POSSIBILITIES TO CONTROL STUDENTS' KNOWLEDGE WHILE TRAINED FOR THEIR FUTURE OCCUPATION IN FIELD OF AGRICULTURAL ENGINEERING

Stanislav Nikolaenko[1], Maria Bondar[1], Oksana Bulgakova[2], Kaspars Vartukapteinis[3]
[1]National University of Life and Environmental Sciences of Ukraine, Ukraine;
[2]Institute of History of Ukraine, National Academy of Sciences of Ukraine, Ukraine;
[3]Latvia University of Life Sciences and Technologies, Latvia
vbulgakov@meta.ua, kaspars.vartukapteinis@llu.lv

Abstract. The contemporary labour market requires from the future agricultural engineers not only in-depth theoretical knowledge, but also an ability to apply it independently in non-standard production situations. The article deals with problems how to clarify the level of the students' readiness for production activities in the agro-engineering sphere. It has been established that in the training process of engineers, an urgent task is brought to the forefront – to provide conditions that ensure efficient professional self-development of the creative potential of a student's personality; to achieve a high level of development and training of the future professionals, including, perhaps, through new, reassessed approaches to the content and organisation of the students' knowledge control process. The paper substantiates a presumption that the principal task of all kinds of the students' knowledge control is to verify the fulfilment of the ultimate goal of professional training – the formation of a multicomponent structure of technical thinking, as well as engineering and educational-cognitive skills, that is, checking whether the students' technical thinking has reached the structure to be formed the level of readiness for the future engineering occupation in the selected speciality. Implementation of the developing function of the knowledge control can be efficiently carried out by involving students in productive search activities, aimed at solving real engineering problems and problem situations. The results of comparative studies allowed drawing a conclusion about significant advantages of the indicators of the students from the experimental groups over the reference ones. So, 29 % of students in the experimental groups demonstrated a creative level of educational and cognitive activity, while in the reference groups there were 22 % of such students.

Keywords: lecture, contents, agricultural engineering, students.

Introduction

A graduate of a higher education institution must be a highly qualified specialist in the relevant branch. However, is he a professional in his field? After all, a professional should be focused on coping with real affairs under fairly complicated and rapidly changing production conditions for which it is important to solve the problem. He is ready to persistently seek and find new productive knowledge in other areas as well. That is, in addition to the narrow specialised knowledge, a professional also has a deliberate, normal need (hence –motivation → motive) to learn new things independently and constantly [1]. The conducted analysis revealed a contradiction between the need to raise the level of the students' cognitive independence and the limited possibilities to use the available didactic tools that do not fully take into account the selection of the content, methods and pedagogical abilities to control the students' educational achievements [2]. In most cases their control is used only to check the acquisition degree of knowledge, memorisation of the educational material, that is, it was mainly applied to control the students' memory and knowledge, rather than to examine whether their technical thinking, the structure of which was formed, had reached the level of readiness for the future independent engineering activity. It is possible to achieve a high level of development and training of the future professionals by new, deliberate approaches to the content and organisation of the control of the students' academic achievements [3].

M. Staniewski from the University of Finance and Management in Warsaw devoted his research to the identification of a relationship between the selected organisational predictors and the entrepreneurial success by examining samples from 294 companies. The study uses two questionnaires: a table of multidimensional business data that collects information about the entrepreneur and the company, and a scale of successful entrepreneurship that measures the entrepreneurial success. The author uses stepwise regression to verify the predictive value of variables. The results show that the entrepreneurs whose employees have unique knowledge achieve greater entrepreneurial success [4].

The West European scientists did not fail either to notice the principles of developing learning and the role of creative thinking in its formation. In their studies M. Shepard, A. Almasude, L. Korte set a goal to find out whether the creative thinking and teamwork skills are positive consequences of the training programme; they studied the visions of students and teachers about the development of joint and creative thinking skills. The scientists found that the motivators for the development of the creative thinking skills were various ideas, stimulating imagination, generation of new knowledge and a creative climate [5]. The experience of organising professional training in the United States indicates that the control of knowledge is aimed at motivating the students' active cognitive activity, their independent work, assessment of the dynamics of the students' individual achievements and complex skills, that is, the optimal implementation of the educational and developmental control functions [6]. R. Doe has devoted his dissertation to the research of readiness for the scientific activity of the graduates of programs at a research university in the south-eastern region of the United States. Readiness to work, although it is a relatively new construct, is defined as a level to which the graduate students are assumed as having approaches and attributes that allow them to prepare for the success in their professional activities. It is supposed that in the future the students wishing to obtain the master's degree at the universities and colleges are expected to surpass students wishing to obtain the bachelor's degree. The results showed that the graduates of the master program who had undergone internship and assistantship were significantly different from those who did not, from the point of view of their alleged readiness for work [7]. M. Salem, F. Saunders, V. Volstad developed programs for teachers including: the control methods (multiple choice tests); the handout material with assignments for independent work that they could apply during training at a seminar and during teaching in the classroom. Particular attention was focused on the need for a written feedback not only between the students and the teachers, but also among all students [8]. The main attention of researchers is centred on the fact that the future specialist needs not only to be successfully engaged in the system of appropriate professional training, but also to work on himself all the time, to professionally self-develop and improve. At the same time, this process will be efficient, if there are reasonable pedagogical conditions for monitoring the fulfilment of the ultimate goal of training – the formation of a multicomponent structure of technical thinking, the engineering and educational-cognitive skills.

The purpose of the study**-** a search for the most complete disclosure of the possibilities to control the knowledge of the students of technical specialties during the formation of the students' readiness for their future occupation in the field of agricultural production.

Materials and methods

In order to control the formation of the basic knowledge, the test control was widely used (when checking the students' readiness to perform laboratory work, practical assignments, design and graphic work, for setting intermediate certification, etc.). Testing is one of the most technologically advanced forms of automated control with the quality parameters that can be controlled. In this aspect, none of the other well-known forms of the students' knowledge control is comparable.

In the investigations of the pedagogical conditions of self-improvement, the third- and the fourth-year undergraduate students were involved: (82 students in the reference groups and 93 students in the experimental groups), as well as the first- and the second-year students of the master program: (59 students in the reference groups and 56 students in the experimental groups). Thus, the total number of the students from different courses in the reference groups is -141 people, and 149 people in the experimental groups. In the investigations of the developing control functions, as a diagnostic tool and self-diagnosis of readiness for the professional activity, the second-year undergraduate students were involved in three specialties, studying general engineering disciplines at the Department of Mechanics. The number of students in the control groups is 112 people, and experimental groups – 101 people.

Now the developers have a large number of various test assignments at their disposal. In addition, on the issue of their classification the experts have different approaches. For a student's level there are tests of cognition, difference and classification; for an algorithmic level – the substitution tests, constructive and typical assignments; for the heuristic level – test assignments, the solution of which requires a certain transformation of the typical solution algorithms; and for the creative level – tests that allow displaying one's creative abilities [9]. If to the test assignments there are added ready answers for the choice (usually one is correct, and the rest are incorrect), then such tasks are called assignments with the choice of one correct answer. The choice of the right answer provokes a true judgment, but the wrong answer produces a false one. There is no third answer. Therefore, in each assignment with a choice of a single correct answer the latter should provide uniqueness of the purpose of the assignment itself, without allowing conflicting opinions of the students. The second variant of the assignments of the same first form is used to test the comparative knowledge – with a choice of one the most correct answer among the answers that are correct to a varying degree. The third variant of the assignments of the first form contains not one, but several correct answers. In the second form the assignment is formulated so that there is no ready answer, and during the test each student has to enter the answer himself in the space provided for this. Such assignments can be called open-form assignments [10]. The third form of assignments – the test assignments, where the elements of one set need to be matched with the elements of another set – can be called assignments for establishing correspondence between the elements of the sets. And, finally, the fourth form of the test assignments – when one needs to establish the sequence of engineering calculations, actions, steps, operations, deadlines – are assignments applied to establish the correct sequence. An approximately the same opinion is voiced by K. Ingenkamp, who notes that for practical purposes of the knowledge control it is enough to distinguish between the free form of answers and the form that suggests choosing answers from several proposed ones [11].

Each form used to control the knowledge has several types of assignments. The open form includes assignments as an addition to establish the correct sequence; but the closed form – assignments with the choice of an answer, to establish also a link (or for classification). K. Ingenkamp, in addition, believes that the open form of the control tests should also include assignments in the form of a short answer and a micro-essay [11]. Each of the listed forms of test control allows checking specific types of the general engineering knowledge, as well as the use of the corresponding control materials. The choice of the forms depends on the purpose of testing and the content of the test, on the technical possibilities and the level of professional competence of teachers in the field of theory and methodology of the test control of knowledge.

For testing the educational material from general engineering disciplines the most suitable is the first form of the test assignments with a choice of a single correct answer from 4 – 6 answers given in the test. Using this form, one can control not only the presence of but also continue to form:

- the visual-figurative component of technical thinking;
- the conceptual component of technical thinking;
- technical language.

Many years of the teaching experience and experimental studies show that the developing possibilities to control the students' knowledge are better implemented when using the test assignments of the open form. In addition to remembering a certain amount of knowledge in a discipline, such tests allow checking the ability to operate creatively with the knowledge in answering the control questions posed.

The methodology for such a control provides for the engagement of students in testing without prior warning. Testing was carried out in writing, and its duration was 30 minutes. Each student received an individual test, and he had the right to employ any reference literature when preparing a written response. This circumstance allowed bringing the control of the students' knowledge closer to the actual working conditions of an engineer in production and helped establish a positive emotional background. Each test contained 10 questions, of which: 40 % were questions of remembering a certain amount of theoretical knowledge; 60 % – questions of the student's ability to creatively apply the acquired theoretical knowledge.

The tasks were of the kind: "What measures should a design engineer take in such a calculated situation, if ...?" Or they gave incomplete conditions for solving computational and design problems and the student had to answer which particular data are not indicated and which one can "ask" oneself why, and the like. The last type of questions is the main one, which requires from the student to have a deep understanding of the calculation methods and the cause-effect relationships in them. Examples of the contents of this type of tests are given in Table 1.

Table 1

Example of a test for the control of the level of formation of creative technical thinking

It is necessary to make an approximate of a shaft. Your actions:
Indicate the recommended inclination angles of the teeth of cylindrical helical gears.
Write down the condition under which the transmission is considered long-running when calculating the bend.
What is an irreversible gear?
What measures can the designer take to reduce the centre-to-centre distance a_w when designing a gear? (The gear is attached).
What gear parameters require refinement after the gear is designed?
What measures can a designer take to reduce the actual contact stress of a spur gear?
What can the designer offer if Z_Σ, when designing a spur gear turns out to be very large ($Z_\Sigma \geq 200$)?
What measures can the designer take to increase the actual contact stress in the teeth of a spur gear?
How is the calculated permissible bending stress determined for a continuously operating reverse gear?

The boundary thematic control is provided for the control and self-control of the personality development process, the formation of one's creative technical thinking, engineering skills when performing engineering calculations on specific topics. The criteria for the boundary thematic control were the characteristics of mastering information at the creativity level from the main topics of the discipline. For this, each student was given personal, comprehensive homework for independent execution. In addition, this homework contained data for the execution of a small research work. Verification of the completeness of this small independent study, the generalised conclusions and suggestions made by the student, revealed his creative abilities and a skill to carry out a productive engineering activity having a nature of subjective novelty, based on the information he has acquired. The issues of the boundary control are designed to check not just the acquisition level of certain knowledge by the students, but also the ability of the future engineer to operate it deliberately and creatively. Information about the progress of this process helped the students in self-learning, timely identification and study of the material, not yet finished by them. Such information made it possible for the teacher to make corrections to the learning process.

The boundary thematic control was carried out twice. The first stage of the boundary control is verification of the content of complex individual home assignments done in a written form. The second stage is the protection of each topic of the homework according to specially developed control tests of a combined form. Although the questions posed concern the material of a specific problem, the calculation conditions and the kinematic scheme are fundamentally modified. That is why this form of defence of the homework requires broad theoretical training of the student on the topic, a creative approach to solving the proposed atypical tasks, and it tests his ability to transfer knowledge and skills to non-standard calculation situations [12]. The criteria for the boundary control were both the aforementioned issues and the level of the student's understanding of the principles and rules of design, the ability to perform structural analysis, to choose a suitable design from the typical ones, to take into account the specificity of the design scheme, and to acquire the ability to offer their design solutions verbally and graphically. The boundary thematic control made it possible to verify the completeness and correctness of acquisition of knowledge and skills, to clarify deficiencies in the activities of individual students, find out their weaknesses in the process of self-control, as well as deficiencies in the educational process and make timely corrections.

An important control means of the developing possibilities of the students' academic achievements is a written five-minute timeline in order to solve the design problem, which is held at the beginning of the lecture. It is aimed at activation and mobilisation of the engineering thought, motivation of the students, their attraction to independent solution of small real problems taken from the practical activities of an engineer, thus introducing the students into the creative laboratory of the designer and the inventor. The main content of these five-minute assignments are creative tasks but their purpose is to psychologically prepare a student for the meeting with problem situations of a varying degree of difficulty in the future professional activity.

The five-minute problem questions should meet the following requirements: they should be short and with an easy access to the student, that is, so that he can answer them, based on his personal theoretical and practical experience; they require a relatively small depth of study of the educational material; they should not be without a solution; they should be formulated so as to serve as a way of introducing the student to certain heuristic techniques of technical creativity (morphological analysis, synthesis, individual elements of the theory of solving inventive problems, etc.); so that it could be possible to organise discussions on the basis of questions, “brain attacks”, etc., that is, they should concern determination of the maximum number of shortcomings of the technical objects; and they should also demand from the student proposals that can eliminate these shortcomings in new products in accordance with the current level of development of engineering and technology; they should include a potentially large number of solutions, that is, be multivariate; they should be based on visual material (sketches, drawings, diagrams, natural elements, etc.); they should contain questions that require criticism – irrational decisions that are erroneous for particular conditions of work; the questions should relate to the material covered, various aspects of problem situations (manufacturing, assembly, disassembly, operation, repairs, etc.); they should focus on the correct definition of the ultimate goal or identifying what prevents to obtain the desired result, finding rational solutions leading to the ultimate goal; the students’ written answers should be as concise as possible, revealing the essence of the proposal and concise argumentation, without rewriting the conditions of the problem assignment. A significant contribution to the implementation of the developmental abilities of control of the students’ current inquiry at practical and laboratory studies is the use of simple and non-standard production situations [12]. These are characterised by special conditions and limitations, contradictory requirements for manufacturing and design technology, production difficulties and the like. The students are asked questions that require technical expertise, permission to use the workpieces or parts, operations performed with deviations from the drawing due to violation of the manufacturing technology, evaluation of rationalisation proposals.

To solve a part of the problem situations, the student must independently perform a small theoretical study. Besides, he needs to formulate the problem and deliberately apply fundamental knowledge in the discipline to solve it, attracting in a compulsory way reference materials for reasonable defending his point of view. In solving this problem the future specialist should display a creative approach, acumen; he should demonstrate mastering intellectual skills (for example, an ability to conduct a theoretical analysis of situations, to conduct a conversation with the teacher at a professional level in accordance with the logical scheme: problem → judgments → conclusion). At the same time, he should show the ability to anticipate the results of solving the problem, the ability to see the insufficient and redundant data, the ability to put himself in place of the performer, to formulate professionally a question for him (that is, to show his production training), to express his opinion in a technically correct form. An illustration for these situations generally is the design of the gearbox (in section), or the diagram of its execution, or the exterior view of the gearbox without sections. The second part of the problem situations is from the field of engineering practice. As a rule, there is attached a full-scale detail, its sketch, the photo of a destroyed surface (a surface photograph taken using an electron microscope). Such problem situations require from the student to develop a specific creative technical proposal and its theoretical justification, involving reference literature, which will reveal the level of formation of the multicomponent structure of creative technical thinking. Let us give examples of such a kind of theoretical problems and problem questions.

You are a technical expert. The helical cylindrical gear transmission of the gearbox is broken. The gear wheels are delivered to you for technical examination. Identify the reasons for the failure of this transmission. How will you make analysis of the accident? What way out can you offer to restore the transmission and the gearbox, as a whole? Justify your suggestions theoretically. (To this problem there are added field details that have failed, and a photography of the destroyed detail).

You are a designer. This is a closed gear, cylindrical helical gear. When the gear wheel at the factory was manufactured at the factory, they did not take into account the surface roughness of the tooth you specified in the drawing, 1.6, but give only 3.2. As a designer, will you allow this deviation as an exception? If you do not give permission, then offer a way out of this production situation. Give arguments for your decisions.

You are a technical expert. The following rationalisation proposal was sent to you for your comment: to replace the gear shaft material of the spur gear transmission of the gearbox – Steel 40 XH with a cheaper one – Steel 45, leaving the tooth hardness unchanged and increase the degree of accuracy from 8 to 7. The gearbox is in the workshop. Substantiate your point of view on the expedience of this proposal.

As it can be seen from the above examples, in fact, the solution of a specific production problem involves two sub-problems:

- when inspecting the destroyed surface of a particular detail, the student must hypothetically identify and theoretically substantiate the causes of premature destruction, using the accumulated theoretical knowledge base, while demonstrating good orientation in the contemporary reference technical literature;
- to consider his proposals of a design and technological nature to restore the working capacity of the details of this particular production situation and theoretically prove these variants.

Consequently, during the current control of the students' knowledge, educational, cognitive and engineering skills we can conditionally distinguish the following stages of the students' work:

1. To see the problem and formulate it;
2. To put forward theoretically justified arguments in defence of their hypothesis;
3. To analyse the situation and "request", if necessary, from the teacher the missing data;
4. To prove the hypothesis, use the necessary technical literature;
5. To propose several options for the particular solution to the problem, justifying the most rational option for specific conditions.

Conducting the current control of the acquired material in the particular form makes it possible to identify and evaluate objectively understanding of the laws of physics, and the processes occurring in the structures, mechanisms of machines and their details; the ability of students to freely operate with the acquired amount of theoretical knowledge at a professional level; to create an ability to offer a series of subjectively new proposals for the calculation and design of machines and mechanisms; to perform independently a multivariate analysis of technical solutions; theoretically justify the choice of a rational option, and the like. According to the student's high-quality answers, the teacher has an opportunity to check by many parameters the amount of knowledge the student has gained in the discipline, to objectively and accurately evaluate the complex formation of the multicomponent structure of a creative engineer's thinking.

Results and discussion

The pedagogical experiment was carried out in two stages. At the first stage there were preliminary experimental studies. The students were asked to give a subjective assessment of their own readiness for independent engineering activity according to a twelve-point scale. As a result, there were 0.96 % of students who rated their readiness at 12 points, 4.29 % – at 11 points; 13.87 % – at 10 points; 22.33 % – at 9 points; 30.47 % – at 8 points; 13.23 % – at 7 points; 8.62 % – at 6 points; 4.79 % – at 5 points; 1.44 % – at 4 points. Summarizing the above data, we note that the average score of a subjective assessment of the students' readiness for independent engineering activity is 8.16 points (Fig. 1).

As the evaluation criteria in the study, there were selected independence criteria and subjective novelty of the proposed solutions, their number and the level of the student's intellectual activity (reproductive, transitional, creative). The final control of the formation of creative technical thinking, educational, cognitive and engineering skills of the future specialists in agricultural engineering was carried out during the exams and defence of the course papers. The first stage is the defence of the course paper. The design of any machine or structure consists of a design and calculation, these concepts are closely related. Here the formation of a multicomponent structure of technical thinking, educational, cognitive and engineering skills was checked using the material of the design methodology and establishing the ability for the student to produce subjectively new constructive solutions or proposals to improve the designs of various types of gearboxes.

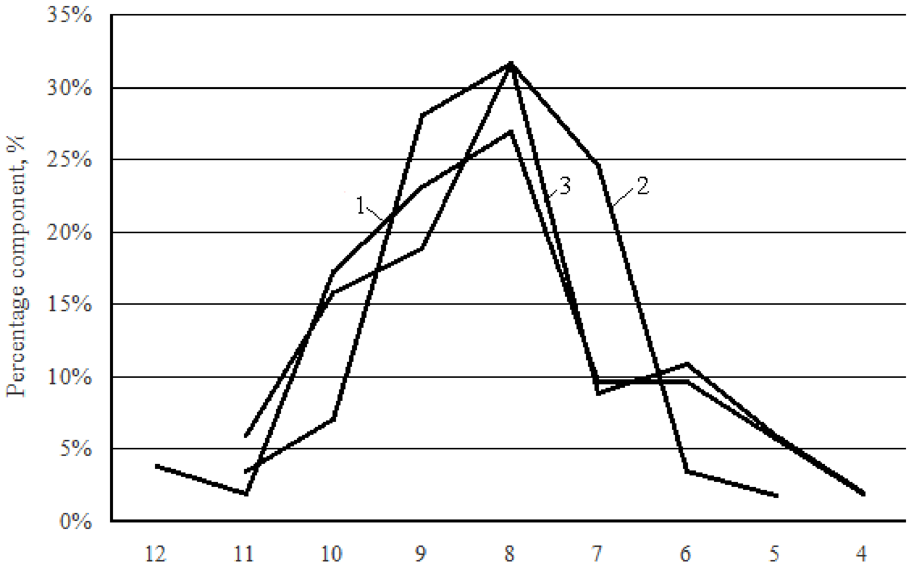

Fig. 1. **Self-assessment of the students' readiness for independent engineering activities:** 1,2 (K_1, K_2) – the reference groups; 3 (E) – the experimental groups; %

The second stage is an examination. The check was carried out on the basis of individual, complex control assignments of a theoretical direction. The contents of the control tasks allowed verification of acquisition of the calculation methodologies by the example of typical details of compounds that are widely used in agricultural engineering. The results of the comparative study led to a conclusion about the significant advantages of the indicators of the students from the experimental groups over the students from the reference group (Table. 2).

Table 2

Distribution of the students from the experimental and the reference groups by the levels of their educational and cognitive activity ($K_{(1)}$, $K_{(2)}$ – the reference group; E – the experimental group; %)

Measurements	Groups	Levels of students' educational and cognitive activity		
		Reproductive	Transitional	Creative
At the beginning of the experiment	$K_{(1)}$	34.60	48.07	17.33
	$K_{(2)}$	36.36	49.09	14.55
	E	37.62	44.56	17.82
At the end of the experiment	$K_{(1)}$	30.00	48.00	22.00
	$K_{(2)}$	25.45	52.72	21.83
	E	20.00	51.00	29.00
Increase	$K_{(1)}$	– 4.6	– 0.7	+ 4.67
	$K_{(2)}$	– 10.91	+ 3.66	+ 7.28
	E	– 17.62	+ 6.44	+ 11.18

By the way, the educational achievements of these students, who were registered according to the results of the current and the final controls (the exam on the course, defence of the course paper), were significantly higher compared to the results of students in the reference massif. At the exam most students freely operated with the necessary technical terms, thoroughly possessed the skills of calculating parts, units, gears. During the defence of the course paper the students freely reproduced technical knowledge in a logical sequence and relationship, demonstrated the ability to independently identify shortcomings in the design of the units and parts, as well as their elimination, to solve professionally the production and technical problems. The fact that 26 % of students of experimental groups participated in the annual Olympiad also testifies to the shifts in the development of technical creative thinking, while in the reference groups only 14 % of students found a desire to participate in this competition. The obtained results are graphically displayed in Fig. 2.

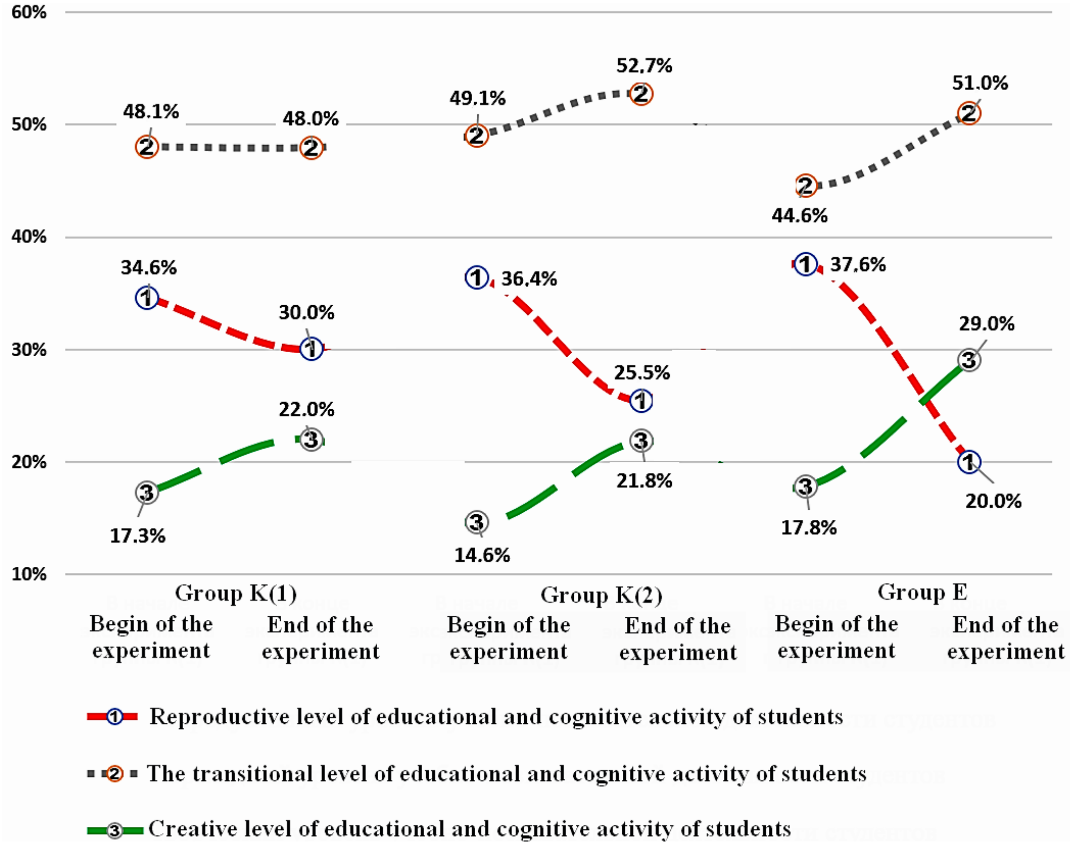

Fig. 2. **Distribution of students from the experimental and the reference groups according to the levels of educational and cognitive activity**

The efficiency of the applied methodology for developing learning is manifested by the dynamics of changes in the levels of the students' formed educational and cognitive activity when studying the course "Machine Parts and Design Basics" in a formation experiment.

Conclusions

1. Implementation of the developing function of the knowledge control can be efficiently carried out by involving students in productive search activities, aimed at solving real engineering problems and problem situations.
2. The studies showed a significant increase in the levels of educational and cognitive activity of the students from the reproductive to creative groups; so in the final experiment 29 % of students from the experimental groups displayed a creative level of educational and cognitive activity, while in the reference groups of such students there were 22 %; 51 % of students in the experimental groups and 48 % of students in the reference groups were referred to the transitional level. It was found that at the reproductive level there are 20 % and 30 % of the students from the experimental and the reference groups, respectively.
3. There has been established a need for systematic control and self-control of the students' promotion in the creative cognitive activity, while the main task of all kinds of control of their knowledge is to verify the fulfilment of the ultimate goal of professional training – the formation of a multicomponent structure of technical thinking, engineering and educational-cognitive skills.

References

[1] Nikolaenko S., Bulgakova O., Dukulis I., Pilvere I. methodological aspects of theoretical training of the future agroengineers. Engineering for Rural Development, Proceedings, Vol. 18, 2019, pp. 1933-1940.

[2] Бондар М. М. Розвивальне навчання майбутніх аграрників засобами загальноінженерних дисциплін (Developmental training of future agrarians by means of general engineering disciplines). Ніжин: Поліграф, 2007. 240 p. (In Ukrainian).
[3] Novotny J. Physical principles in technical education. Engineering for Rural Development, Proceedings, Vol. 17, 2018, pp.1002-1005.
[4] M. W. Staniewski. The Contribution of Business Experience and Knowledge to Successful Entrepreneurship. [online][11.02.2020] Available at: http://www.staniewski.vizja.pl/pdf/The %20 Contribution %20of %20Business %20Experience %20and %20Knowledge %20to %20Succesful %20Entrepreneurship.pdf
[5] Korte L. Collaborative and Creative Thinking Skill Development through the Design of Wearable Technologies. Dissertation Submitted in Partial Fulfillment of the Requirements for the Degree of Doctor of Philosophy, Educational Technology Walden University, 2014. [online][11.02.2020] Available at: http://www.semanticscholar.org/paper/Collaborative-and-Creative-Thinking-Skill-Through-Korte/0ccbf45e4478bb5e435528018aedb23cad5c71d7
[6] Кабанова-Меллер Е. Н. Формирование приемов умственной деятельности и умственного развития учащихся (The formation of methods of mental activity and mental development of students). Москва: Просвещение, 1968. 288 p. (In Russian).
[7] Baltusite R., Briede B. Implementation of findings of generation theories in engineering studies, Engineering for Rural Development, Proceedings, Vol. 17, 2018, pp.1078-1083
[8] Кальнік О. Контроль навчальних досягнень у системі освіти США. Available at: http://77.121.11.9/bitstream/PoltNTU/324/1/Kalnik_Kontrol_Navch_Dosyagnen_U_SSHA.pdf (In Ukrainian)
[9] Doe R. Work Readiness among Graduate Students. LSU Doctoral Dissertations Graduate School, Louisiana State University and Agricultural and Mechanical College, 2015. Available at: https://digitalcommons.lsu.edu/cgi/viewcontent.cgi?article = 2007&context = gradschooldissertations
[10] Семенова А.В. Словник-довідник з професійної педагогіки (Vocabulary guide for professional pedagogy). Одеса: Пальміра, 2006. 272 с. (In Ukrainian).
[11] Vintere A. Study on engineering students experience in mathematics learning in context of sustainable development, Engineering for Rural Development, Proceedings, Vol. 17, 2018, pp.1186-1191.
[12] Ингенкамп К. Педагогическая диагностика. Москва: Педагогика, 1991, 240 p. (In Russian).