DOI 10.15276/imms.v15.no4.469
UDC 378.12

Informatics and Mathematical Methods in Simulation
Vol.15 (2025), No. 4, pp. 469-474

# AN ANALYTICAL REVIEW OF METHODS FOR IMPROVING THE QUALITY OF GRAPHIC TRAINING FOR STUDENTS AND A COMPUTER-INTEGRATED MODEL OF A CRITERIA-BASED ASSESSMENT SYSTEM

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In the modern conditions of development of the higher education system, graduates are required not only to have knowledge, skills and abilities in professional activities. The professionalism of future specialists in engineering or creative specialties is determined by their theoretical and practical skills acquired during their studies, among which the most important are the ability to imagine, analyze, and synthesize any object. The importance of graphic disciplines for the professional training of engineers, architects, and designers is fundamentally important because they expand the individual capabilities of future specialists. In our opinion, one of the current problems in teaching leading graphic disciplines is the insufficient number of hours allocated to their study, the incomplete availability of the necessary material resources, including computer classrooms, which is currently quite relevant, etc. Knowledge is acquired more firmly when students understand why it is needed and where it can be applied. In recent years, the range of tasks that can be solved using graphic methods has expanded significantly, and accordingly, the role and importance of graphic disciplines that lay the foundations for spatial perception and form key graphic competencies has increased. In this regard, it is important to increase students' motivation and interest in the learning process and raise awareness of the need for high-quality graphic education, which is a guarantee of success in future professional activities. The article discusses ways to improve methods for enhancing the quality of graphic training for students in technical and creative specialties. The main objective of our study is to provide an analytical overview of methods for improving the quality of education and to summarize the results of monitoring the characteristics of the formation of practical graphic competencies of junior students majoring in construction and architecture. The work uses theoretical and empirical methods: analysis, classification, and generalization of the source base of the study; diagnosis of students' classroom graphic works with timing of their homework. Based on statistical data, the authors developed a computer-integrated model of a criteria-based system for evaluating graphic works, which was implemented in the educational process.
**Keywords:** graphic disciplines, criteria system, graphic competencies, junior students of engineering and creative specialties

**Introduction.** The increase in quality requirements for higher education institutions is directly related to the need to achieve results in priority areas of science and technology development at the present stage. In recent years, the range of tasks solved using graphic methods has expanded significantly, hence the relevance and priority of high-quality graphic training for future specialists. Problems remain unresolved in improving methods for enhancing the quality of education and differentiated approaches to the organization of the educational process as a whole, especially with regard to independent work by students, separately by specialty, etc. Modern education is actively transitioning to digital formats, which necessitates the creation of parallel computer systems for distance learning, testing and knowledge assessment, and conducting various student surveys. The formation of professional graphic competencies of future specialists is impossible without a thorough study of the basics of graphic literacy,

therefore, the improvement of the skills and elements of graphic culture of first-year students begins from the first semester.

**Problem statement**. Graphic disciplines for junior students of engineering and creative specialties are the first professionally oriented disciplines that contribute to the acquisition of graphic skills and independence in self-education. It should be emphasized that the success of future specialists is determined not only by knowledge and skills, but also by the degree of development of their graphic competencies. In this sense, from our point of view, aspects of research and improvement of methods for improving the quality of professional graphic training of students of various specialties play an important role.

**Analysis of resent research and publications.** The problems of graphic training and improving its quality in higher education have been considered by many researchers [1, p. 103–113; 2, p. 202–205; 4, p. 354–360; 8; 10, p. 317–325, etc.]. The authors of these works, representing the Kyiv, Odesa, and Kharkiv schools of training specialists in engineering and creative professions, emphasize that higher education institutions periodically reduce the duration of basic graphic disciplines, but the requirements for students to develop the relevant graphic skills are increasing. And if the basics of graphic literacy are not taught in schools, i.e., there is no “Drawing” subject, then, according to teachers, the necessary initial theoretical and practical knowledge and skills must be learned independently by students. Scientists emphasize that teaching graphic disciplines is the most effective means of mastering and developing spatial thinking [3, p. 17–21; 5, p. 110–116; 7, p. 215–227, etc.]. The content of specialized graphic disciplines for future specialists, in accordance with the requirements of the program, clearly defines the educational aspects, content of specialized knowledge, skills, and sustainable competencies that students must acquire during a certain period of study, as discussed in many sources [4, p. 354–360; 6, p. 60–68; 9, p. 175–180; 11, p. 326–331, etc.]. These publications suggest paying attention to the timely development of basic graphic competencies of applicants in higher education.

**The purpose of the article**. As is known, drawing is an international graphic language. Creating flat images of spatial objects and reading them requires students to develop spatial imagination already in the first year of study, so high-quality graphic training is a pressing problem. The result of the work is a critical analysis of the statistical source database and the development of an author's computer-integrated model of a criterion-based system for assessing students' knowledge, which was tested in the educational process.

**Main materials.** The graphic competence of students for the specialties under consideration emphasizes the need for personal development in the context of training in modern higher education institutions, i.e., the emphasis has shifted to skills rather than just theoretical knowledge, which is a very important factor, especially in distance learning. It should be noted that research into the development of spatial thinking and representation in students using visual aids from the point of view of developing professional graphic competence is a rather interesting topic. In our opinion, clarity is an essential factor in the sustainable assimilation of educational material, therefore, studying the forms of simple geometric figures (prism, pyramid, cone, cylinder, sphere) contributes to the accumulation in students' memory of graphic primitives, which allow them to create graphic models in the future. The basic graphic discipline for students of engineering and architecture is "Descriptive Geometry." Its founder, the French geometer Gaspard Monge, emphasized that this science has two main goals: 1 - the ability to accurately represent three-dimensional spatial objects on a drawing, that is, on a plane that has only two dimensions. From this point of view, it is a graphic language that an engineer, architect or designer needs to create his projects; 2 it is a means of searching for truth, of finding possible ways of transition from the unknown to the known. This science is suitable not only for developing intellectual individual abilities. The goal of the discipline is also to develop abstract and logical thinking, spatial imagination, and the ability to analyze and synthesize

spatial forms and relationships based on graphic models of space, which are practically implemented in the form of drawings.

The experimental basis of our study (Table 1) consists of the results of the authors' observations in the process of teaching graphic disciplines at the Department of Descriptive Geometry and Engineering Graphics to first- and second-year students of engineering and architectural specialties at the Odesa State Academy of Civil Engineering and Architecture - OSACEA (86 students) and at the Department of Information Technologies of Planning and Design of the National University "Odesa Polytechnic" for first-year students majoring in construction and design (46 students). Group I consisted of first-year students majoring in engineering at OSACEA, group II consisted of first- and second-year students majoring in architecture at OSACEA, and group III consisted of first-year students majoring in construction and design at "Odesa Polytechnic". A comparison of the results shown in the table and our teaching experience shows that, first, student attendance in the classroom is very important for academic success, especially in the first year. Secondly, student attendance at consultations in the second year is significantly lower, but academic performance is still higher due, in our opinion, to an increase in their motivation to study.

**Table 1.**

Statistical indicators of the source base

| No. of groups | Number of students | Attendance at classroom classes | Attendance at consultations | Average grade point (out of 100 points) | Notes |
|---|---|---|---|---|---|
| I | 26 | 90% | 80% | 85 | |
| II | 60 | 85% | 60% | 88 | |
| III | 46 | 70%)* | 50% | 75 | * only online |
| Total | 132 | | | | |

During the study of graphic disciplines, students learn methods for constructing images of spatial objects on a plane, the rules of visual reproduction and reconstruction of the shape of a spatial object using logical analysis, that is, this is visual activity. It should be emphasized that, as a rule, first-year students who lacked pre-university graphic training immediately show an insufficient level of certain graphic knowledge, skills, and abilities.

For a positive solution to the problem of successful graphic training of students, a clear organization of individual and independent work is required at the initial stage of training, which will be aimed at developing the individual functions of the student's eye, his observation and perception skills. It can be argued that to improve results, it is necessary to use individual differential methods in each group separately, depending on the initial level of graphic training (Table 2).

The quality control system included two stages: 1 - mandatory ongoing verification of theoretical knowledge, high-quality performance of graphic tasks and their timely submission to the teacher; 2- final control (semester).

**Table 2.**

Characteristics of differentiated student success criteria

| No.of groups | Number of students | Theoretical material test (score out of 100 points) | Evaluation of drawings according to requirementso ut of 100 points) | Timeliness of assignment submission (%) | Coefficient success **k** | Notes |
|---|---|---|---|---|---|---|
| I | 26 | 75 | 70 | 65% | 0.79 | * |
| II | 60 | 80 | 75 | 75% | 0.84 | ** |
| III | 46 | 60 | 65 | 45% | 0.80 | *** |

*OSACEA, engineering majors, first year. **OSACEA, , architectural specialties, first and second years. *** "Odesa Polytechnic", first year. ***k*** – relative characteristic of the results of the final control/

One of the methods of improving the quality of education, as tested by the authors, is systematic control of knowledge through written and oral surveys. In the process of performing graphic tasks, it is necessary to constantly update them thematically, which significantly affects the formation and development of skills and graphic abilities in motivated students, and, from the point of view of didactics, such an approach will contribute to the faster achievement of the required level of quality in mastering.

Throughout the year, all methods of ongoing assessment were used in the educational process: oral tests, assignments, tests, and exams, which ensured a fairly objective assessment of students' knowledge and graphic skills.

Based on empirical data collected over many years, a computer-integrated model of a criterion-based knowledge assessment system was developed and tested for implementation in the educational process (Table 3). The main task of the model is aimed at developing students' interest and increasing their motivation for learning, introducing healthy competition in learning, and identifying and developing creative abilities.

**Table 3.**

Generalized criterion-based assessment of student performance

| No. of groups | Number of students | Integrated current characteristic (score out of 100 points) | Average student rating (out of 10 points) | Final score (out of 100 points) | Notes |
|---|---|---|---|---|---|
| I | 26 | 75 | 7 | 82 | * |
| II | 60 | 80 | 8.5 | 75% | ** |
| III | 46 | 60 | 6 | 45% | *** |

*OSACEA, engineering majors, first year. **OSACEA, , architectural specialties, first and second years. *** “Odesa Polytechnic”, first year

All this creates the basis for the development of sustainable graphic literacy and creative opportunities in performing graphic tasks (term papers, course and diploma projects) of other disciplines, as well as in future professional specialties. Tables 2 and 3 show the results of statistical data processing obtained by the authors in comparison with expert assessments of other teachers.

**Conclusions.** Developing the skills and abilities of each motivated student who feels the presence of competition and is interested in deeper mastery of theoretical material, as well as high-quality graphic competencies, are the main methodological tasks in the creative educational process. The development of skills and abilities of every motivated student who feels the presence of competition and is interested in a deeper learning of theoretical material and high-quality graphic competencies are the main methodological tasks in the creative educational process. The final analysis of the results of the research and monitoring of the quality of students' graphic training clearly showed that high-quality study of graphic disciplines is possible on the basis of an integrated approach to the educational process. Our many years of experience show that junior students can gain deeper knowledge only with high motivation, systematic individual work, and obtaining more detailed knowledge independently. Thus, the graphic competencies acquired in the process of studying descriptive geometry will allow you to realize your creative potential in a wide variety of directions. The results of the research were tested and corrected in the educational process, which suggests the development of this topic in the future

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# АНАЛІТИЧНИЙ ОГЛЯД МЕТОДІВ ПІДВИЩЕННЯ ЯКОСТІ ГРАФІЧНОЇ ПІДГОТОВКИ СТУДЕНТІВ ТА КОМП'ЮТЕРНО - ІНТЕГРОВАНА МОДЕЛЬ КРИТЕРІАЛЬНОЇ СИСТЕМИ ОЦІНОК

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У сучасних умовах розвитку системи вищої освіти від випускників вимагаються не лише знання, вміння та навички у професійній діяльності. Професіоналізм майбутніх спеціалістів інженерних або творчих спеціальностей визначається їхніми теоретичними та практичними навичками, набутими під час навчання, серед яких найважливішими є здатність уявляти, аналізувати та синтезувати будь-який об'єкт. Важливість графічних дисциплін для професійної підготовки інженерів, архітекторів і дизайнерів є фундаментальною, оскільки вони розширюють індивідуальні можливості майбутніх фахівців. На нашу думку, однією з актуальних проблем у викладанні провідних графічних дисциплін є недостатня кількість годин, відведених на їх вивчення, неповна наявність необхідних матеріальних ресурсів, у тому числі комп'ютерних класів, що є досить актуальним на сьогоднішній день, тощо. Знання засвоюються більш міцно, коли студенти розуміють, навіщо вони потрібні і де можуть бути застосовані. В останні роки значно розширився спектр завдань, які можна вирішити за допомогою графічних методів, і, відповідно, зросла роль і значення графічних дисциплін, що закладають основи просторового сприйняття та формують ключові графічні компетентності. У зв'язку з цим важливо підвищити мотивацію та зацікавленість студентів у навчальному процесі та усвідомлення необхідності якісної графічної освіти, яка є запорукою успіху в майбутній професійній діяльності. У статті розглядаються шляхи вдосконалення методів підвищення якості графічної підготовки студентів технічних та творчих спеціальностей. Основною метою нашого дослідження є надання аналітичного огляду методів підвищення якості освіти та узагальнення результатів моніторингу особливостей формування практичних графічних компетентностей студентів молодших курсів, які спеціалізуються на будівництві та архітектурі. У роботі використовуються теоретичні та емпіричні методи: аналіз, класифікація та узагальнення джерельної бази дослідження; діагностика графічних робіт студентів у класі з урахуванням термінів виконання домашніх завдань. На основі статистичних даних авторами розроблено комп'ютерно-інтегровану модель критеріальної системи оцінювання графічних робіт.

**Ключові слова**: графічні дисципліни, критеріальна система, графічні компетентності, студенти молодших курсів інженерних і творчих спеціальностей