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SOCIO-ECONOMIC TRANSFORMATIONS AND PRIORITIES FOR INNOVATIVE DEVELOPMENT IN THE CONTEXT OF DIGITALISATION AND GLOBALISATION

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The scientific monograph presents a study of socio-economic transformation and priorities for innovative development in the context of digitalisation and globalisation. It also examines aspects of accounting and financial support for sustainable development in business and the public sector. The monograph describes the interaction between management, marketing, human potential, and digital technologies. Additionally, it highlights topical issues in the humanities and social sciences. The publication is intended for researchers, educators, postgraduate students and students, as well as anyone interested in this issue.

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DEVELOPMENT OF DIAGNOSTIC TOOLS DURING THE PROFESSIONAL TRAINING OF A GRADUATE OF A HIGHER EDUCATION INSTITUTION

Roman Chepok, Inna Varnavska

INTRODUCTION

The main social requirement of society is quality education. Recognition of the value of human individuality, processes of humanization and standardization in the field of education require qualitative changes in the control and monitoring of the process of education and upbringing.

The main task of educational policy at the current stage of its development and formation is to achieve a high level of quality education that meets the needs of the individual, society and the state.

One of the important areas of reforming the national education system is the development and implementation of qualitatively new approaches to assessing students' academic achievements.

The need to fundamentally improve the training of specialists based on the practical orientation of modern requirements, taking into account the labor market conditions and international experience, as well as martial law in our country, necessitates the transition to a graduated education system based on a subjective and activity-based approach to setting goals and content of education and training for each educational level.

The main goal-forming normative document in the design of such an education system is the EPP (educational and professional programs), which, along with the name of the specialty, the appointment of a specialist, the nomenclature of primary positions, the list of means and results of activity, etc., determine the orientation and moral and business qualities of a specialist, the requirements for his or her training through a list of skills of a certain type and level of formation[1].

The set of types of professional activities of a specialist, specified through professional tasks, allows to formulate requirements for the content and forms of qualification tests, which are aimed at determining the level of theoretical and practical preparation of a graduate for the next professional activity provided by the EPP.

Given the variety of activities of a specialist, which can be determined through the EPP, it is logical to establish that the most adequate form of

[1] Конвенції Ради Європи і ЮНЕСКО про визнання кваліфікацій з вищої освіти

qualification tests that would objectively and reliably determine the level of educational and professional training of graduates of higher education institutions is a qualification exam in a specialty, which involves the performance of certain certification qualification tasks. Such tasks can be, first of all, professional tasks that model real situations that a graduate may encounter in practical activities.

On the other hand, the pedagogical system of graduate training requires effective pedagogical control. Some existing elements of such a system are an eclectic mix of objective and subjective, manual labor and computer technologies and do not meet modern requirements. That is why the system of higher education has not been able to protect it from many negative phenomena, such as protectionism, subjectivity in knowledge assessment, etc.

Elimination of the above is possible only through the scientific organization of the learning process, which is based on the following:

1. Mastery of modern technologies of pedagogical and qualification control by all participants of the learning process.

2. Awareness that the main link in the pedagogical system is the subject of learning, and that learning at all its stages should be accompanied by a powerful methodological train in the form of professional tasks and objectives.

It is advisable to pay attention to the connection of pedagogical control with a unified sectoral certification system. In this system, pedagogical control should be viewed as the main link that ensures the continuity of the process of upbringing, education and training. Delay in developing such a control system may backfire both against the educational institutions (those who teach) where it has already been implemented and against the sectoral controlling bodies, as both may be unprepared for standardized qualification exams that have long been used in international practice.

1. Pedagogical control in the system of higher education

Pedagogical control is an integral part of the process of education and professional training of specialists and should be in organic connection with other elements of the pedagogical system. It is not a substitute for didactic teaching tools, but should help identify the achievements and shortcomings of this process and is an interrelated and interdependent activity of the teacher and the subject of learning. This is possible only if a scientifically based system of verification of the quality of education and training results is created and means identifying, measuring and evaluating knowledge, skills and abilities. In relation to vocational training, it should be noted that, in addition to general training, the effectiveness of professional activity will also depend on professional education, professional upbringing and professional training.

Based on the structure of pedagogical activity, the main subject of assessment of educational outcomes is knowledge of learning outcomes – skills and abilities, and the results of education – worldview and attitudes, interests, motives and needs of the individual. The subject of assessment is usually the student or the qualification commission. At the same time, the pedagogical process remains the object of control in higher education institutions[2].

Pedagogical control in higher education institutions has four main functions: diagnostic, educational, organizational and educational[3].

The diagnostic function of pedagogical control is aimed at determining the level of knowledge, skills and abilities in order to obtain scientifically based information to improve the process of training.

It is known that each diagnostic tool used today in domestic pedagogy has both advantages and disadvantages that significantly affect the results of control. The use of the most common forms of control, such as oral and written tests, essays, colloquia, etc., in determining not only knowledge but also verbal abilities leads to significant expenditures of teaching time, generates passivity during weak answers of those who take exams. First of all, exams put a significant strain on their psyche and have a negative impact on their health. In addition, the objectivity of assessments is greatly influenced by the personal traits and subjectivity of teachers.

The educational function of pedagogical control is realized both with traditional forms and methods of control and with the widespread use of programmed learning and control. However, due to the difficulties of implementing the latter, the organization of the educational process in most higher education institutions is oriented, relatively speaking, towards an average trainee. In this case, poorly prepared students will still lag behind, and well-prepared students will gradually be delayed in further accumulation of knowledge and skills.

The organizational function of pedagogical control is manifested depending on the decision-making process of conducting certain pedagogical and administrative activities. Here, the most important organizing point is the activation of such activities of the teacher, which will be aimed at developing and using the means and forms of teaching that can increase the interest and creative independence of the subjects of learning in the acquisition of

[2] Баласанян Г. А. Організація та проведення наукових досліджень: Конспект лекцій з дисципліни для здобувачів третього (освітньо-наукового) рівня освіти по спеціальності – 144 Теплоенергетика. Одеса : ДУ «Одеська політехніка», 2021. 85 с.; Важинський С. Е., Щербак Т. І. Методика та організація наукових досліджень : навч. посіб. Суми : СумДПУ імені А. С. Макаренка, 2016. 260 с.

[3] Нагаєв В. М. Методика викладання у вищій школі. Навч. посібник. Київ : Центр учбової літератури, 2007. 232 с.

knowledge, formation and application of skills and abilities in practice. At the same time, the idea of control over the teacher's activities does not always meet with support, since the current pedagogical control does not allow for an impartial and objective assessment.

The educational function of pedagogical control is realized only under conditions of proper organization. Only in this case, the subjects of learning develop an idea of knowledge as an intrinsic value, and not just as a means of achieving certain pragmatic goals.

As a rule, certain types of traditional forms of pedagogical control can perform only some of the four listed functions (seminars – diagnostic, educational and training functions, examinations – only diagnostic). In the educational process in a multi-level system of education and training, all four of these functions are closely interrelated. Therefore, in order to achieve high quality control and its multifunctionality, it is most appropriate to use methods of pedagogical control based on the use of pedagogical measurements and assessment.

Pedagogical assessment is understood (not to be confused with evaluation – a numerical analog of value judgments) as a judgment about the significance (value) of a certain value, its approximate characterization. Any distinction is subject to evaluation: knowledge, social activity, personality traits, etc.

The main purpose of assessment is to have a formative effect on the ongoing learning process in order to improve it by establishing feedback between the student and the teacher and obtaining final learning outcomes.

In contrast to assessment and evaluation, measurement is a specific procedure for quantitatively comparing the studied attribute with some standard that is taken as a unit of measurement.

The main purpose of the measurement is to obtain numerical equivalents of the degree of expression of the distinction of interest. In the pedagogical dimension, the merit is represented by the content of knowledge and skills. The unit of measurement is control tasks selected to determine the level of knowledge or skills possessed by the subject of learning[4].

Pedagogical tests. The world history of training high-quality specialists shows that the most correct means of measuring the personality characteristics of the subject of learning are achievement tests – psychodiagnostic methods of measuring and evaluating the achieved level of development of abilities, skills and knowledge.

[4] Павленко П. М., Філоненко С. Ф., Чередніков О. М., Трейтяк В. В. Математичне моделювання систем і процесів : навч. посіб. Київ : НАУ, 2017. 392 с.

In this context, a special place is occupied by test technologies. The issues of theory and methodology of pedagogical control based on test technology were considered by such scientists as: V. S. Avanesov, N. A. Gulyukina, V. M. Nagayev, L. O. Fedotova, M. B. Chelnikova and others.

Achievement tests (in contrast to the well-known intelligence tests) reflect not so much the influence of accumulated experience and general abilities on behavior and solving certain tasks, but rather measure the impact of special education programs, vocational and other training on the effectiveness of teaching a particular set of knowledge, the formation of various special skills. Thus, achievement tests are focused on assessing the achievements of the subject after completion of training. In addition, the peculiarity of the latter is their focus on measuring the achievements of the subjects in the field under study directly at the time of testing, while the study of general abilities involves, to some extent, predicting the next criterion activity and future development.

Achievement tests belong to the most numerous group of psychodiagnostic techniques due to the number of specific tests and their variety. They include the most correct means of pedagogical measurements – the pedagogical test, as well as the most advanced means of comprehensive assessment of the quality of specialist training – tests of professional competence, which can be used not only for certification of specialists, but also for recruitment to fill positions, etc.

A pedagogical test is a system of tasks of a specific form interconnected by the subject content, which allow assessing the structure and measuring the level of knowledge and other characteristics of a person.

Only an appropriately prepared set of tasks allows for a reliable assessment of the knowledge of the subjects of the test using certain statistical methods. The main reason for this is that controlling authorities, in particular teachers, are usually not able to operate with qualitative characteristics of students. At the same time, operating with numbers, which to a certain extent describe the subjects of learning, is not particularly difficult. That is why there has been a recent trend in pedagogy to use quantitative methods of pedagogical control.

Among the means of objective control, the most scientifically sound is the method of testing with the use of technical means of learning.

To develop and implement these tools, it is necessary to

– conduct research and development to create tests and grading scales that would have sufficient differentiating ability;

– overcome the passive resistance of all those involved in control.

The use of automated test methods in the system of higher education will reduce financial costs and time while improving quality and information content, and will provide an opportunity to significantly increase the

responsibility of students and teachers for their activities, which is achieved through the objectification of the pedagogical control procedure[5].

Thus, it can be argued that the creation of a system of objective test assessment of knowledge and skills that could be used in all types of pedagogical control and that would satisfy its goals and functions should be based on modern technologies of pedagogical measurement, which require developers not only to be highly qualified in pedagogy and in the subject area, but also to understand the goals of training specialists of a certain profile and deep knowledge of the theory of testing and its components (Figure 1).

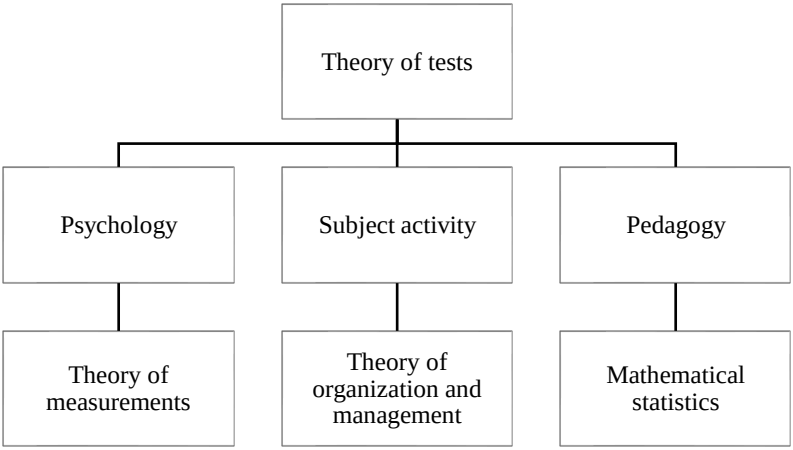

Figure 1. Structure of the objective method of pedagogical measurement[6]

Only with this approach can we hope to create a system of test control of the quality of education and training that meets the basic principles of objective pedagogical control, as shown in Figure 2.

The principle of the connection of control with education, training and education is implemented by promptly identifying and eliminating deficiencies in the educational and educational process. Implementation of

[5] Law A. M. W. D. Kelton. Simulation Modeling and Analysis. New York : McGraw-Hill Publishing Co, 2000. – 3-rd edit. 560 p.

[6] Лапач С. М. Теорія планування експериментів: Виконання розрахунково-графічної роботи : навч. посіб. для студ. спеціальності 131 «Прикладна механіка», спеціалізації «Технологія машинобудування»: КПІ ім. Ігоря Сікорського. Київ, 2020. С 86. URL: https://ela.kpi.ua/server/api/core/bitstreams/e80b3665-5324-4155-a675-a1f0a11f9bdb/content

this principle makes it possible to increase the responsibility of teachers and subjects of learning.

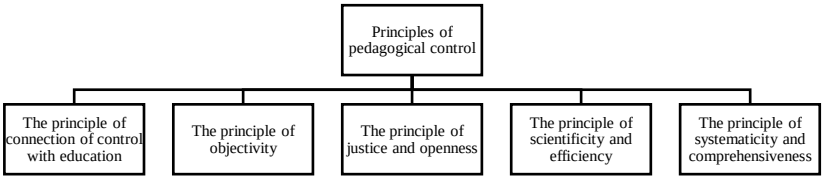

Figure 2. Basic principles regulating the process of pedagogical control in the system of education and professional training[7]

The principle of objectivity of pedagogical control is most often violated in traditional pedagogical systems, which clearly reflect the mistakes and defects of society built on the egalitarian (comparative) principle. Such a society does not need testing and is even harmful, as it undermines the foundations of personal devotion and gives an objective answer to the question – "who is who?". A vivid example of this is the very history of the development of test control in most educational institutions of the world.

A high-quality specialist can be obtained only under the condition of the development of the subject's personality. According to this approach, the social status and privileges should correspond to the specialist's rating, which he receives on the basis of testing. And this applies to every subject of the educational process (student of higher education, teacher, administration, etc.). When applying test control, this principle is implemented by applying standard testing methods both in higher education institutions and by state control bodies.

The principles of justice and openness are close in content to the principle of objectivity. They are implemented through openness of all stages and results of pedagogical control, transparency and uniformity of application of testing methods to all subjects of the educational process without exception, as well as the possibility of checking their results.

The principles of scientificity and efficiency are implemented by building a control system based on scientifically developed testing theory, which ensures the optimal ratio between the achieved effect and the total costs of time and money.

The scientific nature of pedagogical control involves the compliance of tests with certain criteria for assessing the quality of measurement methods,

[7] Павленко П. М., Філоненко С. Ф., Чередніков О. М., Трейтяк В. В. Математичне моделювання систем і процесів : навч. посіб. Київ : НАУ, 2017. 392 с.

the most important of which are: objectivity, reliability, validity, and accuracy.

Measurements are considered objective if the influence of the subjective actions of those who measure is minimal. In other words, measurements are objective when the results of these measurements are maximally independent of the researchers. This means that different researchers, measuring the same characteristic, should get the same result.

In order to minimize the influence of subjective factors, maximum standardization of the conditions of measurement and analysis of its results is necessary. The following requirements apply to the standardization of experimental conditions:

– the objectivity of the measurement, which requires the same conditions of the exam for everyone who is subject to the exam. For this, the measurement process itself is standardized. Only when the same experimental conditions are met, the measurement results can be compared with each other;

– objectivity of data processing, which requires data fixation, their accumulation, analysis and preservation;

– objectivity of the interpretation of the results, which requires the same interpretation of the same measurement results by different researchers. This is possible only if there is a theoretical concept that underlies this method, measurement and evaluation. Within this theory, there are analysis algorithms and criteria that are the basis of the interpretation of the results. Thus, the researcher is given the opportunity to make the only correct decision that is optimal within the accepted theoretical concept.

The reliability of the measurement method is the degree of stability of the results, which affects the accuracy with which one or another specific feature can be measured. Checking the reliability of the method primarily concerns the restoration of results during repeated measurements. The degree of reliability of the method is determined using the reliability coefficient.

The reliability coefficient is equal to the correlation coefficient between the results obtained by the same method and under the same conditions. It shows how well the results of the measurements, which were carried out under the same conditions, coincide.

The degree of reliability of the method depends on:

– objectivity of the method;
– parameters of the measuring device;
– the stability of the characteristic being measured.

Therefore, when ensuring the objectivity of the method, the reliability coefficient proportionally depends on the characteristics of the measuring instrument, which determine the accuracy with which this or that parameter can be measured. Accuracy of measurement, according to the theory of errors,

determines the value of the error of the quantity being measured. So, the greater the accuracy of the method, the smaller the measurement error and the greater the reliability of this method.

It is impossible not to pay attention to the need for stability of the characteristic being measured. This is especially true of pedagogical measurements, since the characteristics investigated in them are labile. They depend to some extent on many internal and external factors, in particular the physical condition of the person undergoing the measurement.

To control the reliability of the test and the quality of knowledge acquisition, test batteries are created, that is, a set of tests of the same level.

The validity of the method is a complex characteristic that is determined both by the parameters of the measurement tool and procedure, and by the properties of the characteristic being investigated.

Thus, the validity of a method is the correspondence of what is measured by this method to what it is supposed to measure. Therefore, this criterion establishes the sphere of reality for which the method gives statistically probable results. If we are talking about testing activities of a certain level, then the qualification tasks offered in the test must correspond to this level of complexity, i.e. They cannot be performed by means of activities of a lower level. At the same time, they talk about the functional validity of the test.

The validity of the method in measuring success can be differentiated according to the following criteria: content validity, relevance validity, and predictive validity.

Content validity is compliance with content requirements. For example, when measuring success, the content of training is determined by the curriculum and the method of training, and the requirements are determined by the list of necessary knowledge, abilities and skills that the applicant must have upon graduation. Of course, the violation of parity between the requirements and the content of training will lead to a violation of the reliability of the measurement results, even if the method meets the first two criteria – objectivity and reliability.

Correspondence validity is the correspondence of the results of measurement and evaluation of one characteristic by different methods. Of course, the results obtained by the new method should be compared with the reference one. In the absence of such a reference method, and existing methods do not meet the quality criteria, determining the validity of a new method based solely on how well it corresponds to a previously used method is not only methodologically incorrect, but also inhibits the search for better methods.

The validity of content and correspondence is also called empirical validity, the statistical indicator of which is the validity coefficient.

It is defined as the correlation coefficient between the results of measuring a certain characteristic by the methods under investigation and the reference one. But, as was determined earlier, the lack of a truly reference method significantly reduces the informational value of this coefficient.

The validity of the forecast is the correspondence of the results obtained in this experiment to those predicted on the basis of the previous experiment. The validity of the forecast definitely determines the validity of the method, but it depends to a greater extent on the dynamic changes of the characteristic being investigated.

Each measurement method, depending on the instrumentation, makes it possible to obtain results only with some limited and clearly defined accuracy, which characterizes the degree of fluctuation of the measured parameter. The accuracy of a measurement method defines the minimum or systematic error with which a measurement can be made by a given method. The theory of errors is based on the fact that when other systematic errors are eliminated, fluctuations in measurement results are subject to statistical regularities. This allows you to quantify the degree of accuracy and take it into account further.

General information about the criteria for the quality of methods of measuring quality characteristics is given in the Table 1.

The criteria for evaluating the quality of the measurement methods listed above are necessary but insufficient criteria for the effectiveness of pedagogical control. In addition to them, effectiveness largely depends on the organization of control, provision of technical and methodical means of higher education institutions. Effective control of knowledge also depends on the answer to the most difficult question – what is knowledge of the subject? Solving this issue leads the teacher-developer of tests to the formation of some image, which should be satisfied by all subjects of learning, who could be classified as those who know this subject. Such an image helps in the selection of appropriate material-content, which already in the form of test tasks must be presented in a certain canonical form.

As already mentioned, the level of professional education of teachers and supervisory bodies in matters of methodology (system of forms, principles and means of organization) and the theory of test control is of great importance to increase the efficiency and reliability of the use of test control methods.

The principles of systematicity and comprehensiveness ensure the regularity of control over the educational process and its full coverage. All this is closely related to the possibility of obtaining a sufficient number of results, which allows us to draw an objective conclusion about the level of education of those who study at each stage of education. These principles of

test control have a noticeable motivating force and stimulate the activity of subjects of learning.

Table 1

Criterion characteristics of the method of measuring qualitative features

Criterion	The content of the concept	Provision conditions	Quantitative characteristic
objectivity	minimization of the influence of subjective factors	- minimization of the influence of subjective factors standardization of the measurement procedure: - objectivity of the procedure; - objectivity of data processing; - objectivity of interpretation of results	not entered
reliability	the degree of stability of the results	- objectivity of the method; - optimization of the parameters of the measuring device; - stability of the sign	coefficient reliability R
validity – content validity – relevance validity – predictive validity	correspondence of what is measured to what should be measured	validity of all categories of the measurement process	coefficient validity of V
precision	determining the minimum error	minimization of measurement error	coefficient accuracy C

In addition, the implementation of these principles contributes to the identification of educational, educational, organizing and, especially, diagnostic functions of pedagogical control. The latter, in addition to special testing methods used in pedagogical practice, makes it possible to assess the physical and psychological training of those who study. At the same time, the organizing function of test control allows to organize a single system of objective control of the state of educational work in educational institutions, to unify training, professional training and certification of specialists of one direction and one level of training in different educational units.

It should also be noted that the implementation of the principles of systematicity and comprehensiveness together with other principles ensures the implementation of the most important function of test control – predictive, which is practically absent in other forms of pedagogical control.

As already emphasized above, the assessment of knowledge performs a number of important functions in the learning process and concerns not only those who study, but also teachers and administration.

The former do not care at all how their academic success is evaluated. A positive or negative assessment gives an adequate idea of an individual's abilities, knowledge and skills. The motivation for their further activities largely depends on how students are evaluated.

Assessment of knowledge enables teachers to get an idea of the quality and quantity of the curriculum material mastered by those who study. The evaluation also affects the organization of the further educational process, leads to revision of the topics of lectures, practical classes, preparation of additional visual material on topics not well mastered, etc. An important function of the evaluation is the verification of new teaching methods that are introduced into the practice of the educational process at the departments. To test the effectiveness of new teaching methods, it is necessary to have accurate measurement methods. Pedagogical tests, which neutralize the personal interests and influence on the experience of the experimenter, one way or another interested in obtaining certain results, belong to such measurement methods.

Assessment of knowledge enables the administration to rank students according to the level of academic achievement and make responsible decisions. The evaluation gives feedback to the students and the administration about their joint activities in the learning process.

Assessment of knowledge using an objective test compared to a traditional oral exam has a number of advantages:

– objectivity – the correct answer to each of the test questions is determined in advance by the commission of developers;

– verification of a large amount of knowledge simultaneously in all examinees in a relatively short period of time;

– machine processing of test results and the availability of a rating scale.

But the test exam has some disadvantages:

– writing test tasks requires certain qualifications;

– selective answers may have an element of a hint;

– test questions make it possible to check knowledge quite reliably, and the level of development of skills and professional thinking of a future specialist can be checked only indirectly with the help of pedagogical tests.

Therefore, an objective test exam is one of the methods used in the comprehensive assessment of the competence of those who study.

Test exams increase the quality of knowledge assessment of those who study, raise the level of educational and methodical work of the departments. The introduction of the final test requires certain changes in teaching: those who study must be prepared for such an exam already in the process of learning, conducting test control on topics or sections in parallel with the preparation of the final test exam.

In traditional exams, the teacher must judge the student's level of assimilation of the entire curriculum based only on the answer to the questions of one ticket, which contains a very small part of the program. Subjectivism and errors in the assessment of knowledge reduce the motivation of the educational activities of those who study, contribute to the increase of emotional stress and the emergence of emotional barriers in the relationship between those who study and teachers. All this eventually leads to an increase in psychosomatic diseases of those who study during the examination sessions. Research by psychologists shows that the examination grade in a traditional oral exam depends not only on the level of valid knowledge of the test takers, but also on the individual tolerance to anxiety, the level of communication techniques, the ability to adapt to exam stress, as well as on the typical mistakes of those who conduct the exam.

There are a number of such errors: errors of leniency, or, conversely, severity; errors of central tendency, when the examiner artificially reduces the variability of his grades; errors caused by the level of training of the group (in a well-prepared group, the examiner is prone to underestimating grades due to the fact that he involuntarily tries to reproduce his own pattern of grade distribution). Widespread mistakes, which were called the "halo effect", where the influence on the evaluation of the contact of the applicant with the examiner before the exam and the emotional attitude of the examiner in relation to the applicant is revealed. In the end, the examiners' assessment of the applicant most often does not coincide with the assessment given to the graduate in real life.

Research by psychologists proves that the examination test is not only a more objective method of evaluating the educational achievements of those who study, but also less strict compared to a traditional exam. It has been established that in testing conditions, the level of exam anxiety among students is lower, the degree of attentiveness is higher, and the physiological characteristics of the body's state are more favorable. The great advantage of the test exam is the unification of requirements, the application of a single criterion and standards of evaluation, saving the time of those who take the exam and teachers.

2. Forms and principles of construction of test tasks

Test tasks are the basis for the formation of criterion-referenced achievement tests, which belong to psychodiagnostic methods aimed at measuring the achieved level of development of abilities, knowledge and skills.

The main forms of test tasks and the principles of their construction are: closed form and open form.

The form (format) of test tasks (tasks) is divided into:

1) a closed-form task with proposed answers, from which one correct one is chosen;

2) open-ended tasks with freely constructed answers.

Closed-form test tasks should consist of three components:

a) instructions for their implementation;

b) interrogative (content) part;

c) answer(s).

The form of submission of text or graphic test tasks (tasks) must meet certain recommendations of diagnosticians:

1. Test tasks of the same form must be accompanied by one instruction on their execution. When changing the form of test tasks, a corresponding new instruction is formed.

2. The text of the instructions must be different from the main text (in a different font or active color, etc.) and separated from the test tasks by a colon.

3. Test tasks are numbered with Arabic numerals, the numbering of test tasks of different forms is continuous.

4. The interrogative part of the test task is formulated, as a rule, in an affirmative form concisely, clearly, without double interpretation.

5. The question part of the test task is highlighted in capital letters or in an active color.

6. Answer elements of part of the test task have separate indexing.

7. The question part of the test tasks and the possible answers are not separated by any sign.

8. The answers are placed symmetrically under the question part.

9. If the answer involves a certain calculation procedure, then the latter should be simple, without the need to use component technical means.

Closed-form test tasks. Closed-form test tasks differ according to the principle of constructing an answer.

– Alternative test tasks provide for the presence of two options for the organization of the "yes – no" answer; "true – false" etc. As a rule, they are used to roughly check the correctness of a choice or make a decision in a condensed form.

– Multiple-choice test tasks involve at least three possible answers (but no more than five). Tasks of this type should be used in cases where it is necessary to check the ability to correctly reproduce the acquired knowledge.

In this type of test task, only one of the proposed several answers is correct. When composing such tasks, difficulties arise in the selection of distractors – plausible answer options that should look sufficiently acceptable as correct.

In turn, multiple-choice tasks are divided into types according to the principle of selecting correct and plausible answers.

A test task with a simple multiple choice, the answer to which is based on the principle of classification is intermediate between alternative test tasks and test tasks with multiple choices. It is advisable to use them when the number of possible answer options is less than three, but the answer is more complex than a yes-no answer.

– Test tasks, the answers of which apply the principle of cumulation, should be used to check the completeness of knowledge and skills.

The interrogative part of such tasks mainly has a comparative meaning: one of several answers should be the best, possibly correct, most correct, most complete, and the one that occurs more often.

In this regard, it is recommended to use expressions such as "as a rule", "of course", "most often", "the main reason", "most often", "most often" etc. in the question part of the tasks.

To check knowledge and skills, test tasks are also used, the answers of which are constructed according to the principle of cyclicity.

When composing multiple-choice test tasks, it is possible to use a combination of all the above-mentioned principles.

The first and second answers use the principle of classification, the third - cumulation.

The principle of double alternative was used in constructing the answer to the test task.

Other versions of the instructions are possible, for example: after the question (which is an unfinished statement, fragment, situation, etc.) given below, five (two, three, ...) answers (statements) are given. Choose one most correct (most complete) answer.

Test tasks built on the principle of restoring the correspondence of parts. Test tasks for restoring the conformity of parts are a modification of test tasks with multiple choices and are divided into four types:

– test tasks for compliance;
– test tasks for comparison and contrast;
– test tasks with multiple "true-false" answers;
– test tasks to determine causality.

Tasks are presented in the form of two or more columns of words, phrases, graphic images, numerical or letter designations, etc.

Each element in the corresponding column is numbered with a number or letter. The person being tested must determine the correspondence of the elements placed in different columns, that is, choose those that are connected to each other.

Certain rules must be followed when compiling such tasks:

1. The list of elements in the first column must consist of homogeneous elements. The number of the latter can be any, but it is advisable not more than five.

2. In order to avoid the possible fitting of the last question to the last, not yet used answer, the number of elements in each column must be different.

3. It is recommended to place the answers in a logical, alphabetical, numerical or chronological sequence.

4. The instructions must clearly indicate the principle of answer selection, as well as the possibility of using the answer one or more times.

Matching test tasks. Test tasks on correspondence (on associative connections) provide an opportunity to establish knowledge of facts, relationships and knowledge of terminology, notations, methods, etc.

Test tasks for comparison and contrast. Test tasks for comparison and contrast (for the analysis of the relationship) are recommended to test the ability to identify distinguishing features of various phenomena, situations, etc. When performing such tasks, the test taker analyzes the proposed material, synthesizes it and draws appropriate conclusions. In the case of analysis, the material proposed for testing is divided into separate parts and their relationships are determined: in the case of synthesis, separate parts or elements of the proposed material are combined into a single whole.

Test tasks built on the principle of questions with multiple answers. Test tasks with multiple "true-false" answers are used in situations where the answers or solutions can only be right or wrong (as opposed to test tasks (as opposed to test tasks with one most correct answer)), do not have any shades of superiority and are categorical In addition, quite often there are several correct answers to the proposed question. In this case, it is considered that the depth of knowledge, understanding of various aspects of phenomena, processes, etc. is being tested.

Tasks of this type contain a framework to which four numbered answers are usually offered. Such a basis can be presented in the form of a statement, fragments of text, illustrations, etc. Answers must be only true or only false (unlike test items with one most correct answer). The instructions must specify the rule for choosing an answer.

Test tasks for determining causality. Test tasks to determine the causal relationship are used when it is necessary to verify the understanding of a certain causal relationship between two phenomena.

The question is structured so that each of the two statements connected by the conjunction "because" is a complete and clearly formulated sentence. The test taker must first determine whether each of the two statements is true or false separately, and only then, if both are true, determine whether the causal relationship between them is true or false.

Test questions to reproduce the correct sequence. Test tasks to reproduce the correct sequence (combination) require restructuring of data or elements of any combination. The use of such tasks is appropriate in the case of testing skills and knowledge of the correct sequence of actions (normative activity), activity algorithms, sequences, technological techniques, etc. It is also possible to use them when testing knowledge of generally accepted wording of definitions, rules, laws, fragments of regulatory documents, etc.

Such test tasks are used, as a rule, in the form of an imaginary model of actions, an imaginary simulator, etc. The test taker must insert the serial numbers of the components of the actions arranged in a free order. If necessary, the task can be accompanied by a certain name, as well as determine the beginning of the proposed sequence of words.

Open-ended test questions. Open-ended test tasks, which involve free answers from those being tested, are tasks without suggested answer options and are used to reveal knowledge of terms, definitions, concepts, etc. The person being tested performs the task according to his own vision. In terms of content, an open-ended test task is a statement with an unknown variable.

It is recommended to start writing open-ended test tasks by asking the question: At what temperature does water boil at an altitude of 1000 m above sea level?

Next, a complete and correct answer is formed in such a way that the key word (in this case – the height of 1000 m above sea level) is at the beginning of the answer, and the educational element, the knowledge of which must be tested, is at the end;

– At an altitude of 1000 m above sea level, water boils at a temperature of 98 degrees Celsius.

The corresponding educational element is removed from the correct answer, and the test task is ready.

In order to prevent the disclosure of test tasks of open and closed forms during the testing process, it is recommended to use the so-called faceted test tasks, the content of the question part of which is reduced without changing the thematic focus of the task as a whole.

Situational test. A situational test is not a new form of a test task. This is a targeted set of test tasks designed to solve problematic situations inherent in the future social and industrial activities of graduates of higher educational institutions.

The number and forms of test tasks in such a test can be quite diverse, but it is possible to use test tasks of the same form. The order of placement of test tasks in a situational test is determined by the actions that the test taker must perform to solve the problem situation.

It is advisable to use the situational test in the diagnosis of the degree of assimilation of a complex activity, adequate activity in relation to the solution of typical tasks of the activity. In this case, the situational test is an analogue of a complex qualification task.

The technology of constructing an objective control test. The test should include a number of test items sufficient to ensure the appropriate accuracy of the measurement method. This characteristic is called test length.

To ensure a measurement accuracy that does not exceed 5%, the length of the test should be from 380 to 420 test items, for an accuracy of 10% – from 80 to 120, and for an accuracy of 20% – from 25 to 30 test items.

At the state qualification exam, the measurement error cannot exceed 5%.

Test exam technology. The technology of conducting a test exam requires the existence of a certain organizational structure that ensures compliance with certain rules for conducting test exams:

1. Unification of measurement conditions.
2. Informational and psychological preparation of applicants for the test exam.
3. Compliance with the rules of secrecy when reproducing test brochures, their storage and use.
4. Unification of conditions and methods of processing test results and forms of their submission.

The technology of psychometric analysis of the test and test tasks. The test must undergo standardization based on the results of pilot testing on a representative sample in order to establish the diagnostic properties of the test through the determination of such statistical parameters.

For the test:

- Average is X.
- Mean square deviation – A.
- Reliability coefficient – R.
- Standard error of measurement – E.
- Validity coefficient – V.

For the test task:

- Index of difficulty of the test task –Ic.
- Index of differentiating ability – Id.

3. Methods of development of diagnostic tools

The development of tests cannot be separated from the mathematical processing of test results and the determination of the quality of the developed tests. Therefore, all these problems should be considered sequentially, as is the case when creating a test.

The work begins with the layout of the test project – the test material, which is later transformed into a test that meets the test quality criteria using the methods of mathematical statistics. Taking into account that the use of mathematical methods in psychodiagnostics requires a high level of qualification of the developers, a simplified technology for the development of pedagogical tests, built on the principles of qualitative analysis of test tasks, is proposed below. It is assumed that in the future, with the acquisition of experience in the development and use of tests, as well as after the appropriate improvement of the qualifications of teachers of higher education institutions, it will be possible to apply modern technologies for the development and use of psychodiagnostic methods for determining the quality of education acquired by a student of higher education.

The composition of the test material begins with the definition of knowledge in the form of modules that are adequate to the topics of the educational components being studied, presented in the OPP. Based on the analysis of the content of the modules in the table, an information base of educational and professional training of specialists is formed in the form of a system of educational elements that make up the corresponding modules. The formation of such a system consists in the selection of educational elements and the determination of logical connections between them (structural decomposition of meaningful modules). This is due to the fact that when constructing tests used in pedagogical measurements, it is necessary to establish not only schemes of formal logical connections between individual sections, but also to clearly distinguish those educational elements and logical connections between them, the level of mastery of which must be checked through tests.

Note that the logical and didactic processing of content arrays and its structural decomposition cannot be separated in time, therefore, when designing the content of training, the specified processing must be carried out in parallel – thereby achieving the adequacy of the structure of the training content to the structure of the relevant field of knowledge.

When forming a system of educational elements, groups of educational elements that have similar content features should be selected from the content module. Let's list them according to the scheme (letters indicate the codes of groups of educational elements, and conventional names of groups are given in parentheses):

1. C (Concept) – categories, terms, concepts, designations.

2. P (Phenomena) – properties, phenomena, facts, observations, statements, descriptions of objects, mechanisms, and so on.

3. R (Relation) – relations, theorems, laws, concepts, rules, hypotheses, theories, models (physical and mathematical), dependencies (including analytical, graphical and logical), structures, etc.

4. A (Algorithms) – activity algorithms (including algorithms for solving problems, proving theorems, equations, etc.), sequences of actions, procedures, rules for decision-making, behavior, and so on.

It should be noted that the introductory level of knowledge can in turn be divided into two sub-levels:

– a sub-level of familiarity, when a person has a general idea of a particular educational object, but is unable to reproduce information about it, form the main provisions, and determine the signs that characterize it;

– sub-level of reproduction, when a person is able to reproduce (tell, explain) the structure of the knowledge system regarding definitions, the most essential features, principles of operation of the main educational objects or other characteristics of phenomena or systems of phenomena that are of the greatest importance.

Such a division makes it possible to choose the required forms of test tasks more precisely in the future.

Assigning an educational element to one or another group and determining the required level of its formation makes it possible to subsequently choose the optimal form of a test task for each educational element in accordance with the principles of pedagogical measurements.

When introducing educational elements of the first group, it is necessary to comply with regulatory documents that establish the procedure for their use (state standards, recommendations of international organizations, etc.). In the absence of such documents, it is necessary to rely on the practice of applying categories, concepts, terms, designations in this professional field (and not on the practice of their application in a specific educational component).

In accordance with each educational element, one or more test tasks are developed, the form of which should most adequately correspond to the group of educational elements to which this educational element belongs, and to the required level of its formation. Test tasks are entered in the table and make up a system of basic test tasks for objective control of the degree of achievement of the final goals of educational and professional training of a specialist.

It is recommended to prepare several test tasks of different forms for each educational element, taking into account that some of them will be rejected in the process of preliminary examination. In addition, part of the test tasks will

be rejected in the process of their approbation on different contingents of subjects of education during the development of criterion-oriented tests, i.e. when determining the compliance of certain test criteria (complexity, validity, differentiating ability, etc.) to the requirements established by the test quality standards.

The development of test technologies of various forms of pedagogical control is recommended to be carried out not by one, but by a group of developers or a test commission, which includes teachers of a higher education institution and experts in test preparation. This makes it possible to use generalized evaluation criteria, rather than the opinion of one teacher.

The main problem of the objective test exam is the decision of the question: passed or failed the test, i.e. passed or failed the exam. In domestic practice, the absolute standard (criterion) for calculating test results is still used. It means that there is a minimum number of test questions, the correct answers to which allow teachers to consider that the applicant has passed the exam. Such a criterion in most cases is correct answers to 2/3 of the test tasks. At the same time, a priori, it is considered that all tasks prepared by teachers are of equal difficulty. The last circumstance appears to be purely abstract, as a result of which sometimes the majority of those who study get unsatisfactory grades or, conversely, all who took the exam get an excessively high score. Therefore, the absolute criterion is rarely used in modern test practice. Most test commissions in England, the USA and Germany use a relative criterion (standard) for calculating test results. This criterion allows you to separately compare the answers of each of those who took the exam with the answers of all others, that is, the assessment of each is carried out on the basis of the analysis of the results of the exam of all. The larger the group of test takers, the more reliable this relative standard.

When using the relative standard, before the final calculation of the test results, a qualitative analysis of each task of the test exam is carried out. Qualitative analysis consists of determining the difficulty index and the index of differentiating ability of each test task, which is included in the objective test exam. The following statistical calculations are correct in the event that the group taking the exam consists of at least 20 people. Qualitative analysis of test tasks consists of several stages.

1. First, the score of each of those who took the exam is determined in absolute numbers. Points for the test are awarded as follows: for a correct answer – one point (1), for an incorrect answer no points are awarded (0). The number of correct answers of each examinee can be easily determined using a computer.

2. Then the test committee distributes all those who took the exam by bases depending on the results obtained, starting from the highest value to the lowest.

3. The next stage is the selection of "strong" and "weak" groups. The strong group includes those who took the exam, who received the highest scores, and the weak group, respectively, the lowest. At the same time, the principle must be observed: the groups must be as large as possible and differ as much as possible from the point of view of the obtained points. In practice, a value of 33% (1/3) is used for this. In this case, a group consisting of, for example, 21 people will be divided into a strong group of 7 people (1/3) who received the highest points, and a weak group of 7 people (also 1/3) who received the lowest points.

The correct answer to each of the test tasks is known in advance. The answers given by each of the 14 examinees (7 strong and 7 weak) to each of the test tasks are summarized in a table. After that, you can start calculating the difficulty index and the discrimination index of each task of the objective test exam.

4. Difficulty index – a measure of the ease of the test task, taking into account all the correct answers to it, given by examinees of strong and weak groups. The higher the difficulty index, the easier the task. A difficulty index of 95, for example, means that for 95% of test takers the answer to this test task is not difficult. Such a task carries only a quantitative load in the test, and it should be removed from the final calculation of points from the exam.

A test task with a low difficulty index is either too difficult or incorrectly composed. In the latter case, both strong and weak test takers find distractors more attractive to the correct answer than the correct answer itself. Such a task should also be removed from the final scoring, and carefully reviewed when using it again. Sometimes, however, a task with a low difficulty index, which is completed, from the point of view of the commission without errors, can be used to distinguish between those who take the exam who know the material "good" and "excellent". A difficulty index of 50...60 is considered ideal for the test task, and fluctuations from 30 to 70 (%) are considered acceptable. The complexity of individual tasks reflects the complexity of the test as a whole.

The index of complexity Ic is calculated using the following formula:

$$Ic = \frac{H + L}{n} \times 100 \text{ ,}$$

where H is the number of correct answers in a strong group;

L – the number of correct answers in the weak group;

n – the total number of examinees in both groups.

5. Indices of differentiating ability Id shows how answers to test tasks divide those who took the exam into more and less knowledgeable, more qualified and less qualified. The higher the index of differentiating ability, the more the correct answer to the task reveals the best among all those taking the exam (which is necessary for obtaining an objective assessment). The index of differentiating ability is calculated using the following formula:

$$Id = 2 \times \frac{H - L}{n}$$

(notations are the same as for the complexity index).

The quality of test tasks is judged by the index of differentiating ability as follows:

0.35 and above – an excellent task;

0.25 - 0.34 – a well-written task;

0.15 - 0.24 – a contradictory task, it needs to be revised;

below 0.15 – a poorly composed task, it should be removed when calculating points.

6. After calculating the indices of complexity and differentiating ability, the commission considers the task once again. Tasks with satisfactory indices of complexity and differentiating ability remain and are included in the final calculation of points. Tasks with unsatisfactory indexes are removed from the calculation. In that case, if the value of Ic is low, and Id is satisfactory, and the commission does not find any flaws in the content and wording of the task, it is left. Such tasks, as already mentioned, help to divide those who took the exam into those who know the material "good" and "excellent".

Thus, the quality of each test item is evaluated before the final exam score. This excludes the influence of unsatisfactorily completed tasks on the results of students taking the exam.

Determination of indices of complexity and differentiating ability has two goals:

1) to remove the influence of the test tasks, which were unsatisfactorily prepared by the teachers, on the scores of the students;

2) help not to miss too difficult, too easy or incorrectly composed tasks into the system of basic test tasks.

Therefore, the test takers received their final individual test scores. Now, on their basis, it is necessary to determine the appropriate assessment for each. To do this, the final score of each winner is plotted on a standard curve and a qualitative assessment of the number of points obtained is determined (that is, a grade is assigned).

The standard curve of the distribution of test results is built on the basis of a fairly large amount of data obtained on the exam for this test. The construction of the standard curve is based on the generally accepted

method of normal distribution with the calculation of the arithmetic mean and the mean square deviation. To calculate the arithmetic mean value, the individual values of each case (here the final scores) are summed up and divided by the total number of observations (here the students who completed the test):

$$X = \frac{E\,x \times p}{n},$$

where E is the sum;

X – arithmetic average (average final score);

x – the value of the final individual points;

p – frequency option (the number of students who received this score);

n is the total number of observations.

In addition to the average value, which characterizes the population as a whole with one number, the root mean square deviation is found, which characterizes the degree of deviation of the characteristic from the average value in the variation series:

$$b = \# \frac{E(x - X)2 \times p}{n}$$

(notations are the same).

The theory of statistics has proven that in a normal variation series, three mean square deviations are added both in one direction and in the other. We will show how this can be used to evaluate the results of an objective test exam.

After calculating the final individual points from the exam, a table of their distribution among the entire number of candidates who passed the exam is compiled, and the arithmetic mean and mean square deviation are calculated.

Let's assume that the arithmetic mean value of the final score X and the mean square deviation were obtained based on the results of the test exam. From the point on the straight line, which is taken as the beginning of the countdown, to the right and left horizontally, we set aside the value X+1b; X+2b; X+3b. Vertically, we put the number of those who took the exam and received the appropriate number of points. Based on the obtained points, we construct a distribution curve. At the same time, if 68% of all observations fit into the interval (X+1) – the results of the objective test exam, 95% in the interval (X+1), and 99.9% of all observations in the interval (X+3), then the resulting graph corresponds to a normal distribution and can be used as a standard curve for deriving an objective assessment.

Usually, in the normal distribution curve, deviations from the arithmetic mean by one sigma in one direction and the other (X+1) give an average score, for example, "average". Deviations from the arithmetic mean from (X+1) to (X+2) give a rating above the average, for example, "good", and deviations

from (X+2) to (X+3) – "excellent". Deviations from the arithmetic mean from (X-1) to (X-2) give a rating below the average, for example, "satisfactory", and from (X-2) to (X-3) – "weak".

The relative standard for calculating the results of the objective test exam was used to construct the standard curve. A correctly calculated curve can be used to assess knowledge from the test for several years. The main disadvantage of the relative standard is a predetermined percentage of failures. But at present, the relative standard is considered the most suitable method for evaluating test results.

Establishing a meaningful and structural relationship between the tasks of the test and the real task of the activity is the most important stage in the development of a criterion-oriented test. For this, it is necessary to carry out a meaningful analysis of the criterion problem, to describe its possible forms and features. Then systematize the knowledge, skills and abilities that ensure the fulfillment of the criterion task. In addition, it is necessary to have samples of test tasks and a description of the strategy for their construction.

There are psychodiagnostic methods that are close to criterion-oriented tests, but aimed not at the criterion, but at the so-called social-psychological norm or socially-set objective meaningful standard, which is normatively regulated in the content of education and training.

The main criteria for assessing the quality of a test include the criteria of test validity and reliability.

The easiest way to measure the reliability of a test is to conduct two series of measurements using the same test on the same group of learners and calculate the correlation coefficient between the scores obtained on the two tests. However, when using this method, the results of repeated testing are affected by the "practical effect" of the previous one, which reduces the objectivity of the obtained results.

With another method of calculating test reliability, only one test is performed. Most often, distribution by even and odd numbers of test items is used. After that, the Pearson correlation coefficient of the two halves of the test and finally the reliability coefficient R are calculated using the Spearman-Brown formula.

$$R = \frac{n \times r}{1 + (n - 1) \times r},$$

where R is the reliability coefficient,

n – the number of parts into which the test was divided (n = 2),

r – Pearson's correlation coefficient.

If the Pearson coefficient was equal to, for example, 0.98 in the calculations made after the test, the reliability coefficient will be:

$$R = \frac{2*0,98}{1+(2-1)*0,98} = \frac{1,96}{1,98} = 0,9.$$

The maximum value of the reliability coefficient is equal to 1. In the final test exams of the USA and Germany, the value of the reliability coefficient should be 0.9 or higher. In addition to the above, there are other formulas for calculating this coefficient.

CONCLUSION

An objective test exam allows you to assess mainly the knowledge of those who study. In the work of a specialist, there are a number of aspects that are not only unnecessary, but also impossible to assess with multiple choice tests. Therefore, it should be recognized that the successful passing of an objective test exam does not mean that the applicant has developed professional thinking and the ability to work professionally.

It should be noted that the test exam is only one of the methods of assessing the professional competence of those who study, which is acquired during the training process. Scores, percentages, obtained when measured by various assessment methods, ultimately make up a comprehensive assessment of the professional competence of those who study. In the process of determining such an assessment, the shortcomings of one measurement method are offset by the positive qualities of the other, and the subjective assessment in principle will approach the objective criteria presented by life itself.

Therefore, the test system for evaluating knowledge meets the following requirements: it reflects the depth of assimilation of the educational material; ensures objectivity and an individual approach in assessing the level of knowledge formation and the quality of education of each applicant as an individual; stimulates students to active independent work in mastering professionally significant knowledge.

The task of the institution of higher education is to make control of the level of knowledge of students predictable, mandatory, correct, which does not deter, but stimulates more meaningful and in-depth study of educational components, to creative search.

SUMMARY

The scientific work deals with the issue of the theory and methodology of pedagogical control of the knowledge of students of higher education based on test technology. Recommendations regarding the organization of the knowledge test control process are substantiated. It is emphasized that test technologies deserve special attention, because this is an effective way of checking the level of quality of knowledge of students of higher education. Proposals for solving the problem of the quality of knowledge control are

presented. A conclusion is made about existing changes in the assessment of knowledge of higher education seekers based on diagnostics and mathematical statistics.

The education management system needs an objective picture of its real state to ensure the validity of the decisions made.

Modern socio-economic and political changes in the state became a prerequisite for reforming the national education system.

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