of "metal", "alloy", "grades of alloys and steels", etc. are examined, which are basic for further study of discipline. Such questions contain fundamental points in technology, misunderstanding of which and, accordingly, non-fulfilment of test tasks from them entails the exclusion of the ability to pass the following levels of testing. For the performance of tests at the entry level the student's maximum assessment is "satisfactory" (E - 0-60).

In this case, the student must be sent to re-training for assessment and (or) re-study of the discipline, including through special courses. If in the future the student does not pass this level,

repeating takes place with a correction coefficient. The student must pass all three stages of testing without breaking the sequence. The second level is the tests where the student is offered to answer the more complex questions, which in case of the correct answer will allow to assess the student's knowledge of the rating "good" (D, C, B - 60-89). In the case of a "four (C)" result the student will be given the opportunity to pass the tests on "four (B)" and "five (A)."

The third level of complication of the proposed tests is the video questions. The difference between such tests from previous test tasks is that the questions to them are in the form of video clips for the production of certain details, which show some technological stages.

The use of video questions to assess students' knowledge eliminates the possibility of using knowledge bases that are freely available on the Internet, Wikipedia, forums, etc., which allows an objective assessment of the level of knowledge, and especially with the distance learning form.

The number of correct answers is not limited to a certain number, but is formed in accordance with the requirements for studying the material (from 4 to 16); the student is also asked to provide his own answer variant, which encourages additional investigation of the material, reduces the likelihood of "guessing" answers, and does not limit the student's creative potential. This number of answers allows you to simplify the lecturer's compilation of the following test tasks, choosing for the correct already inserted answer from the previous task. When choosing an answer, the student will automatically receive the correct answer, which motivates the development of self-control and confirms the objectivity of the test.

When making tests, the options are chosen in a such way that the lecturer could change the question while the options for the answer will remain unchanged. For example:

Test. Choose the cast iron with a tensile strength of 150 MPa among the offered variants. The answers will be as follows: 1) Ст15кп; 2) СЧ15; 3) ЧХ15; 4) Х15; 5) ШХ15; 6) 3Х15.

The proposed options for a student who does not have basic knowledge will be too complex because they have the same number in each of the grades of iron-based alloys. By changing the test questions on "Select Steel with 15% Chromium Content", the lecturer leaves unchanged the answer options, that is, they are universal in the framework of a specific topic.

In case of a shortage of computer equipment, or lack of it at all (rural territory, making it impossible to find the right answer through Internet resources), paper tests can be applied using a specially designed ruler that has the form of a standard, which can be used in seconds to check the test.

When designing a test card, the task and answer options are placed in a table where the parameters for the cells "automatic size selection for content" are displayed in the parameters.

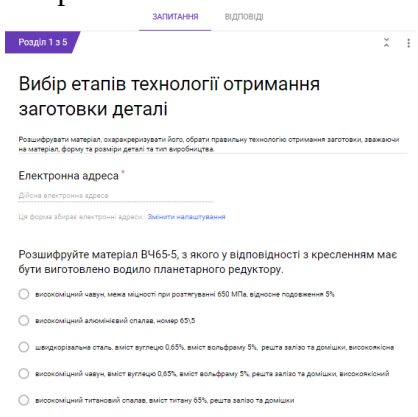


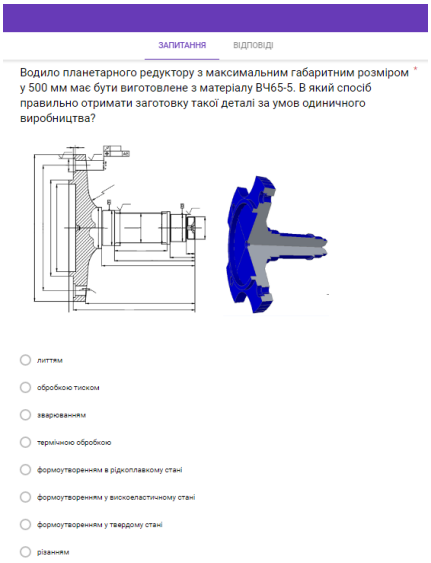
Figure 1. Typical test card with questions and answer options

Thus, when filling up such a table in it the cells will be different in height, which allows to obtain a unique “bar code” for each new table from the horizontal lines - figure 1. The uniqueness of such a “bar code” will be determined by the number of characters in the questions and/or variants of answers, which allows to consider such a system of drawing cards to such that provides the necessary objectivity.

Making up a controller to check the test cards of this type will be manually applied to a pre-created and printed on a sheet of grid from the vertical lines of the extension of the horizontal lines of the corresponding card (Figure 2).

Figure 2. Controller for testing the test card

When checking such a test task the lecturer puts the controller to check and on top of it the test card that he wants to check. Then he shifts the test card to the right/left on the controller's surface until all the horizontal lines of the card coincide with the markings on the controller. When such a coincidence is reached, the lecturer reads the figure, which is the correct answer to the relevant question.



The complete coincidence of the horizontal lines on the card and the controller, which shows the column with the correct answers variants on this card

Here we show three examples of our tests:

Test 1 (the first level of difficulty, 2 points, for E, D -result (60-73)).

Part 1 from 5: The selection of stages of the technology of obtaining the work piece parts. The goal is – to define the material, give a description to choose the correct technology of the work, taking into account the material, the shape and size of the part and the type of production.

Task: to decipher the material ВЧ65-5 from which, according to the drawings, an epicyclical gearbox must be made.

Variants of answer:

1. High-strength cast iron, tensile strength - 650 MPa, relative elongation - 5%;
2. High Strength Aluminum Alloy, No. 65/5;
3. High-speed steel, carbon content - 0.65%, tungsten content - 5%, the rest - iron and crud, high-quality;
4. High-strength cast iron, carbon content - 0.65%, tungsten content - 5%, the rest - iron and admixtures, high-quality;
5. High titanium alloy, titanium content - 65%, the rest - iron and crud.

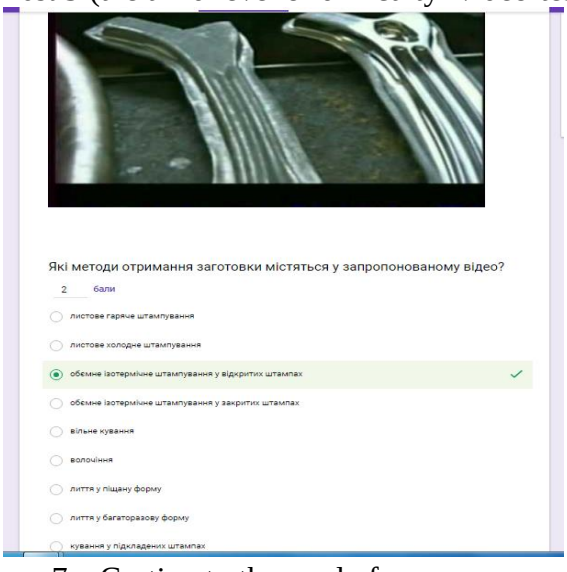
Test 2 (the second level of difficulty, 2 points, for C-result (74-81)).

1. The carriage of a planetary gearbox with a maximum dimension of 500 mm should be made of material ВЧ65-5. How is it possible to prepare correctly the work piece of such a component under the condition of single production?

Variants of answer:

1. By Casting (right answer); 2. Pressure treatment; 3. Welding; 4. Thermal processing; 5. Formation in a liquid state; 6. Formation in a highly elastic state; 7. Formation in the solid state; 8. By cutting.

Test 3 (the third level of difficulty- video-test, 2 points, for B, A-result (82-100)).



Practical application of technological methods for receiving and processing blanks (parts). The students should watch the video (Discovery Channel, *'How it is made?'*) and find out which of the technological methods were applied, moreover, video contains some translation errors (English - Russian), so the students have to notice them and correct.

Variants of answer:

1. Hot blanking:
2. Cold blanking;
3. Insoluble isothermal punching in open punches (right answer);
4. Insoluble isothermal punching in closed punches;
5. Free forging;
6. Drawing (wire drawing);
7. Casting to the sandy form;
8. Casting to the multiple form;
9. Forging in layered punches.

Conclusions

Thus, the applied method of multilevel tests allows:

- exclude the assessment of students who do not even possess the elemental notions of discipline;
- to assess the depth of knowledge acquired by the student during the course;
- to consider and master the technologies of real typical details, directly including in preparation for tests.

In addition, as a self-employed student during the course were given the task of finding video materials among the proposed ones, where certain technological processes are showed. This made students look at the useful technological processes of manufacturing parts, nodes, mechanisms in search of necessary information.

In the basic vocabulary of popular science videos, there is a huge amount of mistakes in fundamental issues. This is actually a system for technical translators/interpreters who do not even understand the elementary technologies, because they are not taught by engineers. Thus, our tests provide the students with a need of improving English language skills.

Consequently, using a video with such a translation for test questions, the student's task is even more complicated, because he cannot adequately use such translation quality.

• You can achieve more effect by creating or installing of your own video clips.

• The preparation of one test task of such a plan requires a teacher of a significant level of integrated knowledge of the basic and many related disciplines, it takes a considerable amount of time to prepare it, and additional work hours should be provided for this work.

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