

RESEARCH WORK OF STUDENTS IN THE EDUCATIONAL PROCESS

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Abstract: *The paper considers the effectiveness of the use of research work of students in the educational process. The optimal structure of the organization of research work of students is presented corresponding to the possibilities of the modern educational process and the realization of the creative abilities of students. In the three-level approach to scientific re-search, the main creative steps that cover all possible combinations of creativity in a wide range of applied problems and goals are revealed. At the same time, the shift of students' motivation into the field of personal creativity is taken into account and discussed, the experience of applying modern methods of increasing creative self-realization in research work of students using the universal creative technologies of synergy and synaesthesia is considered.*

Keywords: students research work, engineering and computer graphics, synergy, synergetics.

In modern education the research work of students is becoming increasingly important, since a modern future specialist is more of a researcher introducing scientific and technical progress into the realities of production than a professional who ensures the normal existence and preservation of the process and production. Therefore, great importance and attention are paid to the active participation of students in creative and research-oriented programs and studies as necessary tasks of future professional activity, without which the competence paradigm of modern education does not provide the necessary level of competence^{1,2}.

In addition to maximizing the realization of the educational potential, students' research work reveals hidden tendencies in the sociocultural dynamics of the information society, allowing to forecast and prepare the most adequate response of the educational system to changes in cultural values and personal priorities of new generations of students, who are increasingly striving not for knowledge, but for interesting and

¹ N.A. Burmistrova, "Methodological Bases of the Competence Approach in Conditions of Polyparadigmality of Modern Educational Space", 2012. Available at: http://www.rusnauka.com/29_NIOXXI_2012/Pedagogica/4_115787.doc.htm.

² M.B. Pozina, "Contemporary strategies of managing the process of learning", in *Astra Salvensis*, 2018, vol. 6, p. 691-700.

fulfilling life in all aspects, which is increasingly dominant in relation to education³.

The scientific and technological progress of society, largely determined by education, through the change in the human environment affects and forms the person himself in his current and long-term interests, ways of self-expression and self-realization, re-turning his education and feedback to the educational system in the form of feedback with new generations of students. Training in strictly regulated work programs is not the only way to obtain a high level of knowledge. The work program determines the mini-mum level of knowledge of the future specialist, therefore, the classes in the educational process provide only the opportunities for students in the perception of knowledge and skills derived from upbringing and conscious necessity, and the research work of students reveals the future specialist in his personal interest, more like an individual, statistically showing deeply hidden tendencies of the total process of deformation of cultural stereotypes and ways of their realization.⁴ Therefore, in the research work, the characteristic features of the generation, their abilities, the dominant qualities and the motives that produce them are very clearly and unambiguously manifested.

In this context, the research work of students becomes not only a place for the infantile realization of future professional activity but also opens the prospects for the educational process itself through the trends of shifting cultural stereotypes and forms of self-expression of generations. Therefore, in order to maintain an adequate response of the educational process to the dynamics of sociocultural changes for the purposes and values of modern society, it is necessary to search for interests and areas of activity that are priority for modern students and find the corresponding educational motivations that are directly related to the quality and effectiveness of the entire educational process⁵.

One of these trends, which has not yet manifested itself in the training courses, but which clearly and unequivocally determines the students' attitudes toward education in the students' research work system, is preferring the vivid personality to any professional competence and erudition. The modern gifted student more and more often re-jects the

³ K.N. Dementiev, O.V. Zashchirinskaya, O.V. Prstav, "Special and inclusive education systems for disabled children: Health technology application potential", in *Teoriya i Praktika Fizicheskoj Kultury*, 2016, no. 7, pp. 41-43.

⁴ V.M. Rozin, *Education as a Synergetic System*, Gnozis, Moscow, 1997.

⁵ N.-L. Popa, A.-M. Ţepordei, A.-V. Labăr, F.-V. Frumos, "Cognitive styles, motivational orientations and learning processes in university students", in *Astra Salvensis*, 2018, vol. 6, no. 12, p. 261-273.

need for education for competitiveness in the labour and consumption market and is engaged in what is interesting and encourages his self-expression, filling life with meanings that exceed personal well-being, including future goods⁶.

In this regard, the competence paradigm of education is supplemented and, in some places, relies on motivation for learning for the needs of self-expression of one's individuality, when feelings of importance of skills and knowledge for oneself are transformed from the own competency value to the value of human individuality, manifested not in the universal essence of professionalism, but creatively inimitable originality of personal use of competence for the purpose of own individuality and self-realization of personality⁷.

The aspiration of modern students to the most enthusiastic and joyful experiences in the course of any creative self-realization, derived from subconscious priorities of the goals and meanings of virtual reality⁸, far exceeds the expected positives in the future and the fruits of the vocational education received without interest.⁹ Interests, motives, significance, value, and with them the need for education increasingly manifests itself in the desire to realize themselves in an interesting personal life full of emotionally creative experiences with the joys of improvisation and overcoming, decisions and incarnations of self-expression instead of the monotonous professional service and maintenance of processes already existing and created by someone¹⁰.

Materials and methods

⁶ I.A. Kapitonov, I.V. Zhukovskaya, R.R. Khusaenov, V.A. Monakhov, "Competitiveness and competitive advantages of enterprises in the energy sector", in *International Journal of Energy Economics and Policy*, 2018, vol. 8, no. 5, p. 300-305.

⁷ E.L. Hasanov, V.D. Panachev, V.P. Starostin, A.G. Pudov, "Innovative approach to the research of some characteristics of choir scenes as culturology issue", in *Astra Salvensis*, 2018, vol. 6, no. 1, p. 749-759.

⁸ M.I. Danilova, G.M. Nikitin, "The phenomenon of "virtualization" of the world in modern society", in *Astra Salvensis*, 2018, vol. 6, no. 12, p. 661-663; G.B. Pronchev, D.N. Monakhov, N.G. Proncheva, A.P. Mikhailov, "Contemporary virtual social environments as a factor of social inequality emergence", in *Astra Salvensis*, 2018, vol. 6, p. 207-216.

⁹ S.S. Sheveleva, "On the Formation of a Synergetic Model of Education", 1997. Available at: <http://ecsocman.hse.ru/data/116/291/1218/013Shevelev.pdf>.

¹⁰ S.Yu. Razheva, "Search for New Architectural Ideas through Synaesthesia Effect", in *Arkhitektón: Izvestiya Vuzov*, 2006, no. 16, p. 3-9.

The main tasks of the research work of students are: ensuring integration of classes and the research work of students; creation of conditions for realization of personal creative abilities of participants of the research work of students; identification and selection of the most talented students for further study in the master's program and post-graduate study; formation of abilities for realization of the received results of scientific research work in practice; attraction of students to research on the most priority areas of science related to the needs of modern society, etc.¹¹ Research work of students is one of the most important and universally recognized ways of increasing the effectiveness of the educational process, which achieves the optimum result when mastering the skills of scientific research, collecting and systematizing the resulting material. Work with students begins in the first courses and is gradually complicated and achieves practical results of scientific research at graduating departments. In addition to research skills, research work in the first courses of study allows learning the features of the future profession and get acquainted with the latest and promising developments in the industry that are not included in the current training course¹².

Results and discussion

In this connection, the Department of Descriptive Geometry and Graphics conducts research work in the scientific student club "Modern Computer Graphics Technologies" on the prospective subjects of computer-aided design, 3D modeling, and design. The subject of research is determined by the scientific directions of the course "Engineering and Computer Graphics" and provides the necessary targeted use of CAD systems, AutoCAD, KOMPAS-3D. Students are offered topics on solid modeling, necessary in engineering, and in construction, as well as topics that use the engineering graphics course to develop creative and spatial thinking when executing projects in various graphics programs, such as Autodesk 3ds Max, Autodesk Maya, Z – brush, etc. To this end, research topics are developed in three categories of complexity, covering and

¹¹ O.V. Shubarо, "The System Approach in the Organization of Students' Research Work. Problems of the Organization of Educational Practices and Research Work of Students", in *Materials of VII Scientific-Methodical Conference of the Faculty of Philosophy and Sociological Sciences of BSU*, May 15-16, BSU, Minsk, 2010, p. 18-23.

¹² A.A. Feoktistova, V.A. Shabalin, "Creative Self-Realization of Students in Research Work. Investigation of Various Areas of Development of Psychology and Pedagogy", in *A Collection of Articles of the International Scientific and Practical Conference*, March 15–16, Ufa, 2017, p. 103-105.

providing all levels of creative and intellectual capabilities of students who according to their own interest choose their level of research.

The first level of research involves initial knowledge and creativity in the development of a model in the field relative to the interests of students. This level allows, without additional efforts and search, getting acquainted with the practical application of knowledge obtained in the training course by the example of solving the problem proposed as the goal of practical application of the results of the learning process. Depending on the interests and abilities, students choose the object of application of their creative abilities and receive all necessary information about the selected part, materials and dimensions, etc. Themes for the first level are selected in such a way that in the cognitive and playful form they easily proved themselves both as the goals of the educational process and the opportunities for achieving them in the form of the acquired ability to professionally solve the task. An example of such work can be modeling 3D assemblies in the basic AutoCAD package, presented in Figure 1.

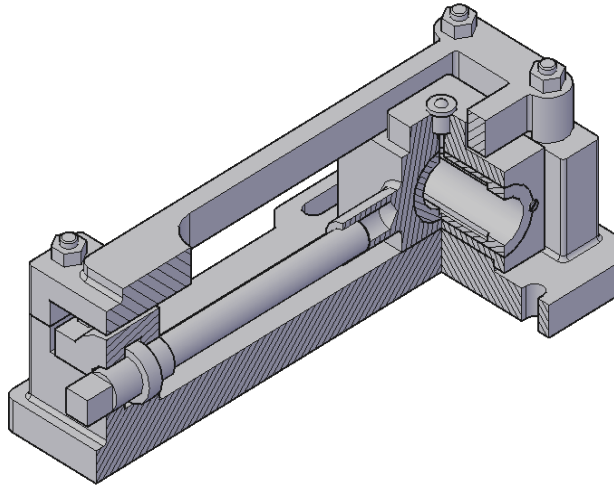


Figure 2: Modelling 3D assemblies in the basic AutoCAD package

The second level of complexity includes elements of self-realization of the individual in the creative use of the knowledge and skills obtained in the training course and provides the experience to independently expand the horizons of basic knowledge by the joint search and application of practical skills in solutions that are apparently simpler but more original ways of achieving the goal. This level is based on a deeper acquaintance with the technological process, its algorithms and tasks, therefore it expands the space and tools of creativity, including the latest

achievements of science and technology, the introduction of new materials and technologies. In the educational process, this level assumes knowledge and comparison of the optimal use of various graphic programs and modules in the process of achieving the goal, resulting in a creative consumer attitude to the toolkit and new developments.

At the same time, the student goes beyond the limits of the user, limited by the possibilities of the graphic program, and is included in the research process, independently choosing and evaluating the suitability of the toolkit for a more elegant and original solution. Figure 2 shows a 3D model made in KOMPAS-3D, independently selected by the students from the programs proposed by the manager.

The third level of complexity, the fewest one, offers students the task of improvisation, both in the means of achieving the goal, and in shaping it, reducing the creative process to the solution of any even hypothetically solved and applied tasks, the development within which is the purpose of using the results of knowledge and skills of scientific research obtained in the educational process. The third level contains the features and properties of fundamental research as much as possible, therefore it requires the maximum development of own creative abilities by the student himself in using graphic programs that are ideally suited for this purpose. The third level sets the goal, not indicating either the methods of instrumental execution nor the form and properties of the final result, which the student needs to find and develop himself.



Figure 2: 3D model made in KOMPAS-3D

This goal trains and cultivates the research abilities to search for the optimal use of the given properties of the modeling object, giving the

author the status of the developer and the performer in solving the prospective task found. The third level provides maximum opportunities for self-expression for those who find and plan self-realization in the chosen profession. Figure 3 shows a project performed by students in the ALLPLAN program using elements of BIM-technologies.

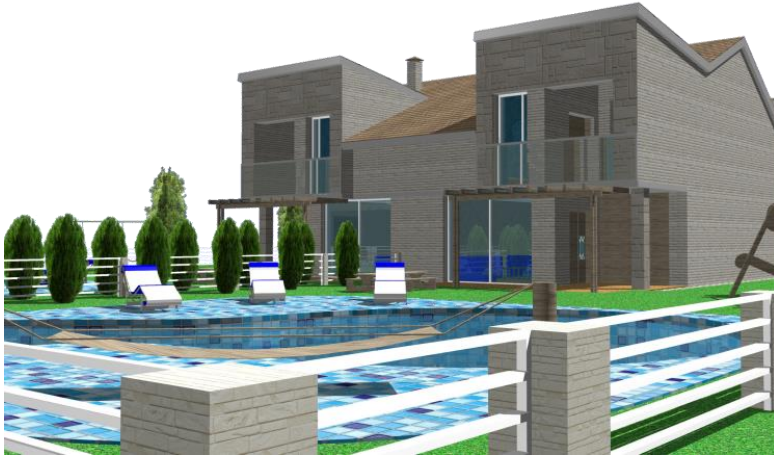


Figure 3: The project performed by students in the ALLPLAN program using elements of BIM-technologies

All three levels of complexity of the research work of students ensure understanding and self-determination of students in the formation of their main scientific and practical interests and research opportunities, broaden their horizons, train mental and professional mobility, learn to navigate independently in the streams of scientific and technical information, establish the relationship of the taught disciplines with professional opportunities and perspectives. In this regard, in the scientific student club, on all three levels of complexity, group work on a research topic is preferred, teaching researchers to cooperate in achieving the goal and independently redistributing the individual load¹³. "This approach to learning within the framework of graphic disciplines is synergetic, involving in interpersonal interaction and encouraging individual, perhaps not yet revealed, abilities of the student; it teaches dialogue with oneself, searching not only for ones own ways of solving the task posed, but also

¹³ L.I. Eremina, "Formation of Students' Creativity in Joint Creative Activity", in *Modern Problems of Science and Education*, 2013, no. 2, p. 4-9.

for synergetic interaction in collective"¹⁴. The synergetic approach suggests that teaching students in a university should go beyond the conventional model.¹⁵ That is, "methods and techniques should be based on previous experience of students, on the integration of various concepts and practices, on the transfer of knowledge in the field of various disciplines into the baggage of new professional information"¹⁶.

The head of the scientific student club, in addition to encouraging and stimulating the cognitive activity of students, must skillfully organize and direct research work, leading to a positive result and achieving the goal, which is provided by constant monitoring and self-control. The reliability of research results is one of the most important elements of the research work of students and therefore the results are compared at all stages of the work¹⁷. Usually this is a step-by-step control, which helps to avoid replicating errors and save time. Great importance in achieving the goals of research work of students is conducting academic competitions and participation in conferences of various levels on topics close to the objectives of the research work¹⁸.

At the Department of Descriptive Geometry and Graphics, academic competitions on disciplines "Descriptive Geometry", "Computer Graphics" and a scientific and educational student conference on graphics disciplines are held annually. Analysis and discussion of the results of academic competitions and conferences in an unconstrained creative environment broadens the outlook, stimulates the search for original solutions, teaches an understanding of erroneous and useless directions, and the exchange of ideas and opinions forms a culture of communication in solving a common problem, teaching the skills of professional teamwork. The research work of students, having scientific

¹⁴ A.A. Feoktistova, N.I. Krasovskaya, "Creative Component in the Educational Process", in *Higher Education Today*, 2016, no. 10, p. 34-36.

¹⁵ I.N. Kuznetsov, *Fundamentals of scientific research: a manual for bachelors*, Publishing Trade Corporation "Dashkov and Co", Moscow, 2013.

¹⁶ A.V. Gvozdeva, Kh.Kh. Naing, "Synergetic Approach to Teaching Methods", 2015. Available at: <http://cyberleninka.ru/article/n/sinergeticheskiy-podhod-k-metodam-obucheniya>.

¹⁷ V.V. Moroz, "Axiological Resource of Using Information Technologies for the Development of Students' Creativity", *Vestnik Orenburgskogo Gosudarstvennogo Universiteta*, 2015, vol. 176, no. 1, p. 53-59.

¹⁸ I.A. Kapitonov, I.V. Zhukovskaya, R.R. Khusaenov, V.A. Monakhov, "Competitiveness and competitive advantages of enterprises in the energy sector", in *International Journal of Energy Economics and Policy*, 2018, vol. 8, no. 5, p. 300-305.

and practical importance and carried out at a high level, are recommended for publication¹⁹.

Modern research work of students unambiguously witnesses the shift of educational motives of students from every day to the field of personal creativity, and creatively active students in accordance with the Pareto principle determine 80% of the effectiveness of the entire educational process. Therefore, in order to preserve the effectiveness of education at the essential level, in the near future there will be a need to develop teaching methods that take into account and are based on motives for personal self-expression in the learning process. On the other hand, the transformation of society into the information society radically changes the attitude towards scientific and technological progress. Modern students perceive it as an instrumental attachment to self-actualization, and not as a professionally necessary tool that relieves from the heavy, emotionally empty mechanical and monotonous activity in the implementation of the solution. However, in the educational system the potential of information technologies remains not fully understood.

Therefore, the goal of learning from the knowledge and professional skills of using graphic computer programs shifts to self-expression in an interesting and creative pas-time. Modern students have little interest in the power, possibilities and achievements of technological progress, which has become ordinary and familiar and long surpasses all the necessary needs for domestic and creative use. Therefore, the study of graphic programs as a professional tool itself only for educational purposes when studying the course of engineering and computer graphics passes to the field of inefficient educational efforts without the use of innovative technologies that reveal the personal creativity of students. That is why "modern education should ensure the integration of various ways of its development and thereby increase the creative potential of a person for free and meaningful actions".

In the process of students' research work, there are growing contradictions between the new educational motivations and their artificial limitations, previously significantly contributing to the increase of competence and the quality of education. Synaesthesia in the educational process which fosters and gathers the resources of education in the single goal of the competence paradigm, enters insoluble contradictions with personal creativity, artificially restricting the areas of its expression, and

¹⁹ A. Sailaukyzy, R. Shakuova, K. Sak, T. Lebedeva, "Contemporary view to the history of Kazakhstan's democratic journalism and publicism", in *Opcion*, 2018, vol. 34, no. 85-2, p. 825-849.

anonymously subordinating the objectives of competence, and consequently reduces the creative life of the individual, deforming personal interests and knowledge in a highly specialized area, which, as a rule, has almost no creative space for self-expression. For this reason, students of technical specialties prefer subjects of visualization outside their specialties, which are of interest for communication.

Current rates of scientific and technological progress very quickly turn synaesthesia into a means of intensifying learning, reducing horizons and personal space. Therefore, the most adequate response to the new motivation of creatively gifted students is the introduction of methods of synergy and synergetics in the research work of students, revealing and culturally connecting the creative potentials of individuals without deforming them. From the point of view of synergetics, education is "a complex social organism whose main functions are reproduction of experience accumulated in culture and creation of conditions for its purposeful change".

Personal creativity of a specialist uses education as an instrument of self-expression, but by nature does not depend on ways and places of self-expression, surpassing everything, thanks to the abundance of technical and production solutions of the information society. Thus, one of the ways to improve the effectiveness of education is the use of universal creative technologies in the learning process to develop skills and competencies in self-expression and self-realization of the individual. Acquisition of scientific knowledge, willingness and ability of students to conduct independent re-search is an objective prerequisite for the successful solution of scientific and education-al problems.