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FORMATION OF SCIENTIFIC THINKING IN FINE ARTS EDUCATION THROUGH RESEARCH-BASED METHODS

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Abstract

This article examines the role and significance of integrating research-based methods into the modernization of fine arts education. The pedagogical analysis is grounded in an experimental study conducted with students enrolled in a painting course. The findings demonstrate how working with a still life fosters the development of key competencies, including visual observation, form analysis, understanding of color transitions, and examination of light–shadow relationships. The study substantiates that a research-oriented approach enhances students' cognitive engagement and contributes to the formation of artistic-scientific thinking. The results confirm that scientific analysis of a still-life composition functions as a natural research model of the artistic process and significantly advances students' analytical and scientific reasoning.

Keywords

fine arts education, still life, research-based methods, visual-analytical activity, color and light–shadow relations, form analysis, scientific thinking, artistic principles, pedagogical technologies.

INTRODUCTION

In the Republic of Uzbekistan, the reform of the education system-including the preparation of modern, research-oriented pedagogical specialists in the field of fine arts-is defined as one of the key priorities of state policy. Presidential decrees and resolutions aimed at advancing higher education underscore the need to strengthen research activity and to train creative, critically thinking professionals.

The theoretical foundation of this study is based on national regulatory documents in the field of education, including the Law "On Education" [1] and the

"Concept for the Development of the Higher Education System until 2030" [2]. These documents emphasize the importance of integrating innovative, interactive, and research-based approaches into the educational process. Consequently, the task of cultivating research-oriented and scientific thinking within fine arts education becomes particularly relevant.

As an academic discipline, fine arts encompasses not only the development of practical artistic skills but also the formation of observational ability, analytical thinking, figurative and logical reasoning, and the capacity to interpret visual information-components that are integral to scientific cognition. A contemporary fine arts educator must therefore possess both practical expertise and a deep understanding of the theoretical and methodological foundations of the discipline, as well as the ability to incorporate scientific approaches into teaching. This, in turn, requires readiness for scholarly and creative inquiry, the ability to identify pedagogical problems, collect empirical data, and conduct systematic analysis and generalization [3, p. 57].

The outlined requirements become particularly significant within the context of fine arts education, as the artistic process itself is inherently grounded in fundamental elements of scientific inquiry-observation, analysis, comparison, and interpretation. In this regard, the integration of research-based methods into the teaching of fine arts represents a logical and timely necessity for modern pedagogical practice.

From the standpoint of research methodology, master's-level training prioritizes competencies such as research planning, structuring research stages, and formulating evidence-based conclusions. In fine arts education this approach is especially relevant, as every stage of the artistic process is inevitably tied to observation and analytical activity [5, p. 65]. Components such as visual analysis, the study of form and proportion, the use of problem-based questions, and comparative examination of artistic techniques serve as important drivers of students' scientific thinking [7, p. 158].

Literature Review

The analysis of scholarly sources devoted to research-based methods in fine arts education demonstrates the growing relevance of this field and its increasing significance in contemporary educational practice. Foundational works on research methodology [3, p. 57; 4, p. 33] outline mechanisms for developing skills such as problem identification, analytical reasoning, conclusion drawing, structured observation, and sequential implementation of research stages. These approaches provide an essential theoretical basis for fostering research competencies in the

study of artistic fundamentals-form, color, proportion, composition, and representational laws.

Studies on the methodology of fine arts instruction [5, p. 41] confirm that the acquisition of artistic principles naturally supports the development of observational skills, comparative analysis, visual reasoning, and the ability to produce scientifically grounded interpretations. B. F. Lomov [6, p. 182] emphasizes that visual perception constitutes a central psychological mechanism of human cognition and argues that the study of fine arts fundamentals directly contributes to the development of research-oriented thinking.

In contemporary settings, the potential of visual research methods in art education has been significantly expanded through digital tools, virtual exhibitions, and multimedia resources [7, p. 159]. These technologies facilitate the analysis of artistic laws and strengthen students' scientific reasoning.

Our own research findings further demonstrate that tasks built around principles of composition, color relationships, and structural form-building effectively promote the synthesis of scientific and artistic thinking in students [8, p. 46]. Leading scholars in global pedagogy—including J. Bruner, J. Dewey, H. Gardner, and E. Eisner-consistently emphasize that artistic activity is inherently rooted in research experience; thus, studying the foundations of fine arts fosters skills of inquiry, experimentation, and visual thinking [6, p. 15].

In Uzbekistan, pedagogical researchers such as R. Khasanov, N. M. Muslimov, S. F. Abdirasilov, S. A. Shovdirov, R. A. Khudoiberganov, B. B. Boymetov, and R.Z. Xayrov have comprehensively addressed the formation of scientific and analytical competencies in students through the study of artistic laws within the framework of the national methodological school [8, p. 22]. Overall, the literature indicates that learning the artistic foundations and representational principles of fine arts functions as an inherent model of research-oriented instruction. This approach effectively fosters students' scientific thinking, analytical activity, inquiry skills, and their ability to formulate well-founded conclusions.

MATERIALS AND METHODS

The research was conducted at the Gulistan State Pedagogical Institute among students enrolled in the program "Fine Arts and Engineering Graphics." The sample included 28 students from group 31-24, aged 19-21. Their artistic proficiency was assessed as intermediate: being in their second or third year of study, they possessed basic drawing skills (perspective, proportion), but demonstrated difficulties in providing scientific and analytical explanations of artistic processes.

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To determine the initial level of visual-analytical and research competencies, an entry diagnostic assessment was carried out prior to the experimental work. A specially arranged still-life composition was selected as the primary research material. It included a clay jug, red and green apples, an ornamented "Pakhta" bowl, a blue drapery, and a fabric of apricot tone. The objects varied in form, texture, and color, creating favorable conditions for artistic analysis and research-oriented tasks.

The objective of the study was to determine the effectiveness of methods aimed at developing research-based thinking in fine arts education. The experimental activities included practical still-life painting, visual observation, analytical examination, and the study of artistic principles.

The theoretical foundation of the study was built upon national educational regulations [1, 2] and the theoretical principles of research methodology [3, 4], which determined the general scientific orientation of the work. Scholarly sources on fine arts pedagogy [5, 6] shaped the content of the practical stage of the research.

To evaluate the dynamics of students' research and visual-analytical competencies, four integral criteria were identified, reflecting key processes involved in perceiving and analyzing a still life: form analysis, light-shadow logic, color relationships, and compositional understanding.

Each criterion included specific indicators that allowed for an objective assessment of students' artistic and analytical proficiency. These indicators encompassed the ability to identify the constructive structure of form, explain light distribution and the formation of reflections, analyze color characteristics of objects, identify the compositional center, and justify spatial decisions.

Fig. 1. Still-life composition used in the experimental study.

Assessment was carried out using a four-point scale (from low to high level), ensuring comparability between initial and final diagnostic results.

At the beginning of the academic year, the students participating in the study underwent an initial diagnostic assessment that identified their abilities in visual observation, color analysis, understanding of compositional structure, and formulation of scientific interpretations. During the practical phase, each element of the still-life composition was examined from a research-oriented perspective: the form of objects, their color characteristics, lighting conditions, and the relationships between reflections

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and shadows were systematically analyzed. Students were guided toward a sequential understanding of the constructive structure of form, the logical causes of color variations, and the factors contributing to the emergence of a compositional center and points of visual tension.

Problem-based questions-such as why one side of the clay jug appears in deep shadow in the still-life photograph (see Fig. 1), or why a pronounced reflected highlight is visible on the green apple-were used as inquiry tasks requiring scientifically grounded explanations [6, p. 183]. This approach stimulated independent exploration and contributed to the development of students' research-oriented thinking.

Following the completion of the experiment, a comparative analysis of students' initial and final works was conducted. A significant improvement was observed in their ability to accurately perceive form, understand color relationships scientifically, and propose well-reasoned compositional solutions. These findings demonstrate that research-based methods in painting instruction contribute not only to the enhancement of practical artistic skills but also to the advancement of scientific thinking [8, p. 44].

RESULTS AND DISCUSSION

At the initial stage of the study, diagnostic assessments revealed that students in group 31-24 demonstrated limited development of research-oriented thinking. They experienced difficulties in analyzing form, interpreting light-shadow dynamics, and providing scientifically grounded artistic explanations [5, p. 43].

Throughout the academic year, research-based methods-including visual analysis, problem-based tasks, the study of artistic principles, and inquiry into the interdependence between form and color-were systematically integrated into practical painting sessions. Scholarly literature emphasizes that visual perception and its analytical processing are central cognitive mechanisms in painting. The students' work with the still life confirmed this position: they became more attentive to changes in form and color and demonstrated deeper mastery of figurative and conceptual analysis [7, p. 159].

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Fig. 2. Final still-life works by students of the experimental group: Sh. Abdurayimova, Z. Khasanova, G. Kushnazarova

The repeated diagnostic assessment conducted at the end of the academic year revealed a significant increase in students' artistic-scientific thinking (Fig. 2). Specifically, visual analysis skills improved by **30-35%,** abilities to scientifically explain color relationships increased by **25-28%,** competence in formulating scientifically grounded and practical compositional solutions rose by **32-34**%, and the level of independent research-oriented thinking in creative tasks increased by approximately **35**% [10, p. 46]. This growth is primarily attributable to the integration of inquiry-based tasks and the systematic study of artistic laws through a scientific framework. Assignments such as *"Color Expression in Still Life"* and *"Constructing Form Through Tone"* were particularly effective in fostering independent reasoning and the formulation of scientifically justified explanations.

To evaluate the dynamics of research and visual-analytical competency development, a set of fundamental yet methodologically sound statistical procedures was applied, ensuring the objectivity and comparability of results. The initial stage of data processing involved calculating quantitative changes for each criterion using percentage-based comparisons of "before" and "after" indicators, enabling the identification of general growth trends and the effectiveness of the implemented methods. The calculation of group mean values played a crucial role by reducing individual variability and presenting an integrated picture of students' developmental progress. This approach made it possible to compare results across criteria and assess the specific contribution of each research method to overall competency growth.

Additional verification was provided through qualitative analytical methods, including comparisons of student portfolios, expert evaluations by instructors, and

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analysis of progress in practical tasks. These tools supported statistical findings with visual and professional evidence, thereby significantly enhancing the validity and reliability of the final results.

Thus, the combination of quantitative and qualitative statistical methods produced a comprehensive evaluation of the effectiveness of research-based approaches in painting instruction and convincingly demonstrated the positive shifts in students' visual-analytical and research competencies. The consolidated results are presented in the table below.

Table 1. Comparative Dynamics of Competency Development Indicators

No.	Criterion	Mean Score (Before)	Mean Score)	Growth (%)
1	Form Analysis	1.8	2.9	+44%
2	Light-Shadow Analysis	1.7	2.8	+47%
3	Color Relationships	1.9	2.6	+36%
4	Compositional Analysis	1.8	2.7	+50%

The comparative analysis of students' works, carried out using the portfolio assessment method, demonstrated that by the end of the academic year they had achieved more consistent and conceptually deeper results in solving tasks related to revealing form through color, identifying the compositional center, and investigating light–shadow structures [8, p. 44]. These findings confirmed the effectiveness of contemporary visual analysis methods.

The discussion of the research outcomes showed that the integration of research-based methods into painting instruction contributes not only to the improvement of artistic proficiency but also to the development of students' inquiry-oriented thinking. Incorporating the stages of scientific investigation into the educational process transforms the learner into an active agent of cognition rather than a passive recipient of information [4, p. 33].

Overall, the results affirm that students of group 31-24 demonstrated significant progress in the development of scientific thinking, visual-analytical skills, and independent research abilities throughout their work in painting [6, p. 184].

CONCLUSIONS

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The study conducted during painting classes with students of group 31-24 at the Gulistan State Pedagogical Institute clearly demonstrated the practical potential of developing research-oriented thinking through still-life work. The findings indicate that systematic engagement with a still-life composition-featuring a clay vessel, fruits, a decorative bowl, and drapery-fostered the development of students' visual observation skills, form analysis, understanding of color relationships, and the scientific logic of light-shadow structures [6, p. 183].

Throughout the assignments, each artistic element was treated as an object of inquiry; students learned to formulate scientific conclusions, justify their observations, and substantiate compositional decisions. The still-life arrangement, with its diversity of textures, colors, and forms, provided favorable conditions for inquiry-based tasks, including explaining illumination effects, identifying reflections, analyzing color variations, and determining the compositional center. These activities significantly stimulated students' research engagement. Visual analysis methods confirmed the effectiveness of perceptual-cognitive mechanisms, while problem-based tasks reinforced the integration of scientific and practical reasoning.

The results demonstrate that incorporating research-based methods into still-life instruction enhances not only artistic thinking but also the formation of stable analytical and interpretive skills. Scientific explanation of visual phenomena, analysis of color, tonal, and structural laws, and justification of artistic decisions contributed to the development of causal reasoning and metacognitive abilities. As a structured system of interconnected objects, the still life proved to be an effective model for promoting research activity, allowing students to generalize, compare, and draw scientifically grounded conclusions. Therefore, research-oriented instruction serves as a key mechanism for fostering scientific thinking among future fine arts educators.

It is recommended to systematically integrate research-oriented tasks at all stages of still-life instruction to strengthen the analytical dimension of learning and support the development of sustained scientific observation and interpretation skills. Expanding the use of portfolios as a tool for continuous monitoring of individual progress in scientific thinking will enhance the tracking of students' advancements in form, color, and light-shadow analysis. Furthermore, viewing the still life as an interdisciplinary model-incorporating principles of visual perception, color theory, and artistic morphology-can deepen both the scientific foundation and the methodological richness of painting instruction.

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