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A.A. SAGIMBAYEV[1], E.B. AUELBEKOV[2], A.K. ZHANPEISSOVA[1]✉
[1]*Aktobe Regional University named after K. Zhubanov*
[2]*Khoja Akhmet Yassawi International Kazakh-Turkish University*
✉*e-mail: alma_g@mail.ru*

FORMATION OF A CREATIVE ATTITUDE TO RESEARCH AS A PERSONAL NEED

Abstract. This article explores the organization of the educational process for the formation of general technological knowledge, which requires the teacher of a higher educational institution to solve many issues related to the definition of content, organizational forms, methods and means of education. However, the problem of selecting educational content is the most important, because it is the content that determines the structure of individual classes and the educational process as a whole. The main goal is to develop students' knowledge, skills, and personal qualities, allowing them to navigate the ongoing changes in the field of graphics and design, and to activate their activities. On the other hand, any branch of scientific knowledge is an ever-increasing set of factors, concepts, patterns, hypotheses, etc., which, at a sufficiently high level of science, are united by theory. In order to effectively solve this problem, students should read a special section on graphics and design to optimize the creative process by mathematical modeling. The methodological basis of the study includes methods of statistical control, analysis, and synthesis. Mathematical modeling was performed using methods for solving metric and positional graphical problems based on data analysis.

Special attention is paid to the process and result of mastering systematized tasks in psychological, pedagogical, art history, economic disciplines in order to develop and form the creative abilities of students in the field of graphics, design and technology in modern conditions. The task is to form students' knowledge, skills and personality traits that allow them to navigate the ongoing changes in the field of graphics and design, and to intensify their activities.

Keywords: creativity, thinking, model, graphics, design, technology, educational process.

Introduction

Person’s interests and inclinations in choosing a future profession or a labor are formed in his adolescence. The young man strives to improve the objects and phenomena surrounding him, to rationalize the process of reality.

The interest contributes to the acquisition and development of knowledge of that area; moreover, it helps the formation of practical skills. The person experiences the emotional satisfaction by applying this knowledge and skills in future professional activities. Thus, interest and innovation activities are closely interrelated: it should be highlighted that the interest of young people in extreme sports in our country has recently increased, for example, the well-known motocross, which causes many problems at the same time. For example: in order to straighten the dents in the fuel tank of a

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sports motorcycle, first of all it is filled with water, after that a tightly fitted wooden plug is inserted into the neck and then beaten with a hammer. What are the physical foundations of this operation?

Answer: Liquids have low compressibility. When the hammer hits the plug, pressure arises in accordance with Pascal's law, which is transmitted in all directions without change, and the deformed section of the tank is straightened out. Such method of involving teenagers in creative activity should be recommended: where the teacher, together with the students, identifies possible ways to expand the functionality in the conditions of the university workshops. From a pedagogical point of view, it is important to mind the tasks for the creative activity of students in training workshops are easy and not burdensome. Experience shows that an effortless task that does not require sufficient application of mental and physical strength cannot cause student’s inner satisfaction; moreover it cannot give them the joy of performing. The proposed tasks should be feasible, and at the same time they should encourage them to work hard, overcoming certain difficulties of both mental and physical nature to the full extent of their strength and abilities.

A creatively working teacher should adopt the forms, the techniques and the methods of work that are most effective in relation to the given topic and creative group, and they should correspond to his individual abilities. At the same time, the teacher ought to improve his skills constantly. The theoretical and practical training of students plays an important role during their studies at the university.

Theoretical and practical training of students contains two main components of the education process students’ getting the specialty, they are "Visual Art, art work, graphics and design". These processes are unified, and components are closely related to each other. Theoretical training is carried out by students studying subjects of the psychological and pedagogical cycle, natural science disciplines, special and economic subjects.

The leading discipline is the design course. The purpose of which is to provide students with knowledge of the scientific foundations of modern technology and technologies in volume, it is necessary for a conscious and deep mastering the profession being studied. They get acquainted with the scientific justifications of modern technological processes and the most appropriate techniques and methods of work, at the level of the requirements of modern technology.

In the course of studying the disciplines of the natural science cycle (such as descriptive geometry, engineering graphics, graphics and design, layout design), students' general pedagogical and general technical knowledge is formed, their general horizons are expanded. The main content of these subjects involves the disclosure of the essence of their meaning of general scientific and technical principles, common structural elements in the formations, technical phenomena and patterns.

Any educational subject requires the knowledge of content consisting of systems of various degrees complexity, its concepts, phenomena and facts. The depth of their disclosure and the strength of assimilation depend primarily on the extent the intersubject connections were used in the formation of these concepts. The use of a system of intersubject, intrasubject connections. It provides a deep and comprehensive assimilation of professional knowledge by students, their formation and consolidation of theoretical and practical skills in the process of forming concepts.

Therefore, having based on the benefit of our own nation's contribution to the growth of humanity or on the understanding of the worldviews, cultures and fine arts of other peoples, we are able to come to a common genetic understanding of the noosphere. It is paramount to examine optimal directions that do not contradict both, and not be one-sided in learning and development, but critically explore the consider of the two directions, holding a balance between "tradition" and “new idea.” This should be selected based on the student's exceptionality. As some students aspire for new ones reflecting on and perceiving culture and fine art, they are seeking for a new direction, while others, on the other way, are diving deeper into national art, looking into the future and, thereby, revealing their potential. Therefore, when trading visual perception of art, taking into consideration the

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personality-oriented positions of noospheric education, it is indispensable to take into account the interest and abilities of students. [1, pp. 116-117].

There is a tendency to consider technical and technological thinking separately in modern science. Most researchers define creative thinking as the process of cognition in the mind of technical processes and objects, the basics of their structure, as well as the flow of thought processes in the field of technical images, the functioning of these images using techniques of mental activity not only in their static, but also in a dynamic form. The capability to consider technologically is treated as "... the opportunity to focus reasonably one's activities in any fruitful environment and in distinct, newly created environment: the ability to assume the whole complex of phenomena quite clearly taking place during the production process of the part, their chorological sequence under different possible options, mentally compare these options, assess and choose the most appropriate of them, understand the impact of the choice of bases and the sequence of processing on the technical requirements for the mutual arrangement of the surface: ability to choose the most productive processing methods. [2, pp.14-15].

However, the existing design training programs in the university's training workshops are aimed to developed students' professional subject-manipulative skills and they do not assume that students are able to solve systems of productive technical or volume-design tasks, work of which thoroughly develops the creative thinking of students. The lack of a general method of students' practical communication hinders the implementation of one of the main principles of personal education – the formation of creative, intellectual, emotional and volitional principles.

As a result of the psychological and pedagogical analysis of the research materials, we determined that students' creative thinking develops most effectively in the process of solving a system of creative tasks when the solution of these tasks begins in design and technology classes and finishes in classes in design departments (firms) in production conditions with the embodiment of a creative image – idea into a material object form.

In educational practice, artistic and design activity in design can be considered as a process associated with certain means of activity and its final results - the products of this activity. Artistic and design activity in design is a creative process that transforms the surrounding subject-spatial environment by solving qualitatively new models (objects) of the subject-spatial environment, artistic objects and universal values [3].

The introduction of students into creative activity, acquaintance with the basics of inventive and rationalization work, classes in clubs have a priceless educational value in the development of talents, the formation of pedagogical skills. However, it is worth to mention that despite the emerging urgent need for creative-minded individuals with highly developed non-standard thinking, the occupation of creativity has not yet received proper development and mass distribution.

The formation of a creative attitude to study, work, and creativity as a personal need is given little attention, this work has not become a system, it is carried out mainly by enthusiasts and creative people.

It is important at the initial stage to classify creative tasks in the study of technology and technology.

Production - technical tasks:

1) labor tasks related to the ability to select and implement the necessary methods of processing and processing products with the lowest cost of funds;

2) tasks that offer a solution to a specific theoretical and technological problem, which is made out in the form of calculations, diagrams, sketches, drawings, models and natural samples;

3) design tasks;

4) design and technological tasks;

5) experimental design tasks;

6) design and technological tasks;

Classification of tasks based on result performance:

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1) Objective-creative tasks – innovation and inventive;

2) Subjective-creative tasks solving in the learning process in order to develop creative thinking.

Technical tasks including the solution of a certain technical problem involve the student to acquire a lot of special skills: reinterpret the projected objects, perform their versatile analysis, work with dynamic spatial images, attach knowledge of special technology, graphics, demonstrate independence, activity and elements of creativity.

Labor tasks, their accomplishment requires the use of not only previously formed, but also new skills and abilities in creative activity (performing a measuring control and verification work, a carrying out work, etc.), they should be distinguished from exercises that represent a conscious, purposeful and a number of repetition by students of the studied labor actions that make up a technological operation. Solving work tasks often acts as a means of implementing specific didactic goals of the lesson related to the activation of educational and cognitive activity, increasing the effectiveness of the professional skills formation and abilities [4].

Graphical tasks. They are targeted at enlarging the skills and capabilities to read illustration parts and details, assembly drawings, diagrams, specifications, tables, graphs, technical drawings, with the assistance of whichstudents' knowledge and ideas are showed in the course of their practical work.

Technological tasks. They are aimed at finding optimal equipment modes, and it also include tasks for the refinement of technological processes where certain names of operations are omitted: the creation of technological processes based on a sample of a part, drawing or workpiece. In the course of solving these tasks, students develop the ability to establish the relationship between technological operations; determine the optimal processing modes; plan the sequence of work; choose material, workpiece, tools, equipment, fixtures.

Design tasks. They are connected with the elements of creativity: the fixture design (according to the drawing of the part to be processed or in accordance with the terms of reference); designing a schematically defined structure; designing by own project, etc.

Designed and technological tasks related to the improvement of various layouts and structures and the identifications of optimal modes for it in the technological chain in order to improve the qualitative indicators.

Experimental design tasks relate to the identification of structural weaknesses, their elimination and selection of the best options for it outside the technological chain.

Research methods and materials

This study examines the formation of general technological knowledge, which requires university instructors to address tasks related to defining content and organizational forms for creative specialties. To effectively address this challenge, a special course section on graphics and design with creative assignments is offered. However, it does not cover all aspects of the effective organization of the entire educational process. The primary focus is on developing students' knowledge, skills, and personal qualities that enable them to navigate ongoing changes in the field of graphics and design. Therefore, future research may focus on analyzing other important aspects of education for creative specialties.

The requirements of scientific and technological progress for training were manifested by the imputes for the development of didactics. Over the last three months, new directions in research have appeared in our country. Theories have been developed: activation of the learning process, formation of cognitive interest, program and problem-based learning, optimization of the learning process, etc. We will focus on one of the problems of modern didactics – the activation of the training of students of a professional pedagogical profile.

Didactics and psychologists distinguish different motives of educational activity: social, moral, cognitive, communication motives, self-education motives. Professional motives and cognitive interest are the most favorable for the problem of activating the teaching that interests us. It is possible

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to note a group of methods for activating the cognitive activity of students, the basis of which are these motives. And if the educational process is built in such a way that learning from the first year of university becomes the start of activity, then professional and cognitive motives merge. However, to solve the professional orientation issue in all curriculum disciplines is a difficult task. This is more accessible in the disciplines of the general scientific and professional-pedagogical cycle. A general technological training occupies a special place, which provides for mastering the system of knowledge about the basics of scientific technology of shaping. This knowledge reflects the most general patterns underlying the study and construction of various forms and the further development and functioning of creative processes.

For effective analysis and management of the creative process, it is necessary to identify the relationships between the factors that determine the course of the process and present them in the form of a mathematical model (Fig. 1)

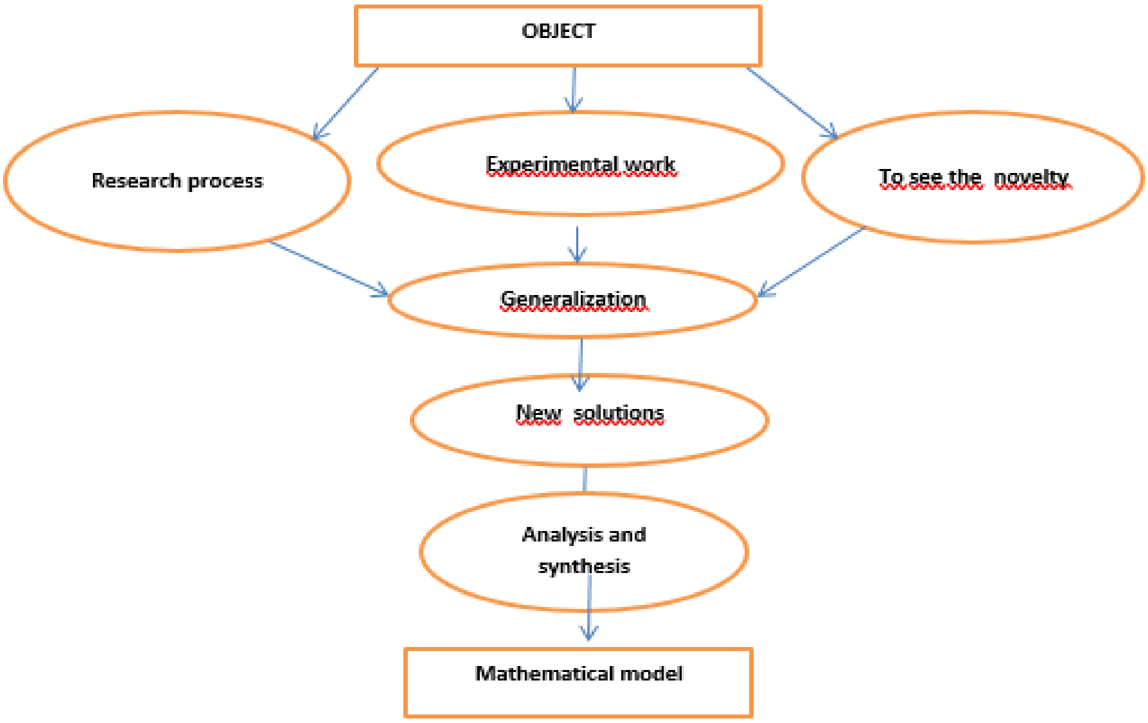

Figure 1. Mathematical model of the object under study

The model allows:

- get information about the processes taking place in the object;
- analyze the system and design it;
- receive and control information for the simulated object;

Static models have a relatively simple structure and they will be more accessible to students. It is customary to distinguish between static stationary and dynamic models. The first of them describe stationary, i.e. time-invariant relations in the object.

The following stages of model construction can be distinguished:

1. Problem statement.

The content of this stage is the definition of the goal, the clarification of the initial situation, the assessment of the allowable costs of time and money, as well as the establishment of the type of task:

- identification of the structure or parameters;
- object management;
- finding optimal conditions.

2. Collection of a priori information and ranking of facts.

By studying the literature, interviewing specialists involved in the field of graphics and design, it is necessary to collect and evaluate the possibility. Conduct a ranking of facts.

3. The choice of the solution method and the strategy of their implementation.

At this stage, there is a need to manufacture the installation necessary for conducting experiments, the devices are selected to register the results of the experiment, moreover, a methodology for their analysis is being developed.

4. Checking the selected solution method.

It is aimed to identify and eliminate on time possible errors in the problem definitions, the selected model, the experimental setup, as well as to save time and money, preliminary (screening) experiments are conducted.

Taking them into account, not only the experimental setup and methodology are checked, but also a preliminary assessment of the quality of the model is made, as well as screening out less significant factors.

5. Implementation of the chosen solution method.

The implementation of the proven and corrected solution methodology is consisted in the final determination of the goal and factors, in the volume of samples and the plan of the main experiment, in the frequency of repetition of experiments, as well as in conducting experiments and statistical processing of their results.

6. Analysis and interpretation of the results.

At this stage, a statistical analysis of the experimental results is carried out and the parameter estimate accuracy of the resulting layout or model is checked.

In the present study, the groups were formed using random assignment; to ensure their comparability, the experimental intervention was applied exclusively to the experimental group. Learners in the experimental group carried out tasks focused on the construction and transformation of projections in the process of solving metric and positional problems. The control group did not receive any experimental intervention and completed standard tasks, serving as a basis for comparative analysis. Participants were allocated randomly to groups to reduce bias and ensure the comparability of groups. The experimental research was carried out among first-year students of the specialties “Design” and “Fine Arts, Artistic Work, Graphics, and Design,” while strictly maintaining gender equality.

Analysis and results

The study carried out at the preliminary stage of studying the problem of assessing the level of general training of students based on the results of their studies allows, without claiming to be final, to recommend the following criteria and indicators:

The first criterion:

Broad horizons of the student.

According to this criterion, students' knowledge is determined:

- the main directions of scientific and technological progress;
- modern level of training technology (including information technology); new materials with specified properties;
- basic information about ecology;
- basic psychological and pedagogical principles and the ability to apply creatively in practical work;

The second criterion:

Students' knowledge of the scientific foundations of pedagogy, psychology, engineering and technology.

According to this criterion, the scientific level of the student is evaluated, his ability to apply the general laws and principles of the studied sciences is determined to explain the particular laws

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underlying the design and operation of technical objects, the implementation of technological operations.

The effectiveness of students' assimilation of scientific foundations is assessed by indicators of five levels.

The first level of indicators – correctness, completeness, consistency – is used to assess students' assimilation of industry content in psychological and pedagogical general technical and economic disciplines.

The depth and significance of an artistic image depends on what meaning and meaning is generalized and aesthetically conveyed. The higher the aesthetic value of the image, the more aesthetic information and aesthetic values are interpreted and manifested [6].

The process of special cognition includes approaches used in a certain field of science. For example, geometric transformations, the use of mathematical symbols, modeling, etc.-These are special approaches used in mathematics. The assimilation of any knowledge in the learning system cannot be carried out without these methods of cognition. And, on the contrary, through the acquisition of specific knowledge, the methods of the general cognitive process should also be mastered [7].

The indicator of the second level of mastering the scientific foundations of the pedagogical foundations of pedagogy, psychology, engineering and technology is generality. It is used to assess students' ability to analyze independently (rather than reproduce the acquired knowledge) the scientific foundations of various objects and technological operations [8].

Artistic dimensions of volumetric Archives: form, composition, ergonomics, design, compositional relationships, integrity, mobility, etc.artistic dimensions of works depicted on a flat surface: idea, composition, color solution, methods of representation, techniques of execution form directions [9, p. 157].

The indicator of the third level of assimilation is mobility and effectiveness, it is used to assess the student's ability to apply existing knowledge directly in their practical activities.

The indicator of the fifth level assumes the ability to use knowledge creatively in psychological and pedagogical disciplines, taking into account the age, knowledge, desires of students.

<u>*The third criterion:*</u>

Mastering practical skills and abilities.

Practical skills can be classified according to:

1) functional – work planning, labor organization, improvement of equipment and technology, improvement of pedagogical skills;
2) by the nature of the activity and the degree of complexity they could be elementary, medium complexity, complex with the use of measuring, computing and other equipment;
3) according to scientific principles and the ratio of physical and intellectual labor – with the predominance of physical labor, with the predominance of intellectual labor, intellectual.

Each of the above groups contains a wide set of specific skills in relation to a particular occupation, the criterion of mastering practical skills is, in some way, a reserve, since the formation of these skills is included in the methods of work in the profession and is taken into account when assessing professional readiness in accordance with the requirements of a qualified teacher. The classification of the student's readiness criteria is shown in Figure 2.

Graphic methods. A comprehensive problem-solving approach was employed to foster students' creative attitude in solving metric and positional graphical tasks. The use of the plane of projection replacement method contributes to the development of general technical knowledge and the ability to identify interrelationships between technological operations. This method enables the identification of design shortcomings and promotes the development of students' figurative–conceptual and visual–practical thinking.

The educational process at the university should be formed in such a way that each lesson, regardless of the discipline studied, has a creative character. It includes criteria for graphics, design and technology of teaching creativity, a criterion for evaluating the functioning of learning technology and a criterion for the effectiveness of learning outcomes: a criterion for the level of knowledge and a criterion for the formation of creative skills.

A feature a digital educational process is the introduction and use of digital technologies, many of which have the following didactic properties: freedom of search (unlimited opportunities for independent adjustment in accordance with the needs and characteristics of students); interactivity(ensuring multi-subjectivity in the process of educational interaction); multimedia (integrated launch of various channels of information perception); hypertext (free movement across the text, the use of cross-links, the reference nature of information, etc.); subculturalism (compliance with the usual picture of the world for the digital generation) [9].

Theoretical training should be reinforced with practical knowledge, skills, including the conduct of laboratory and practical work. And mathematics in formulas retains their abstract character, without being reflected in visual implementations [10.p. 218-219].

Such qualities as social activity, a clearly visible positive attitude to one's profession, the ability to find and justify professional problems, readiness and ability to creative activity, the search for non-standard solutions should be counted as the most important qualities that determine the personality of a special teacher [11. pp. 228-229].

The criterion for dividing the process into related operations provides the sequence of the student's work in the field of object design and layout.

The criterion of algorithmicity determines the process of performing actions to identify, clarify and resolve technical contradictions (fig. 2).

The criterion of technological sequence takes into account the rational sequence of operations for the manufacture of a product, object.

The criterion for evaluating the content of training includes methods of cognitive activity, methods of teaching activity, methods of scientific activity, etc.

The criterion for evaluating the teaching methods used is the method that gives the greatest return. [12].

The criterion for evaluating the didactic tools used takes into account the use of technical training tools, visual aids, including those actually manufactured.

The criterion of the level of knowledge takes into account the depth of knowledge, the effectiveness of knowledge, systematic and awareness, accuracy and strength of assimilation, as well as the amount of acquired knowledge [13].

One of the important indicators of teaching students' creativity is the criterion of formation of creative skills, which includes:

- independent transfer of knowledge and skills to a new situation. This feature of creative activity consists in the fact that when solving a new problem, a person is able to use the previously acquired knowledge and skills to find a solution;
- vision of a new problem in a traditional situation. The essence of the trait is that a person sees the problem when it is not obvious;
- vision of the new function of the object. In inventive activity, there is an application of a known device for a new purpose;
-independent combination of the known methods of activity of the new. This trait is manifested in solving physical and mathematical problems by various methods;
- vision of the structure of the object. This trait is found in the fact that a person distinguishes the essential and non-essential from an object, determines the relationship between them;
- vision of an alternative solution and its course, i.e. possible different solutions to this problem, solutions, the presence of contradictory facts;
- construction of a fundamentally new solution method, different from the known ones. The manifestation of this trait, indicating the vision of a new way of solving.

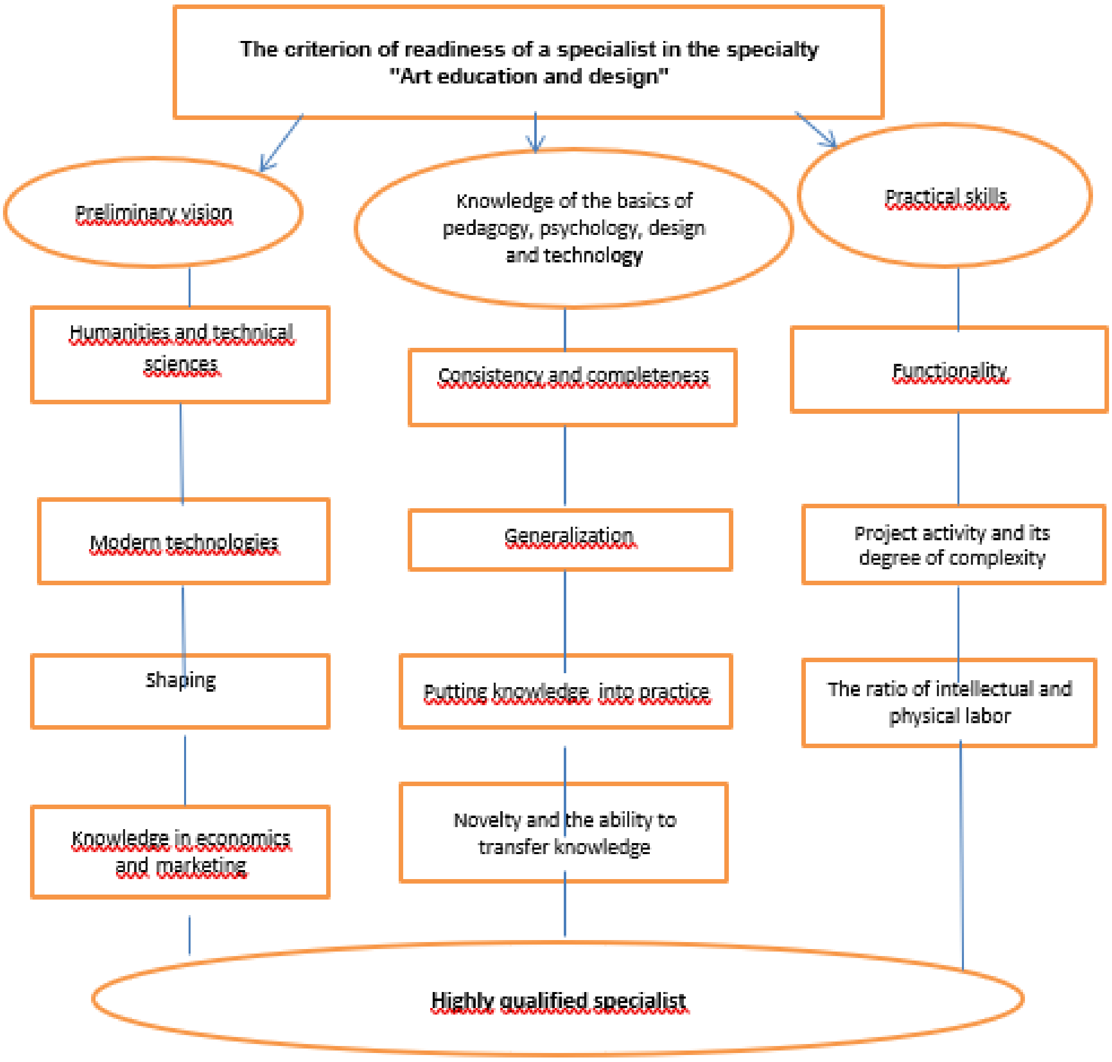

Figure 2. Criteria for the preparation of a future highly qualified specialist

At the final stage, the student 's readiness for future work is determined according to the following indicators:

Design skills (indicators of formation)

1. Be able to explain according to the model, layout, scheme of the device, the principle of operation and design features of the object.

2. Be able to update the knowledge of the theory to explain according to the drawing, the scheme of the principle of operation of the device, object.

3. Be able to predict constructions using the knowledge of theory.

4. Master the techniques of design activity.

a) select the necessary materials for construction;

b) plan design work;

c) carry out settlement work;

d) carry out drawing and graphic works;

e) carry out assembly work;

e) evaluate the quality of the resulting design;

Applied to project creativity:

1. Be able to justify the advantages and disadvantages of the design, build a plan for its improvement.

Experimental and practical skills (indicators of formation)

1. Be able to identify the essence of experimental and practical work and its purpose.
2. Be able to prepare for experimental and practical work:

a) plan the conduct of the experiment;
b) select measuring instruments;
c) prepare tables for recording observations;

3. Be able to perform experimental and practical work:

a) to carry out surveillance;
c) make tables of the significance of the values;
d) build graphs;
e) perform approximate calculations.

4. Be able to make a work report:

a) formalize the results, analyze;
b) evaluate the reliability of the results, compare them with existing data, tables, reference books;
c) explain the essence of the results obtained.

Graphic skills (indicators of formation)

1. Know the basic rules for drawing up drawings and be able to draw up drawings in accordance with the requirements of the ESCD GOST.
2. Be able to analyze the geometric shape of the object and apply the basic provisions of projection when performing various drawings.
3. Know the purpose and features of the graphic representation of views, sections
4. Be able to place views on the drawing field, select the main image, determine views by their image.
5. Be able to execute and read drawings using cuts and sections.
6. The ability to apply sketches as a simplification when performing and reading drawings.
7. The ability to read assembly drawings and diagrams typical for this industry.

Computing skills (indicators of formation)

1. Be able to identify information about the calculated value, the purpose of the calculation, the required accuracy of the calculation.
2. Be able to analyze the results of calculations and select the rules (patterns, dependencies) by which the desired value can be calculated.
3. Be able to restore the necessary rules from textbooks or other reference materials.
4. Be able to determine the calculation method (operation sequence).
5. Be able to calculate the desired value, check the results of calculations, evaluate measurement errors.
6. Be able to compare the results of calculations with the predicted ones, evaluate the reliability and draw conclusions.

Measuring skills (indicators of formation)

1. The ability to identify the initial information about the measured value and the method of its determination;
2. The ability to select measuring instruments or technical devices and measurement methods.
3. The ability to measure the desired value.
4. The ability to analyze the measurement result and make a conclusion about the desired value.

Experts in the field of qualitative research argue that there is no definitive answer to the question of "how many," as the sample size depends on a range of factors related to methodological and practical considerations [14].

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Sandelowski recommends that the sample size in qualitative research should be large enough to allow for "new and richly textured understandings" of the phenomenon under study, yet small enough to enable "a deep, case-oriented analysis" of qualitative data. She argues that the more useful data are obtained from each participant, the fewer participants are needed overall. She suggests that researchers consider factors such as the scope of the study, the nature of the topic (i.e., its complexity and accessibility), the quality of the data, and the study design [15].

In solving metric problems, students first constructed various geometric figures in three projections using axonometric projection. Later, the tasks were made more complex: the same objects were solved using the plane-of-projection replacement method to align the given figures and their elements parallel to one of the projection planes. The comparison revealed that the control group, studying under the standard program, made more errors in theoretical tasks involving creative elements. The experimental group demonstrated superior performance in tasks requiring image comparison, analytical skills, relatively creative thinking, and basic part design.

Indeed, our findings indicate that the level of structure within the specially selected creative tasks in graphics and design has a significant impact on the depth and completeness of the data obtained.

In the classroom, the following key requirements were applied to stimulate creativity and create a problem-based learning environment:

The first component was a modified paper-and-pencil test utilizing various sets of symbols, including graphic elements (such as geometric figures and colored icons). The advantage of using computer technology in this context lies in its ability to generate symbol combinations randomly, thereby producing an unlimited number of such variations.

Immediately after the student's response, the computer displayed a close-up view (with 2x magnification) highlighting the differences between the two lines, in cases where an error had been made.

The second part of the training module involved a modified test aimed at identifying missing elements in an image, with a time limit imposed for each response.

To develop students' attentiveness, a computer-based method was used to present minor inaccuracies and subtle errors commonly found in technical drawings. This approach helps students become accustomed to noticing fine details and small discrepancies during the drafting process.

AS NM PY HG NL Lz KK Wf Up Jk vL lD pX zQ Cb Lu yF Nx jH tY	PY vL zQ NL Tr Up Jk Cb Ge Ud pX jH tY NM AS Lz lD yF Nx Wf

a) In the first task, certain symbols are underlined. Within a limited amount of time, the student is required to identify and mark the exact same symbols on the response sheet.

83200119642103891		**83200116942103891**
Saljltyrwnporebkjlfd		**Saljltyuwnporebkjlfd**
5:20:423817:20:5317:21		**5:20:423817:20:5317:21**
Достигну поставленной цели		**Достигнуть поставленной цели**
32501473689-1450-8701		**32501473689-1450-8701**

b) During the test, pairs of long numerical or textual sequences (either meaningful or random) are presented. If the sequences are found to be completely identical, the student is required to mark the appropriate response (plus or minus).

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c) During the test, the student is required to mark or cross out all occurrences of the symbol ∩.

Figure 3. Sample items from the questionnaire test: tasks from the initial stage of the interactive training.

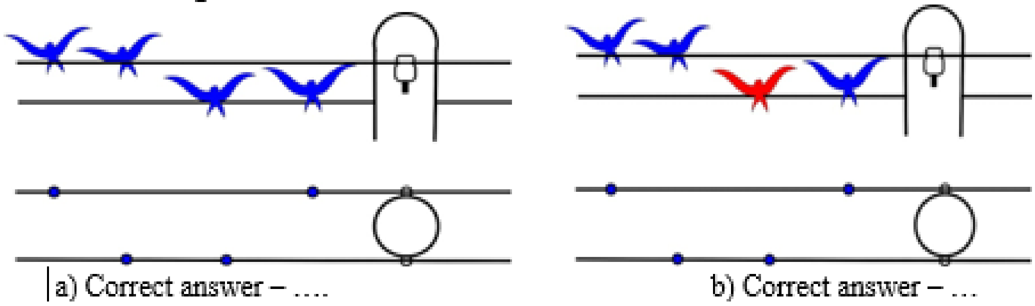

Figure 4 – Examples of tasks from the second stage of the interactive training module: identifying the number of birds sitting on the wires

This questionnaire makes it possible to obtain quantitative characteristics of the need for achievement and the need for self-improvement, which, in our view, correspond to the capacity for self-organization. Motivation for communication and group activity reflects students' communicative abilities and contributes to the development of their creative potential.

Evaluation criteria for the results obtained:
Score range from 1 to 4 indicates a *low* level of motivation intensity;
from 4 to 7 – *moderate*;
from 7 to 9 – *high*;
from 9 to 10 – *very high*.

Since this method of measuring motivation levels provides only relative data–due to the absence of normative indicators for different age groups - we combined the "high" and "very high" levels into a single category labeled "high", for the purpose of facilitating monitoring of the development of students' creative abilities (Figure 3).

The final results of the pedagogical experiment confirmed that creative activity organized through programming didactic computer games is an effective means of developing students' creative abilities (Figure 4).

Development levels of creative abilities among students in the experimental group (formative experiment):

Data analysis revealed that 40% of students in the experimental group showed an increase in motivation and creative activity. The final results confirmed that creative activity, organized through programming of didactic games in the *Graphics and Design* course, effectively fosters the development of students' creative abilities.

In the experimental group, the following changes were observed:
- the number of students with a high level of abilities increased by 38%;
- the number of students with a moderate level decreased by 17%;
- the number of students with a low level decreased by 21%.

In contrast, changes in the control group were minimal.

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To compare the results of staged and formative experiments after each test for the student, a complex indicator of the level of compliance with was calculated on the screen.

The tasks of the ascertaining experiment included determining the initial level of observation and the ability to independently analyze students (before using the experimental technique). The obtained values of did not have significant differences in individual subgroups. Thus, the ascertaining experiment revealed minor discrepancies in the generalized indicators of the level of observation and the ability to analyze in general by subgroups. However, within separate subgroups, due to the presence of different initial levels of observation and independent analysis, the software simulator was chosen in accordance with the principle of an individual approach to teaching (i.e., students were offered creative design tasks of varying complexity depending on their level of observation and independent analysis.

The research identified differences in the speed of drawing completion. A significance level of $p<0.05$ was adopted, meaning that the likelihood of these differences occurring by chance is less than 5%. Student's t-test was employed to compare the mean performance of the two groups in solving metric and positional graphical tasks.

To test the hypothesis about whether the experiment has an impact on the development of students' observation, a statistical criterion was used. The results of statistical data processing are presented in Table 1.

Table 1 – Results of statistical data processing

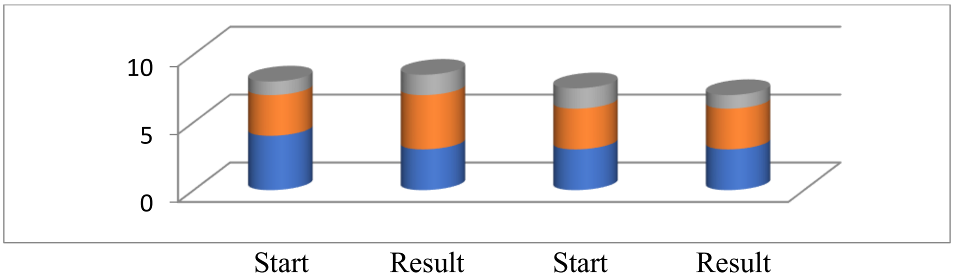
Subgroups		D_{cp}	S_d	n	T	t_{n-1} α = 0.001	t_{n-1} α = 0.5
	Experimental (1)	0.206	0.264	51	5.753	3.481	0.676
	Control (2)	0.005	0.262	53	0.219	3.473	0.676

To study the issue of the development of creative abilities of students, a pedagogical experiment was used, including several stages

– state-standing (search);
– forming (training);
– control (comparative);
– statistical processing of experimental data.

The preparation and conduct of an experimental study of the development of creative abilities of 1st year students was carried out from 2020 to 2023 at the Department of "Artistic Work and Design" of Aktobe Regional University named after K. Zhubanov. 54 students were included in the experimental work. Let's imagine the step-by-step actions of experimental work. This questionnaire allows us to obtain quantitative characteristics of the need to achieve a goal and the need for self-improvement, which, in our opinion, corresponds to the ability to self-organize. The motivation of communication and collective activity reflects the communicative abilities of students.

Communication skills Motivational and creative activity



□ low secondary high

Figure 5 – Levels of development of creative abilities of students in the experimental group (baseline experiment)

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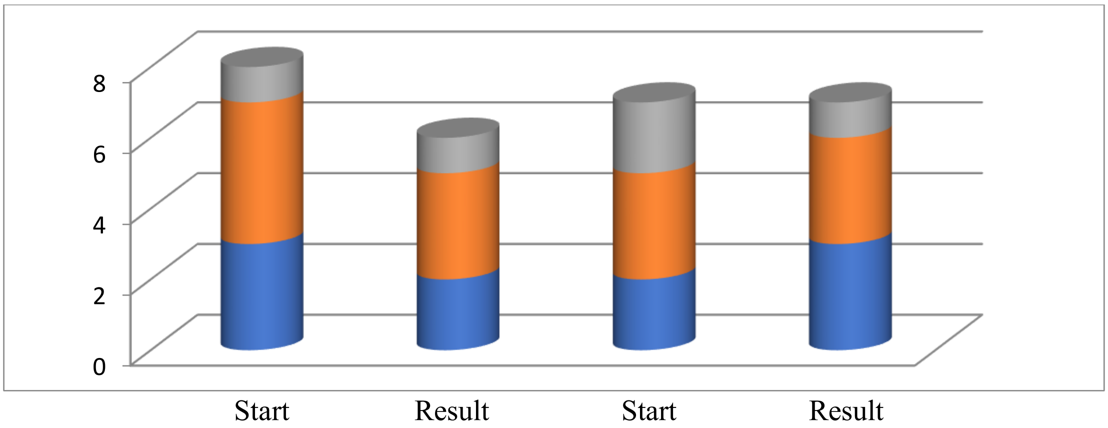
Communication skills Motivational and creative activity



□ low secondary high

Figure 6 – Levels of development of creative abilities of students in the control group (baseline experiment)

This questionnaire allows us to obtain quantitative characteristics of the need to achieve a goal and the need for self-improvement, which, in our opinion, corresponds to the ability to self-organize. The motivation of communication and collective activity reflects the communicative abilities and contributes to the development of students' creative abilities.

There was no direct “independence” scale; however, high scores of participants in our study on computer-based tests aimed at developing critical thinking, combined with measures of cognitive flexibility and low tendency toward confrontation, indicated a high level of independent thinking among the students. In the course of the lessons, key methods were employed to enhance students’ creative abilities and create a problem-based learning environment: the trial-and-error method, which consisted of sequentially testing various versions of graphical tasks until the required outcome was obtained. Moreover, the tasks were divided into simpler subtasks.

Criteria for evaluating the results obtained: Number of points: from 1 to 4 - low intensity of motivation, from 4 to 7 – average, from 7 to 9 – high, from 9 to 10 – very high intensity of motivation. Since this method of measuring the level of motivation indicators allows us to judge the degree of development of these indicators only relatively, since it does not contain normative data for different age ranges, we combined high and very high levels of motivation into one and called it “high”, this was done for the convenience of monitoring the development of indicators of creative abilities (Figure 2). Levels of development of creative abilities of students in the experimental group (formative experiment). Data analysis showed that 40% of the experimental group’s students increased their level of motivational and creative activity. The final results of the pedagogical experiment confirmed that creative activity organized in the process of programming didactic computer gamesis an effective meansfor the development of creative abilities of students**.** The evaluation criterion reflects a shift from an average to a high level, emphasizing not only accurate task completion but also independent thinking, courage in expressing original ideas, striving for excellence, novelty and depth of content, full self-realization, and active emotional involvement in the learning process. The grading criteria for creative assignments were defined as follows: a “satisfactory” level implied the completion of approximately 50% of tasks and requirements (e.g., 1/2 or 50–59%), while a “good” level corresponded to the completion of 75% of tasks, taking into account originality, logical consistency, and the absence of serious errors.

A grade of “3” (satisfactory) implies mastery of approximately 50% of the material, the use of insufficiently reasoned or illogical analytical methods, the presence of logical errors, and incomplete answers.

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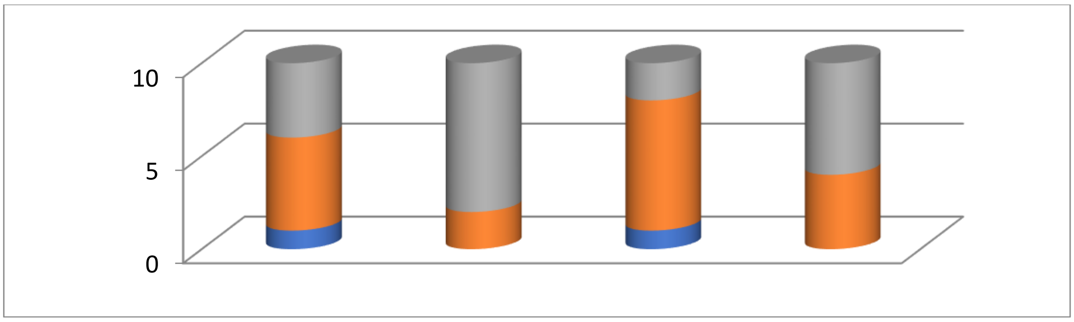
A grade of “4” (good) implies error-free completion of approximately 75% of tasks, demonstration of independent judgment, use of additional materials, and only minor shortcomings.

Alongside the evaluation of correctness, qualitative criteria were taken into account, including originality and novelty, thoroughness and depth, and the structure and logical coherence of the solutions. If a work is logical and original but includes minor errors in solving tasks (e.g., metric tasks), it is awarded a grade of “4” (good) (Figure 7).

The levels of development of students' creative abilities in the experimental group (formative experiment). Data analysis showed that 40% of the students in the experimental group increased their level of motivational and creative activity. The final results of the pedagogical experiment confirmed that creative activity organized in the process of programming didactic games in the discipline “Graphics and design” is an effective means for the development of creative abilities of students.

Communication skills Motivational and creative activity

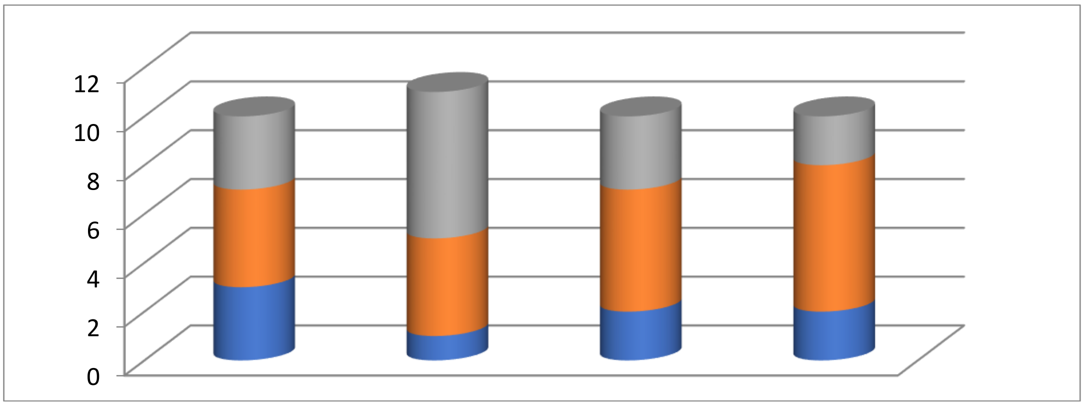


Start Result Start Result

□ low secondary high

Figure 7 – Levels of development of creative abilities of students in the experimental group (formative experiment)

Communication skills Motivational and creative activity



Start Result Start Result

□ low secondary high

Figure 8 – Levels of development of creative abilities of students in the control group (formative experiment)

The following changes occurred among the students of the experimental group: The number of students with a high level of abilities increased by 38%; The number of students with an average level of abilities decreased by 17%; the number of students with a low level of abilities decreased by 21%. In the control group, the changes that have occurred are insignificant.

Conclusion

Materials of personal experience and research suggest that the best option for organizing training is achieved in case the same teacher conducts engineering graphics, graphics and design, mock-up in training workshops. The task of recruiting teachers of the department in this way is a difficult task. But there is another way – it is the development of methodological manuals. Thus, the authors have developed and are introducing into the educational process a methodological complex for the organization and conduct of educational, pedagogical, industrial and pre-graduate practices of students of the specialties “Visual Art, art work, graphics and design”. This manual helps to strengthen interdisciplinary connections of engineering graphics and design disciplines with various types of practices.

A special place in the development of creative thinking is occupied by productive tasks used in the learning process. First of all, it is a system of tasks that should:

1) according to the thematic orientation and the nature of the content, meet the requirements of the curriculum of both theoretical and practical training and include elements of interdisciplinary connections;

2) it is built on the principle of gradual complication, from subjective to objective novelty;

3) contain tasks in which the level of complexity and objects of the creative application should reflect the specific features of the teacher of the interdisciplinary field “Visual art, artistic work, graphics and design” and meet the requirements of the educational standard.

Compliance with all these requirements when developing systems of productive tasks for a specific course ensures the implementation of one of the leading didactic principles – the principle of systematic connection of the learning process with life practice.

The conducted research allows us to conclude that the need for technical creativity is closely related to the structure of a person's interests and life activity motives. It contributes not only to an increase in professional and technical competence but also to the elevation of the individual’s value orientation, which leads to a more rapid and positive qualitative transformation in the social image of the rationalizer and inventor as a whole. In this context, the moral and educational aspects of technical creativity are of particular importance.

The use of heuristic (partially exploratory) teaching methods and problem-based learning approaches (with game elements) enabled students to think independently, form their own opinions, and draw conclusions. Therefore, it is necessary to incorporate a significant creative component into the educational process of schools, colleges, universities, and other educational institutions—through the use of computer technologies with integrated game-based elements.

Based on the research conducted, the following conclusions can be drawn:

We identified four key factors that influence the conditions for creative learning in *Engineering Graphics*:

1. Knowledge of natural laws or scientific foresight.
2. Persistence and emotional engagement.
3. The ability to tolerate failure.
4. The capacity not only to design and construct but also to “think with one’s hands.”

An analysis of these factors leads to the conclusion that creativity is inseparable from a deep desire to find better ways to meet human needs and from an understanding of physical and technical principles - not only intellectually, but also through tactile and visual experience. It is only through the combination of all these elements that it becomes possible to create something new or improve upon what already exists.

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Зерттеу барысында шығармашылықты қалыптастыру
тұлғаның бойындағы басты қажеттілік ретінде

Аңдатпа. Бұл мақалада жоғары оқу орнының оқытушысынан оқытудың мазмұнын, ұйымдастырушылық формаларын, әдістері мен құралдарын анықтауға байланысты көптеген мәселелерді шешуді талап ететін жалпы технологиялық білімді қалыптастыру және осыған байланысты оқу процесін тиімді ұйымдастыру жан-жақты қарастырылады. Басты мақсат – студенттердің бойында графика мен жобалау саласындағы болып жатқан өзгерістерді бағдарлауға, олардың қызметін жандандыруға мүмкіндік беретін білім, дағды секілді жеке қасиеттерді дамыту. Алайда, осы сұрақтар кешендерінің ішінде оқу мазмұнын таңдау мәселесі ең маңыздысы, өйткені бұл жеке сабақтар мен жалпы оқу процесінің құрылымын анықтайтын мазмұн. Екінші жағынан, ғылыми білімнің кез-келген саласы ғылымның жеткілікті жоғары деңгейі мен теорияның біріктірілген көптеген факторларын, ұғымдарын, заңдылықтарын, гипотезаларын және т.б. білдіреді. Бұл мәселені тиімді шешу үшін шығармашылық мамандықтарда білім алушыларға математикалық модельдеу әдісімен оқу процесін оңтайландыру үшін графика және жобалау бойынша арнайы бөлім оқылады. Зерттеудің әдістемелік базасы негізінде қолданылған әдістер: статистикалық бақылау, талдау және синтездеу әдісі. Математикалық модельдеу үшін деректерді талдауға негізделген өлшемдік және позициялық графикалық есептерді шешу әдістері пайдаланылды. Қазіргі жағдайда графика, жобалау және технология саласында білім алушылардың шығармашылық қабілеттерін дамыту және қалыптастыру үшін психологиялық-педагогикалық, өнертану, экономикалық пәндер бойынша жүйеленген тапсырмаларды игеру процесі мен нәтижелеріне ерекше назар аударылады.
Кілт сөздер: шығармашылық, ойлау, модель, графика, жобалау, технология, оқу үдерісі.

Формирование творческого отношения к исследованию как потребности личности

Аннотация. В данной статье подробно рассматривается формирование общих технологических знаний, требующих от преподавателя вуза решения многих задач, связанных с определением содержания, организационных форм, методов и средств обучения, и в связи с этим эффективная организация учебного процесса. Главной целью является развитие у студентов знаний, умений, личностных качеств, позволяющих ориентироваться в происходящих изменениях в области графики и проектирования, активизировать их деятельность. Однако среди этих комплексов вопросов наиболее важным является вопрос выбора содержания обучения, так как именно содержание определяет структуру отдельных занятий и учебного процесса в целом. С другой стороны, любая отрасль научного знания представляет собой все увеличивающееся множество факторов, понятий, закономерностей, гипотез и т.д., которые при достаточно высоком уровне науки объединяются теорией.

Для эффективного решения этой задачи обучающимся творческих специальностей читается специальный раздел по графике и проектированию для оптимизации учебного процесса методом математического моделирования. Методологической базой исследования являются методы статистического контроля, анализа и синтеза. Для математического моделирования использовались методы решения метрических и позиционных графических задач, основанные на анализе данных.

В современных условиях особое внимание уделяется процессу и результатам освоения систематизированных заданий по психолого-педагогическим, искусствоведческим, экономическим дисциплинам для развития и формирования творческих способностей обучающихся в области графики, проектирования и технологии.
Ключевые слова: творчество, мышление, модель, графика, проектирование, технология, учебный процесс.

Information about the authors
Sagimbayev A.A. *– Candidate of Pedagogical Sciences, Associate Professor, Aktobe Regional University named after K. Zhubanov, e-mail: adun_8s@mail.ru, Kazakhstan, Aktobe.*

Auelbekov E.B. *– Candidate of Pedagogical Sciences, Associate Professor, Khoja Akhmet Yassawi International Kazakh-Turkish University, e-mail: erzhan.auelbekov@ayu.edu.kz, Kazakhstan, Turkistan.*
Zhanpeissova A.K. *– The Corresponding Author, Senior Lecturer, Aktobe Regional University named after K. Zhubanov, e-mail: alma_g@mail.ru, Kazakhstan, Aktobe.*

Авторлар туралы мәлімет
Сагимбаев А.А. *– педагогика ғылымдарының кандидаты, доцент, Қ. Жұбанов атындағы Ақтөбе өңірлік университеті, e-mail: adun_8s@mail.ru, Қазақстан, Ақтөбе қ.*
Ауелбеков Е.Б. *– педагогика ғылымдарының кандидаты, қауымдастырылған профессор, Қожа Ахмет Ясауи атындағы Халықаралық қазақ-түрік университеті, e-mail: erzhan.auelbekov@ayu.edu.kz, Қазақстан, Түркістан қ.*
Жанпейсова А.К. *– корреспондент-автор, аға оқытушы, Қ. Жұбанов атындағы Ақтөбе өңірлік университеті, e-mail: alma_g@mail.ru, Қазақстан, Ақтөбе қ.*

Сведения об авторах
Сагимбаев А.А. *– кандидат педагогических наук, доцент, Актюбинский региональный университет имени К. Жубанова, e-mail: adun_8s@mail.ru, Казахстан, г. Актобе.*
Ауелбеков Е.Б. *– кандидат педагогических наук, ассоциированный профессор, Международный казахско-турецкий университет имени Ходжи Ахмеда Ясави, e-mail: erzhan.auelbekov@ayu.edu.kz, Казахстан, г. Туркестан.*
Жанпейсова А.К*. – автор-корреспондент, старший преподаватель, Актюбинский региональный университет имени К. Жубанова, e-mail: alma_g@mail.ru, Казахстан, г. Актобе.*