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APPLYING INSTRUCTIONAL DESIGN METHODS TO IMPROVE THE EFFECTIVENESS OF BLENDED-LEARNING

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ABSTRACT

The article describes the application of instructional design techniques to form and increase the effectiveness of training courses. A key emphasis is placed on blended learning techniques, involving the separation of study time between learning using online technology and learning with a more traditional form of instruction involving a teacher.

The basic principles of the organization of the educational process using instructional design are outlined; the nuances of this approach are considered taking into account the specifics of blended learning. The classification and descriptions of the main methods of blended learning are given. The nuances and features of each of the methods are considered.

The process is described, and the basic principles of creating curricula are described taking into account the specifics of the mixed form of training. The main approaches and methods for the formation of the training course are determined; the use of this technique in practice is described as an experiment.

1. INTRODUCTION

The key factor determining the effectiveness of any form of training is the degree and completeness of the students learning the advanced teaching material. The use of this criterion to evaluate the effectiveness of training predetermines the need for reorganization of both the educational process itself and the transformation of educational material to increase returns (Bashynska et al., 2019; Lavrykova et al., 2020; Olshanska et al., 2019; Prokopenko et al., 2018).

The essence of the mixed form of learning involves a combination of the classical learning process with the participation of the teacher, and the use of information technologies such as online learning, involving elements of independent control of the student's path, time, place and pace of learning.

Considering ways to increase the effectiveness of blended-learning, the question arises about the place of instructional design techniques in this area (Chen, 2013; Jones & Davis, 2011; Spector, 2016).

The role of instructional design in itself is to identify the needs of students and determine the purpose of training with the further transfer of knowledge and information as quickly, accurately and efficiently as possible (Faber et al., 2018; Vidal-Castro et al., 2012).

At the same time, the role of instructional design in the processes of improving the effectiveness of blended learning increases many times, precisely because many of the teacher's functions are replaced by information technology.

2. METHODOLOGY

The main task laid down in the very essence of instructional design is to increase the efficiency and effectiveness of both educational materials and expand the capabilities of students to increase the volume and quality of information that students learn. It is safe to say that the use of instructional design techniques in the preparation of any educational resources, courses or materials allows you to organize the learning process in such a way that it is as effective and efficient as possible.

2.1. Principles and Objectives of Instructional Design in the Preparation of Blended Learning Courses

Instructional design, as from the point of view of the curriculum design process, is an algorithm consisting of specific procedures, grouped into a series of successive stages, in essence, a cycle for creating educational materials using instructional design techniques consists of six main stages (author's interpretation) presented in Fig. 1.

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The application of instructional design techniques is always aimed at solving target problems, the main of which is the formation of the educational process and the mechanism for supplying educational material so that students can master the material studied as efficiently as possible. In modern conditions, the need to study large volumes of information with limited period, an incorrectly arranged training course, can lead to information overload of students, in which a large flow of incoming information triggers the brain's defence mechanisms that reduce the emotional and intellectual susceptibility of consciousness, and as a result, reduce how mastering the material and the effectiveness of the learning process.
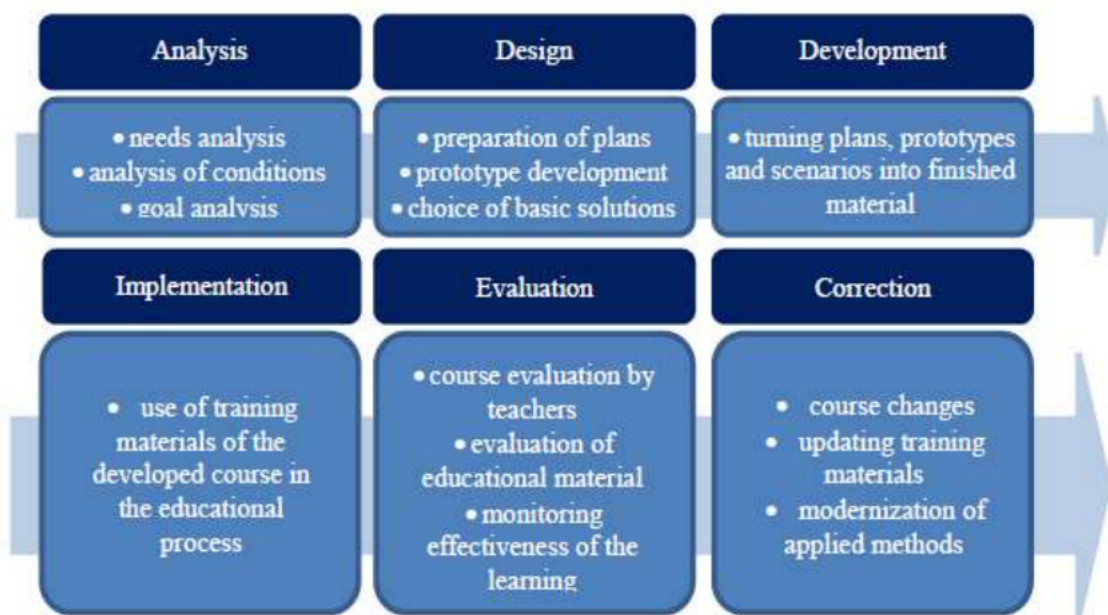
Figure 1 The cycle of creating a training course for blended-learning using instructional design techniques

The process itself using the methods of instructional design in the formation of educational material about the above algorithm, forms and successively solves the following key points:

• Analysis of the needs of the target audience, its competencies and expected to learn outcomes.

• Determining the goals and objectives of the training material.

• Analysis and structuring of documents under the objectives.

• The choice of means and methods of educational work.

• Creation of elements, style and visual design of the course.

• Development of tests and tasks, means of control and collection of information.

• Create a route using appropriate tools.

• Development of methods for evaluating the results and effectiveness of materials.

• Development of a solution for the further improvement of educational content.

The principles on which all modern methods of instructional design are based on 8 basic principles set forth by the American psychologist Robert Gagne (Gagne, 1985) and, although they were set out for the traditional methodology of education, their modification is easily applicable to both electronic and mixed educational processes.

The key features of these principles, when applied to a blended learning system, are a greater emphasis on personal interest and involvement of students in the educational process, which is the authors' opinion that is a fundamental factor in the success of the electronic part of blended learning, their detailed presentation is indicated below, and the scheme is presented Fig. 2 (Cheung et al., 2010; Elkilany, 2015; Simsek, 2013):

**Figure 2** Principles of instructional design with a blended-learning model

1. Attracting the attention of students, motivation for learning, arousing interest in the topic and methods.

2. An explanation of the goals and objectives of training. Here, not only the answer to the question "why?" Is given, but also a certain level of expectations is formed from the outcome of the process itself.

3. Efficient supply of new material. The most challenging part of the process, since the selective perception of any original content, is inherent in the human psyche. And this means that it is necessary to foresee certain elements that will help keep the student's attention on important points and bring him the main idea in the most accessible form.

4. Unobtrusive training support. In essence, this is the leadership of students and the semantic form of the attitude to keep the received material in long-term memory. Still, at the same time, the management process itself should be as invisible as possible for students, to strengthen their consciousness and independence.

5. Practice. It is necessary to quickly, while new knowledge is still fresh, test it in real conditions or simply confirm it with an appropriate experiment, which will clearly and very effectively link the theory and application of knowledge.

6. Constructive feedback. Evaluation of the chosen teaching method and its effectiveness is impossible without operational analysis. Therefore, even at the stage of the course development, the most flexible feedback system should be laid down (the results of the study of the target audience and its capabilities are useful here).

7. Timely performance assessment and overall assessment of the effectiveness of the training course.

8. Transformation and expansion of practical skills, helping students to maintain knowledge and their proper application. Unlike the fifth principle, it is essential to transfer practical skills

to new conditions that are not specified by the original framework of the course. This will allow you to assess the depth of assimilation of knowledge.

2.2. Models of Blended Learning, as Well as their Features and Nuances of Use

As already mentioned above, a mixed form of training combines a traditional approach to the learning process with the participation of a teacher, and in one form or another a pronounced electronic component using modern information technologies. This approach to blended learning distinguishes online learning in a separate category of the educational process, in which the teacher is not involved, and the electronic course itself performs his role.

Speaking about methods of increasing the effectiveness of blended learning, one cannot but touch upon the topic of the very forms of this teaching system. To date, all types of blended learning used are grouped into four groups, shown in Fig. 3.
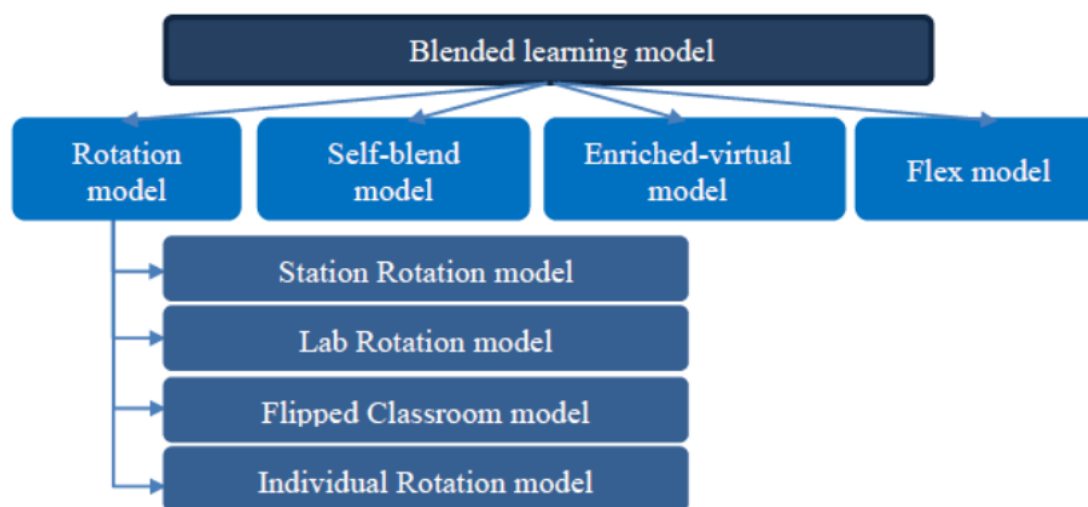
Figure 3 Types of blended learning models

It will be more detailed to dwell on each of the possible forms of a blended learning model.

1. Rotational model – this training model provides for the alternation of modules with traditional training and online learning. At the same time, the conventional form of exercise also contains separate types of modules, work with which can involve the entire group of trainees, different small groups and group projects. At the same time, this model includes some subspecies that differ in the manner and intensity of the inclusion of the online component of training in the general educational process. This form is the most flexible and therefore, has found full application in various educational fields; it uses modern information technologies and closely intertwines them with the traditional educational process.

2. Self-mixed model – a feature in this form of training is that students take one or more online courses in addition to the usual ones. Students can study in these courses both in educational institutions and outside the walls of an educational institution. This form of training has a more significant bias towards traditional learning, attracting the online component only as necessary.

3. Virtual enriched-virtual model is a model in which, during the study, students divide their time between attending full-time classes and distance learning. The difference between this model and the subspecies of the rotation model is that students do not attend school every day, and this model is not the basis of a separate course, but the entire educational process.

4. Flexible training model (flex model) – this form of training involves an emphasis on the individual approach of each student to the training course, most of the material is provided online, the role of the teacher is to support and monitor the educational process, including in the online form. This training model is the closest to online learning. Still, the process itself can be arranged so that teachers can provide significant in-person support, and certified online consultants who provide daily consultations can participate in the learning process.

Each of the presented models has its characteristics, its advantages and its own nuances, the choice of each of them in the preparation of the training course should take into account all the nuances of the future educational process, educational material, the specifics of the educational institution, and technical capabilities. It is impossible to say with certainty that any of the models is better or worse than others, only their correct or vice versa ineffective application can speak of their general usefulness for the educational process.

2.3. Methods of Increasing the Effectiveness of the Educational Process using the Approaches of Instructional Design

The proposed methodology for constructing the training course will be based on a mixed form of training, that is, assume that students actively use interactive sources and online means of obtaining information. Students are expected to gain basic knowledge of how

When building a course, it is recommended to be guided by the principles of ALD techniques:

• The course material is presented in the form of a dialogue, and the material passed is fixed;

• Fast and efficient execution of tasks is provided by the use of standard tools and built-in templates;

• In the learning process, the listener's interest is actively used, and his constant stimulation takes place;

• The presentation of critical points is a priority, but this principle does not mean that ALD makes the learning process primitive. If necessary, less risky points can be quickly entered into the course program.

• Concentration on the learning process, not on its planning;

• Evaluation of the results and needs of the student occurs at all stages of training.

All the principles of the proposed methodology, taking into account the approaches of instructional design, for use in the process of constructing a training course are presented in Fig. 4.

Figure 4 Key principles of building a training course using instructional design

It should be noted that the implementation of this methodology for a mixed form of training, regardless of the specific type of training, will be based on the modularity of the structure of the educational process, built on four-component systems:

1) The module of traditional training - this module assumes the form of organization of the educational process in the form of full-time education with the participation of the teacher. The specific form depends on the particular module and the needs of the training course.

2) Online learning module - involves the use of an online learning form, both within the institution and outside it. The specific form of implementation of this module also depends on the needs of the course, technical capabilities, and the specifics of the institution.

3) Practice module - can be implemented both in the form of online training and in a traditional form.

4) Additional information module - this module assumes an online form for obtaining information, may include both theoretical and practical knowledge.

The methodology does not focus on specific knowledge and skills, but on their system, which is formed in the learning process on authentic problematic tasks. Authentic tasks are the problems that professionals face in the process of their activities. This approach allows students to effectively coordinate and combine different knowledge and skills and teaches them how to solve real professional problems.

Another distinctive feature of the model is the separation of the two types of information that is presented to the audience: supporting information and critical information. The first type contributes to the creation of cognitive and mental circuits, which allows you to use the resulting knowledge system in different situations. Essential information enhances classroom learning by reducing students' cognitive overload.

An exemplary scheme of the organization of the educational process is presented in Fig. 5.

In this scheme, three stages are implemented, but their specific number depends on the need and specificity of the training course. Nevertheless, the proposed scheme includes three main stages-phases: a familiarization phase, a phase of knowledge accumulation, a period of practical development of acquired knowledge.
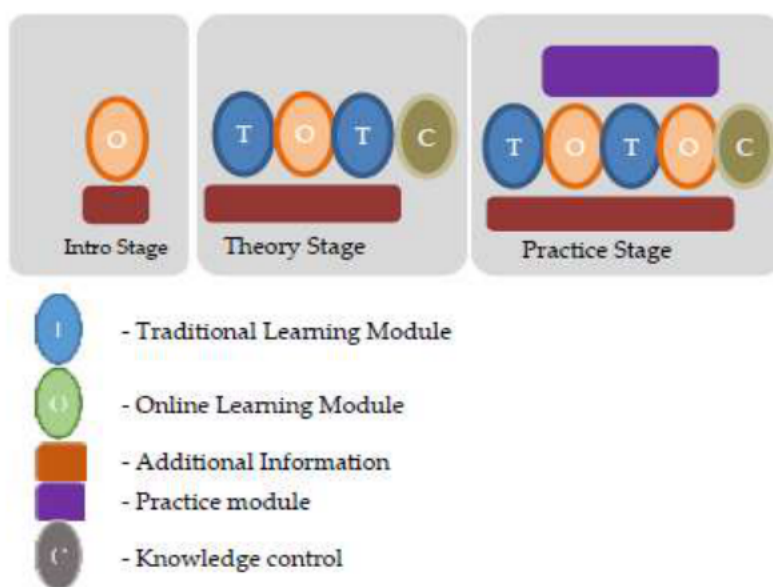

Figure 5 The scheme of the organization of the training course using the four-component methodology

At each stage, both traditional and online learning is combined, besides, throughout the entire educational process, students have the opportunity to access auxiliary information, which goes in a separate block, without interfering with the leading educational process and excluding information overload of students. Timely control of knowledge also includes the ability to collect feedback at all stages of training. The entry phase eliminates knowledge control; instead, it focuses on introducing students to basic teaching methods, course information, and the practical application of the knowledge gained.

3. EXPERIMENT AND ANALYSIS OF THE RESULTS.

The beginning of the experiment was predetermined by the instructional need to increase the effectiveness of training for students of a machine-building university, traditionally full-time and part-time forms of education prevailed in this institution, and for some training courses, a mixed form of instruction was used according to a self-mixed model.

The first stage of the analysis was based on a survey of applicants, students and graduates of the university, to determine the need for a training course. The questions of the questionnaire were grouped in several blocks; it was supposed to clarify the preferred form of training, the intensity of the material, the need for interactive elements, the possible need for an online component, etc., the results of the processed 236 questionnaires were reduced to four key questions for three target groups, and presented in Fig. 6.
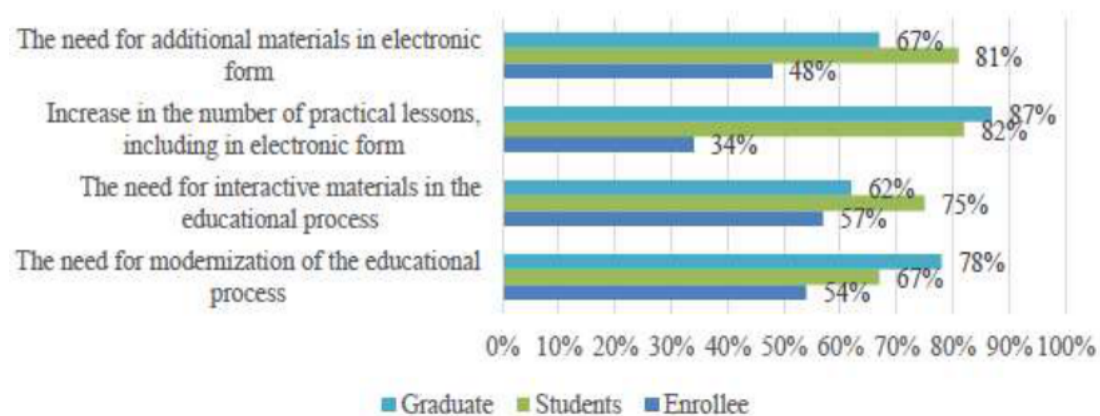
Figure 6 Preliminary survey results to identify training needs

The results were transferred to the teaching staff and administration of the university, the development of a new curriculum was supposed to be carried out with the participation of the teaching staff in the form of a mixed form of training on a rotational model "inverted class", using the methodology for preparing the course according to the proposed four-component model.

The creation process was based on an existing specialist training course, but interactive elements were included in this process, including video lectures, interactive training programs, as well as an electronic knowledge base previously created to implement distance learning online forms of training. In preparing the training course, the emphasis was placed on:

1) Search and analytical tasks

2) Productive tasks

3) Communicative tasks

In each of the training modules, it was supposed to solve the problems that arise in practice for university graduates working in the speciality, similarly, the preparation of the course and the formation of tasks used the same experience of the teaching staff in related specialities.

All this, coupled with the technical ability to implement practical and theoretical exercises using personal computers, an online knowledge base, and interactive specialized software, made it possible to ensure the number of online modules in the amount of 50% of the total study time, as well as bring the number of practical lessons to 65% (in compared to 35% earlier).

The general course included 3 stages with knowledge control after each, as well as an introductory stage without knowledge control. To work with the course, a group of 20 students was formed, as well as a control group, a similar-sized group engaged in a similar direction, but in a traditional form of training, and a sample of 20 distance learning students involved in a pilot online learning project acted as a control group.

Testing of knowledge was carried out on a 50-point scale (0-15 unsatisfactory, 16-25 satisfactory, 26-40 good, 41-50 - excellent). A control test of education was carried out after each stage of training, to complete the experiment and to exclude additional influence, testing was carried out in an electronic form.

The results of all three stages are presented in Table 1; the average score for all students is presented in the last row of the table.

Table 1 Test results at each stage of training

Stage 1			Stage 2			Stage 3		
Control group	Online group	Blended learning group	Control group	Online group	Blended learning group	Control group	Online group	Blended learning group
30	39	24	28	37	25	29	40	24
36	38	43	37	36	41	36	38	43
34	39	38	32	39	41	33	39	38
25	15	33	28	15	32	30	16	34
15	24	34	16	24	35	15	24	36
33	37	33	34	37	32	36	35	35
46	37	41	48	35	43	50	36	41
48	27	28	48	25	31	50	28	30
49	22	38	50	22	36	51	22	40
44	22	47	43	22	46	44	21	50
35	29	44	36	30	44	38	28	46
36	18	46	36	18	45	37	19	48
46	28	45	45	26	46	43	26	44
40	38	22	43	36	20	41	39	23
40	39	45	41	40	45	41	39	46
30	43	46	28	41	48	31	41	47
39	35	45	41	33	48	40	36	48
40	34	40	40	34	40	40	32	41
46	29	49	49	29	52	48	29	49
38	20	23	37	18	23	38	19	26
37,5	**30,65**	**38,2**	**38,00**	**29,85**	**38,65**	**38,55**	**30,35**	**39,45**

After the first stage of training, it was clear that the group of distance learning online was the most lagging; however, the group with the traditional form of exercise showed worse results than the group in the mixed form of training (35.5; 38; 38.55 versus 38.2; 38.65; 39.45).

For clarity, summary data on the test results will be presented in the form of a graph (Fig. 7).
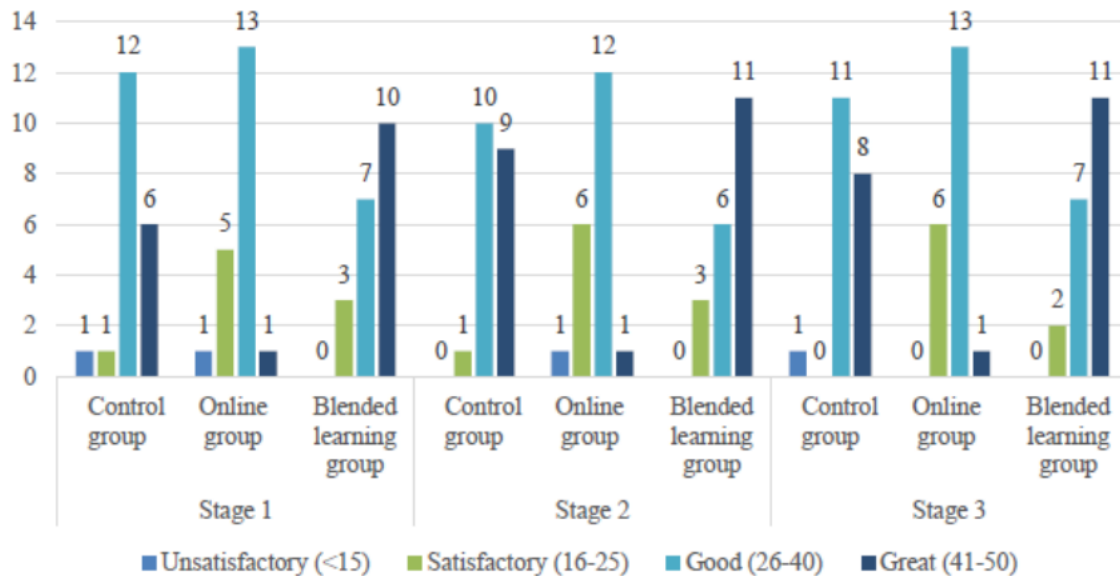
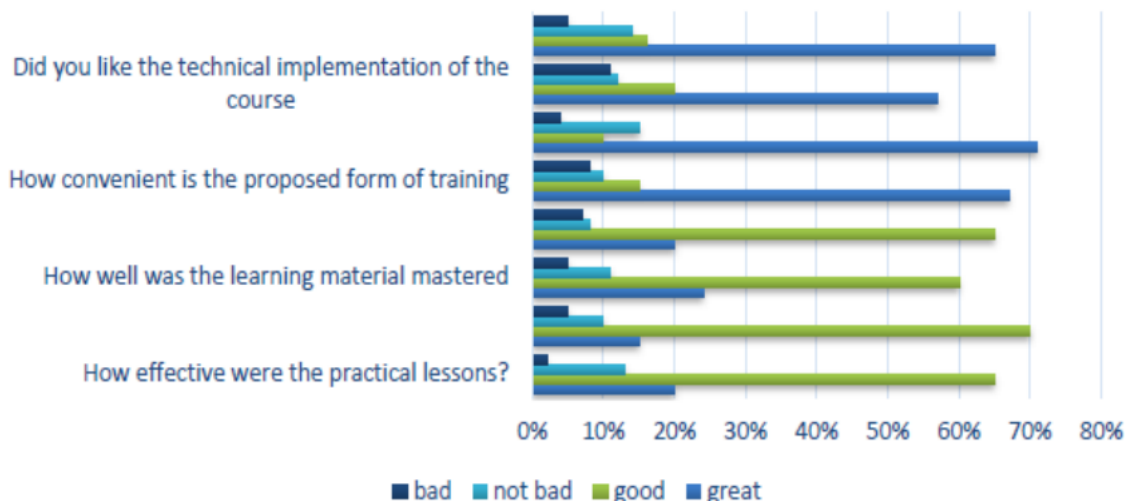**Figure 7** Summary of the three phases of student testing

Based on the data obtained, some problems were identified with the assimilation of material and consolidation of knowledge, both among students of traditional and online forms of training. At the same time, preliminary surveys showed different reasons, students of the conventional way of education lacked practical classes (we recall that they had 35% versus 65% of the mixed form of training). Online learning users faced some technical and psychological reasons that influenced their results.

The next stage was a survey, which was conducted both among students enrolled in the curriculum created using the proposed methodology and among correspondence students engaged primarily in the online form of training. The inclusion of correspondence students in the questionnaire was since the online component of their training program had close interaction with online modules according to a mixed training program, and the survey results would give an adequate picture.

The survey data are summarized in four key groups of questions and are presented in graph Fig. 8.

First of all, I wanted to pay attention to a block of issues related to the technical part, as it turned out that the online system of the pilot project was not perfect, the difficulties that arose in the educational process most seriously affected the part-time students who studied mainly online. This system needs to be improved.

The block of questions related to overall satisfaction with the course was designed to determine how much the new form of training (mixed and online) is suitable for teachers and convenient for students themselves. The result indicates overall satisfaction, but the percentage was reduced due to part-time students due to difficulties with the technical part.

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Figure 8 Results of the final survey of course participants

The results of the survey showed increased satisfaction of students and teachers from an increase in the share of practical classes, which affected both overall performances and reflected on the competencies of students - their overall confidence in the firmness and practicality of the knowledge gained increased.

Students and teachers also highly appreciated the work of the online knowledge base, where it was possible to obtain additional knowledge on the subject being studied, as well as pass testing (which did not affect the overall result) in a playful way. It turned out that the implementation of such an innovation made it possible to provide additional material to interested and capable students, and made it possible to reduce the information load.

4. CONCLUSION

The use of instructional design techniques has already become a mandatory practice in the educational system; nevertheless, the emergence of new instructional techniques, such as blended and online learning, necessitates a review of traditional approaches to the process of preparing teaching materials. At the same time, the use of procedures postulated by the theory and methodology of instructional design remains relevant and useful in the age of information technology; new teaching methods developed using the established principles and approaches of instructional design at times increase the effectiveness of the educational process.

Methods of instructional design, this is the base that allows you to use modern information technology to create not just useful, but effective educational material. A weighted and thoughtful approach, a thorough analysis of needs and packaging, taking into account the nuances and opportunities that provide both interactive techniques and information technology, can increase efficiency regardless of the form of the educational process.

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