An Integrated EdTech Framework for Teaching Graphic Art Courses to Future Art Educators

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***Abstract*—This exploratory pilot study examines how an integrated EdTech framework combining traditional art pedagogy, Artificial intelligence (AI)-enhanced digital tools, and Project-Based Learning (PBL) may support the preparation of future art educators. The approach responds to growing demands for hybrid creative competencies as digital transformation reshapes visual communication and teaching practices. A mixed-methods quasi-experimental design was implemented with 13 graduate students from two Kazakhstani universities. Data were collected through pre/post-tests, surveys, and interviews. Quantitative results provide preliminary evidence of improvements in creativity (+21.5%), digital competence (+27.8%), and pedagogical readiness (+20.7%), supported by large effect sizes within this pilot sample. Qualitative findings revealed increased motivation, self-efficacy, and reflective thinking, confirming the benefits of combining analog and digital art-making processes. The findings suggest the potential of the integrated framework for combining traditional craftsmanship and digital innovation in graphic art teacher education, while highlighting the need for further large-scale validation. The study offers practical implications for curriculum modernization, instructional design, and teacher professional development, particularly in resource-limited higher education contexts. It also aligns with global agendas such as UNESCO Education 2030, emphasizing the need for digital literacy, creativity, and adaptive pedagogy in teacher education. The findings highlight the potential of AI-supported methodologies to enhance both artistic learning and pedagogical readiness.**

***Keywords*—integrated methodology, graphic art education, future teachers, project-based learning, digital pedagogy, Artificial intelligence (AI)-enhanced art instruction, creativity; teacher preparation**

I. Introduction

Education, as one of the fundamental pillars of human development, is inseparably linked to the processes of creation, learning, and cultural transmission [1]. Since the earliest forms of human organization, teaching and learning have been vital mechanisms for transferring experience, fostering creativity, and shaping social progress. Behavioral science theorists affirm that learning represents a relatively permanent change in behavioral capacity as a result of experience—continuously passed to future generations through educational systems [2]. Thus, the foundations of education are not merely cognitive but also deeply social, ethical, and creative in nature.

Recent research on Artificial intelligence (AI)-supported art education demonstrates increasing alignment between digital pedagogy, visual communication, and teacher preparation [3, 4]. These studies show that hybrid creative practices play a central role in developing future teachers' competencies, thus reinforcing the relevance of integrated methodologies in graphic art instruction.

Within this philosophical and pedagogical context, graphic art education holds a unique position. Teaching graphic arts, as a creative and dynamic discipline, requires innovative and efficient methodologies capable of transferring both artistic sensibility and technical proficiency to future teachers [5]. In today' s rapidly evolving world—where digital technologies and media continuously reshape modes of creation and communication—traditional studio-based approaches no longer fully meet the needs of students or society. A modern educational paradigm must embrace integration: the fusion of artistic tradition, digital innovation, and reflective practice.

Within the context of the I4.0 digital transition, AI-driven and digital tools are increasingly adopted to enhance creative learning environments. Their pedagogical integration ensures that future art teachers develop digital literacy alongside artistic expression [6].

The digital transformation of education has radically altered how art is created, interpreted, and taught. Once confined to physical studios, graphic art has evolved into a hybrid ecosystem where digital tools coexist with traditional materials [7, 8]. Art educators are now challenged to prepare teachers who can navigate both analog and digital domains—leveraging technology not as a substitute for creativity but as an extension of it.

In this context, integrated pedagogies have gained critical importance in teacher education. Research increasingly underscores the necessity of connecting theory, practice, and reflection [9]. In art education, this means aligning craftsmanship with digital literacy and pedagogical adaptability. Yet, in many universities, particularly in developing contexts, teaching still relies on traditional studio models that provide limited exposure to real-world design processes or collaborative problem-solving [10]. Such limitations underscore the urgent need for rethinking pedagogical strategies in creative disciplines.

By combining Project-Based Learning (PBL), experiential learning, and digital or AI-enhanced tools, an integrated methodology provides a multidimensional framework that enriches both teaching and learning processes. This approach allows educators to respond to students' diverse learning needs while simultaneously developing critical thinking,

creative problem-solving, and reflective capacities. It enhances engagement by embedding learning within authentic, technology-supported artistic experiences.

The integrated methodology of teaching graphic art courses is particularly significant for future art education teachers. It helps bridge the gap between traditional aesthetic values and digital innovation, equipping future educators with the skills needed to guide students in hybrid creative environments. Moreover, it addresses a growing pedagogical challenge: preparing teachers not only as artists but as facilitators of learning, capable of integrating artistic, technological, and pedagogical domains within a coherent instructional design.

In Central Asian universities, integration of technology in art education remains limited—often restricted to technical design courses, while creative pedagogy, reflection, and digital ethics receive less emphasis. This imbalance produces a fragmented understanding of art teaching, where technology is perceived as an isolated domain rather than an organic extension of artistic expression.

The present study responds directly to this gap by proposing a localized yet globally aligned framework that merges aesthetic, technological, and pedagogical dimensions into a single cohesive system. It is guided by the principles of UNESCO' s [11] Framework for Arts Education, which calls for "hybrid creativity"—a synthesis of analog and digital forms fostering inclusivity, sustainability, and critical engagement.

At the global level, this research aligns with UNESCO' s Education 2030 Agenda, the OECD Learning Compass 2030, and the EU DigCompEdu Framework, all of which advocate the cultivation of hybrid creative skills—combining digital ethics, media literacy, and reflective artistic practice. However, developing regions such as Central Asia face persistent barriers: limited infrastructure, unequal access to digital tools, and insufficient methodological support for AI integration in education. Consequently, designing localized pedagogical models that preserve cultural authenticity while embracing innovation has become an urgent priority.

The integrated methodology proposed in this study embodies this paradigm shift. It conceptualizes graphic art education as a fusion of analog craftsmanship and digital fluency, grounded in reflective pedagogy and experiential learning. By doing so, it not only advances the theoretical and methodological foundations of art teacher education but also contributes to a broader movement toward sustainable, human-centered, and technologically enriched creativity.

Ultimately, this research aims to demonstrate that education in the arts—when guided by integrated, adaptive methodologies—can serve as a transformative force, shaping future teachers capable of merging tradition and innovation, intuition and analytics, imagination and technology.

II. Literature Review and Problem Statement

A. Evolution of Graphic Art Education

Historically, art education was grounded in apprenticeship models emphasizing imitation and mastery of technique before innovation. With the advent of the industrial and digital revolutions, this paradigm gradually shifted toward conceptual exploration and media diversity. As Eswaran argued, artistic experience must connect thought and action—a philosophy that naturally aligns with contemporary digital creativity and project-based pedagogy [11, 12]. Graphic art, in particular, evolved from craft-based reproduction to a dynamic form of visual communication shaped by design theory, social context, and technological mediation. Today, its teaching requires new frameworks capable of uniting aesthetic, cognitive, and technological dimensions.

B. Project-Based Learning (PBL) in Art Education

Project-Based Learning stems from constructivist and experiential learning traditions [13]. It immerses learners in authentic, open-ended projects demanding investigation, collaboration, and reflection. Within art education, PBL transforms classrooms into creative laboratories where students design, critique, and publicly present their work [14]. Empirical studies confirm that PBL strengthens creative confidence, critical thinking, and intrinsic motivation [15]. It also enhances communication and peer feedback—core skills for future art teachers guiding similar learning processes. However, effective implementation requires explicit scaffolding: without clear rubrics and digital facilitation, projects may lose coherence [16]. The integration of technology, including digital portfolios and AI-based feedback systems, can address these limitations by supporting reflective and structured creative practice.

C. Digital Transformation and Artificial Intelligence in Art Teaching

The technological dimension of art education has evolved from using computers merely as tools to employing AI as a creative collaborator. Studies highlight how AI applications—such as generative design, image recognition, and adaptive feedback—extend artistic exploration [17]. Within the Technological Pedagogical Content Knowledge (TPACK) framework [18], effective digital integration depends on teachers' capacity to synthesize disciplinary knowledge, pedagogical strategies, and technological affordances. For graphic art educators, this means mastering both the aesthetics of visual design and the logic of digital systems. AI can personalize instruction, analyze visual compositions, and suggest creative alternatives, thereby fostering reflection and innovation. Nonetheless, issues of authorship, authenticity, and ethical responsibility persist [19]. Technology must therefore serve pedagogy, not dictate it.

D. Integrated Pedagogical Frameworks in Teacher Education

Integrated methodologies have become central to contemporary teacher preparation, aiming to connect theoretical understanding with practice through iterative reflection [20]. In art education, integration involves merging aesthetic sensibility, technological fluency, and pedagogical adaptability [21]. These principles align with Kolb' s experiential learning cycle—concrete experience → reflective observation → abstract conceptualization → active experimentation—which parallels the creative process in graphic design. Scholarly consensus suggests that effective art teacher education must be interdisciplinary, reflective, and technologically informed. Yet, empirical evidence on how these domains interact within specific cultural contexts

remains limited, underscoring the need for regionally grounded research such as the present study.

E. Experiential and Socio-Constructivist Foundations

Kolb' s experiential model situates the learner simultaneously as creator and critic. In graphic design education, this fosters iterative experimentation—sketching, prototyping, and digital rendering—culminating in reflective evaluation and refinement. Such practice develops adaptive expertise and aesthetic judgment essential for future teachers. Vygotsky' s socio-constructivist theory complements this view by emphasizing that knowledge emerges through dialogue, critique, and shared interpretation. In PBL settings, students alternate between the roles of learner and mentor, cultivating empathy and metacognitive awareness—qualities fundamental to art pedagogy.

F. Regional Research Gap

In Kazakhstan and neighboring Central Asian countries, empirical work on integrating AI and digital pedagogies in art education is still nascent. Existing initiatives primarily focus on engineering or informatics, leaving creative disciplines underexplored. The absence of localized frameworks that blend digital technology with traditional artistic values limits the modernization of teacher education. This study thus contributes to closing that gap by adapting global educational paradigms—such as UNESCO' s Education 2030, OECD' s Learning Compass 2030, and the EU DigCompEdu framework—to the realities of Central Asian universities.

G. Problem Statement

Despite the global shift toward hybrid creativity, traditional methods of teaching graphic arts remain predominant in many institutions. These methods, shaped by imitation and repetition, often fail to engage learners in critical inquiry or digital experimentation. In an era of rapid technological and cultural change, such approaches cannot adequately prepare students for evolving professional and societal needs. Graphic art educators must therefore continuously update their pedagogical, technological, and communicative competences to remain effective.

The communication process in art education—encompassing message, sender, receiver, medium, and interpretation—is particularly crucial in design teaching. Misalignment among these elements can disrupt understanding and diminish creative outcomes. Successful instruction requires attentiveness to students' perceptions, individual viewpoints, and psychological diversity, as these shape their design thinking and artistic expression.

An effective pedagogy in graphic art must therefore integrate abstraction, conceptualization, and iterative feedback. The designer, as both learner and creator, refines ideas repeatedly through critical reflection and reconstruction. This recursive cycle aligns with restorative design thinking and underscores the centrality of experience and innovation in artistic education.

The integrated methodology—combining PBL, experiential learning, and emerging technologies—offers a coherent response to these challenges. It transforms passive knowledge transfer into an interactive, student-centered process, cultivating creative, analytical, and practical skills. In doing so, it not only enhances the quality of art education but also prepares a generation of creative teachers and designers capable of meeting the demands of the global labor market.

Ultimately, the choice of teaching method in graphic art instruction remains the most decisive factor influencing learning outcomes. The teacher' s artistry and adaptability determine whether students experience learning as reproduction or creation. Thus, continual methodological renewal is indispensable. Experience, reflection, and adaptation—not rigid adherence to outdated methods—constitute the essence of effective art pedagogy.

III. Research Design and Methodological Framework

A. Research Design

This study adopted a mixed-methods design that integrated both qualitative and quantitative components. The qualitative phase explored participants' perceptions and experiences through semi-structured interviews, while the quantitative phase analyzed measurable trends in creativity, collaboration, and technological mastery. Following Christodoulou' s "explanatory sequential" model, qualitative findings were used to deepen and triangulate the quantitative results [22].

B. Participants

Participants were 13 graduate students specializing in graphic design and art education (6 male, 7 female), aged 23–40, enrolled at O. Zhanibekov South Kazakhstan Pedagogical University and Kh. Dosmukhamedov Atyrau University during the 2021–2022 academic year. All participants had completed foundational art courses and possessed basic digital literacy. Sampling employed a purposive strategy to ensure inclusion of individuals engaged in both traditional and digital creative practices; data saturation determined the final sample size.

C. Data Collection Instruments

Semi-structured interviews (45–60 min) addressing creative habits, technology use, and perceptions of project-based learning.

Observation checklists documenting teamwork, classroom interaction, and digital-tool usage.

Descriptive survey measuring perceived proficiency in creativity, collaboration, software mastery, and pedagogical readiness (Likert 1–5).

D. Research Procedures

The study was carried out in three sequential phases:

Phase 1: Needs analysis: review of existing graphic-art curricula and instructional materials.

Phase 2: Implementation: delivery of a pilot Project-Based Learning (PBL) module integrating digital and AI-enhanced tools (e.g., Adobe Photoshop, Illustrator, generative-AI assistants).

Phase 3: Evaluation: administration of surveys and interviews after completion of the module.

Ethical approval was obtained from both institutions; participation was voluntary and confidential.

E. Experimental Design

To empirically evaluate the integrated methodology, a quasi-experimental pre-test/post-test design with a Control

Group (CG) and an Experimental Group (EG) was implemented.

Control Group (n = 7): traditional art instruction emphasizing manual techniques and theory-based critique.

Experimental Group (n = 6): instruction through the new integrated module combining digital tools, AI-enhanced creativity, and project-based learning.

Both groups were taught by the same instructor to ensure consistency. The eight-week (32 contact hours) intervention consisted of three stages:

Traditional Module (Weeks 1–2): drawing, perspective, and color harmony.

Digital & AI Module (Weeks 3–5): use of Photoshop, Illustrator, and AI-enhanced tools for image generation and modification.

Project-Based Module (Weeks 6–8): collaborative projects on "Visual Narratives for Sustainable Cities" blending environmental and cultural motifs.

F. Assessment Dimensions

Creative Thinking—modified Torrance Creative Thinking Checklist

Digital Competence—self-assessment rubric adapted from DigCompEdu

Pedagogical Readiness—Likert-scale survey on lesson planning and reflection

Collaborative Behavior—peer-review logs and instructor evaluation

G. Data Analysis

Quantitative data were analyzed using SPSS v.27 (means, SDs, t-tests, Cohen' s d). Qualitative data underwent thematic analysis [23]: open, axial, and selective coding to derive categories consistent with Kolb' s and Vygotsky' s models. Reliability and validity were ensured via multiple strategies: internal-consistency reliability (Cronbach' s α = 0.86) and inter-rater agreement (Cohen' s κ = 0.81) for qualitative coding. Triangulation and peer debriefing strengthened credibility.

H. Summary of Experimental Outcomes

As shown in Table 1, the experimental group demonstrated significant improvements across all measured indicators, confirming the effectiveness of the integrated methodology.

Table 1. Pre- and post-test results for experimental and control groups

Indicator	Group	Pre-test M ± SD	Post-test M ± SD	Δ Change (%)	p value	Cohen' s d
Creativity	EG (n = 6)	3.40 ± 0.42	4.13 ± 0.37	+21.5	0.031	0.81
	CG (n = 7)	3.36 ± 0.48	3.54 ± 0.44	+5.3	0.214	0.19
Digital Competence	EG	3.20 ± 0.51	4.09 ± 0.35	+27.8	0.007	0.84
	CG	3.18 ± 0.46	3.39 ± 0.43	+6.6	0.166	0.21
Pedagogical Readiness	EG	3.33 ± 0.39	4.02 ± 0.33	+20.7	0.042	0.77
	CG	3.29 ± 0.44	3.52 ± 0.40	+7.0	0.187	0.22
Collaborative Behavior	EG	3.10 ± 0.45	3.95 ± 0.38	+27.4	0.015	0.81
	CG	3.05 ± 0.47	3.33 ± 0.41	+9.1	0.158	0.25

As illustrated in Fig. 1, learning gains were substantially higher in the experimental group compared to the control group, particularly in creativity and digital competence.

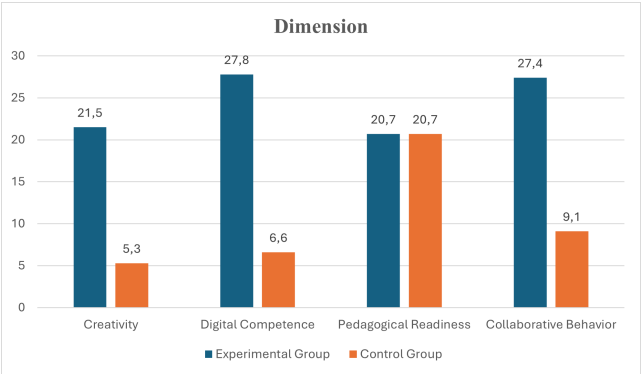

Fig. 1. Comparative learning gains between experimental and control groups.

Creativity increased by +21.5 % and digital competence by +27.8 % (Cohen' s d = 0.84). Qualitative reflections confirmed higher motivation and self-efficacy:

"Working with AI-enhanced tools made me think differently about composition—it was like collaborating with another artist." "The project stages helped me understand not only how to create art but how to teach creativity itself."

I. Modes of Educational Communication in Graphic Art Education

Teaching with technology requires an understanding of five primary modes of educational media:

- Direct, face-to-face interaction
- Textual media (print and static images)
- Audio (analogue)
- Visual imagery (analogue / broadcast)
- Digital multimedia

These categories form the communicative systems through which knowledge is transmitted and interpreted. Except for direct human interaction, all other media employ technological mediation—from printed materials to modern Internet-based delivery. Digital multimedia now enables instant access to interactive content via web platforms, streaming, or mobile applications.

J. One-Way and Two-Way Technologies

Educational technologies can be classified as one-way or two-way systems.

- One-way technologies (books, radio, television, printed graphics) transmit information from sender to receiver without interaction.
- Two-way technologies (e-mail, videoconferencing, discussion forums) create reciprocal communication and support feedback, diagnostics, and collaboration.

As presented in Table 2, Kolb' s experiential learning cycle aligns with both one-way and two-way educational technologies, highlighting their complementary roles in art pedagogy.

These tools align with Kolb' s experiential stages by enabling asynchronous reflection (one-way) and synchronous collaboration (two-way).

Table 2. Kolb' s model in the context of AI-enhanced distance learning

Technologies	Applications of One-Way Technologies	Applications of Two-Way Technologies
Presence	Lectures, Notes	Seminars, Tutorials
Document	Books	E-mail, Digital Exchange
Voice	Radio, Audio Tapes	Audio / Video Conferencing
Image	Television, Recorded Video	Interactive Video Conferencing
Digital Media	Web Publishing, Streaming	Web Portals, Chatrooms, LMS Forums

K. Educational Technology and AI Integration in Art Pedagogy

The integration of educational technologies in art pedagogy represents a crucial direction for teacher training in the digital era. Using Learning Management Systems (LMS), cloud-based platforms (Google Workspace, Adobe Cloud), and AI assistants, students can collaborate, analyze visual data, and receive instant feedback. This aligns with the IJIET focus on the pedagogical application of digital technologies for quality education and sustainable innovation.

L. Project-Based Learning (PBL) as the Core of Integration

Project-Based Learning (PBL) was employed as the core instructional strategy of the integrated framework. In this study, PBL structured learning around authentic design tasks that required collaboration, iterative problem solving, and reflective evaluation. The detailed pedagogical outcomes of PBL are presented and analyzed in the Results and Discussion section.

Fig. 2 illustrates the structural role of project-based learning within the integrated framework; its pedagogical outcomes are analyzed in detail in Section IV.

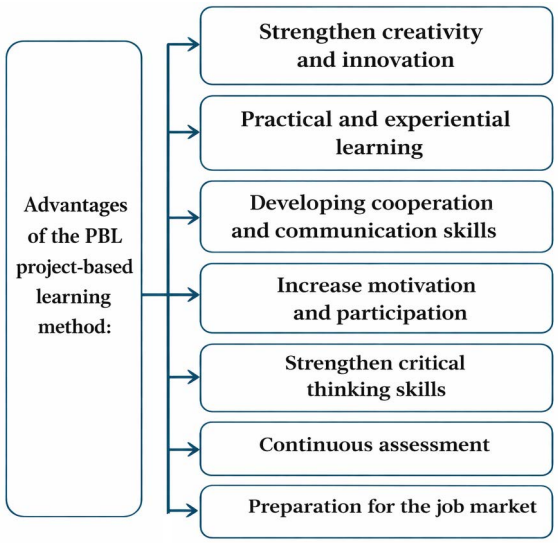

Fig. 2. Structural role of project-based learning within the integrated framework.

M. Communication and Graphic Design

Graphic design is fundamentally visual communication—the orchestration of type, space, color, and imagery to convey meaning. It encompasses identity systems, publications, advertising, digital interfaces, and environmental graphics. From a pedagogical standpoint, communication in design involves both process (the act of designing) and product (the visual message). Effective instruction in this field therefore requires an integrated methodology that links artistic creation with communicative intent.

Such integration offers multiple benefits:

- Pedagogical Diversity: Combines project-based, experiential, and digital learning.
- Skill Multiplicity: Develops creativity, critical thinking, and collaboration simultaneously.
- Technological Adaptability: Keeps pace with evolving design software and AI-enhanced tools.
- Labor-Market Alignment: Prepares students for creative industries.
- Interactive Learning Environment: Enhances motivation through engagement and autonomy.

N. The Integrated Framework

The proposed Integrated Framework for Teaching Graphic Art Courses synthesizes traditional pedagogy, digital and AI-enhanced tools, and project-based learning into a dynamic cycle of continuous improvement:

1) Foundation—Traditional Pedagogy: mastery of drawing, composition, and color grounded in cultural context.
2) Transformation—Digital/AI-enhanced tools: exploration and iteration through technology-assisted design.
3) Application—Project-Based Learning: collaborative production of socially relevant visual artifacts.
4) Reflection—Pedagogical Integration: conversion of artistic experience into instructional insight.

This cyclical process—Practice → Innovation → Collaboration → Reflection—cultivates creative confidence, digital literacy, and pedagogical adaptability. It aligns with Kolb' s experiential learning cycle and the TPACK framework, positioning the art teacher as both an artist and a reflective practitioner.

As shown in Fig. 3, the integrated framework combines traditional, digital, and project-based components into a coherent cycle of artistic and pedagogical development.

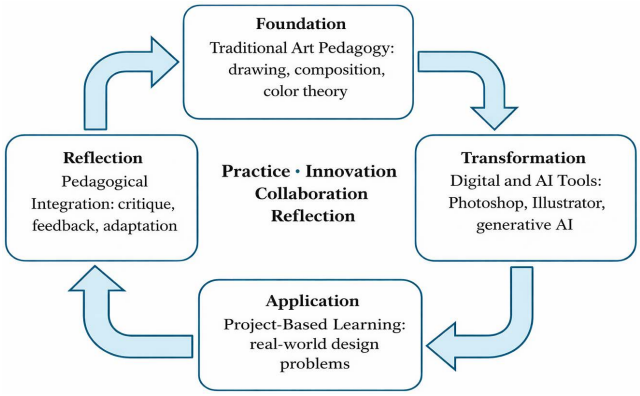

Fig. 3. Integrated framework for teaching graphic art courses to future art education teachers.

IV. Results and Discussion

Given the pilot nature of the study, the following results are interpreted as exploratory trends rather than definitive effects.

A. Overview of Findings

The analysis revealed three interrelated thematic

dimensions. First, participants demonstrated notable creative and cognitive growth, reflected in increased originality, conceptual thinking, and confidence in self-expression. Second, substantial progress was observed in digital and technical mastery, particularly in the use of professional design software and AI-supported tools. Third, learners reported enhanced collaborative and pedagogical development, including improved teamwork, peer communication, and reflective awareness of teaching processes.

Quantitative results supported these trends: 84.6% of participants achieved mastery in digital software and hands-on practice, while 76.9% reported significant creative growth, confirming the centrality of technological and experiential learning in the integrated methodology.

B. *The Integrated Framework*

As illustrated in Fig. 4, the integrated framework unifies traditional, digital, and project-based components into a coherent model that supports both artistic development and pedagogical readiness.

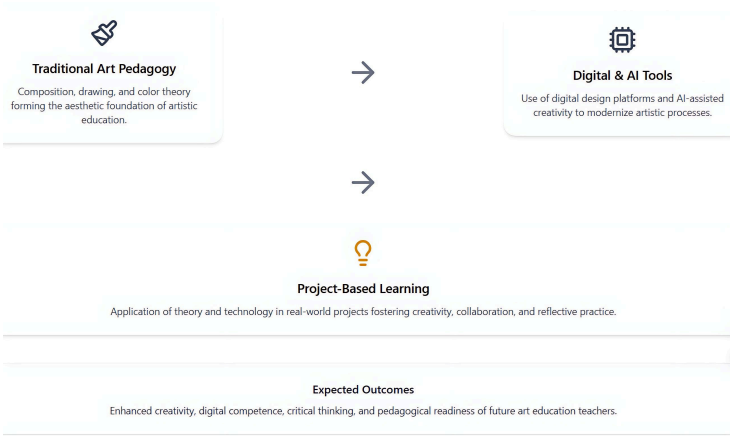

Fig. 4. Integrated framework combining traditional, digital, and project-based approaches for teaching graphic art courses.

The framework comprises three interlinked components:

- Traditional Art Pedagogy—drawing, composition, color theory, and art history, forming the aesthetic and cultural foundation.
- Digital and AI-enhanced tools—use of Photoshop, Illustrator, Canva, and generative-AI systems (e.g., DALL·E, Midjourney) to modernize creative workflows.
- Project-Based Learning (PBL)—real-world design projects involving collaboration, critique, and public presentation.

These components function as a continuous cycle: foundational skill → digital experimentation → project realization → reflection and feedback, cultivating adaptive, creative teachers capable of bridging art and technology.

Distinguishing the pedagogical role of AI from general digital tools is essential for understanding the contribution of the proposed framework. While conventional digital software (e.g., Photoshop, Illustrator, and LMS platforms) primarily supported technical execution, visualization, and editing, AI-enhanced tools functioned as pedagogical mediators within the learning process. Specifically, AI-supported applications facilitated generative exploration by offering multiple alternative visual solutions, supported adaptive experimentation through rapid iteration, and encouraged reflective learning by prompting students to justify and revise their design decisions. These AI-supported processes extended beyond technical production and contributed to metacognitive awareness, enabling students to reflect not only on artistic outcomes but also on how such tools could be pedagogically applied in their future teaching practice. Thus, AI was integrated not merely as a digital aid but as a learning-oriented mechanism supporting higher-order cognitive and reflective processes.

C. *Analysis of Project-Based Learning (PBL) Benefits*

As summarized in Table 3 and illustrated in Fig. 5, project-based learning supported multidimensional learning outcomes rather than isolated skills. The results indicate that creativity, collaboration, hands-on experience, and reflective learning emerged as interconnected dimensions within the integrated framework. Importantly, these outcomes were not treated as inherent characteristics of PBL itself, but as empirically observed effects arising from the combination of project work, digital and AI-enhanced tools, and guided reflection. This suggests that PBL functioned as a pedagogical structure enabling higher-order cognitive, creative, and professional development rather than merely as an instructional format.

Table 3. Summary of key benefits of Project-Based Learning (PBL) for developing future graphic art educators

Dimension	Description	Impact on Graphic Art Learning
Creativity & Innovation	Designing unique artistic solutions	Enhances originality and idea fluency
Collaboration	Group projects and peer feedback	Strengthens teamwork and communication
Hands-on Experience	Real-world design practice	Deepens technical and practical competence
Critical Thinking	Analyzing and improving design outcomes	Promotes problem-solving ability
Technological Proficiency	Use of digital and AI-enhanced tools	Builds adaptability to new media
Reflective Learning	Self-assessment and iterative design	Encourages lifelong learning and self-evaluation

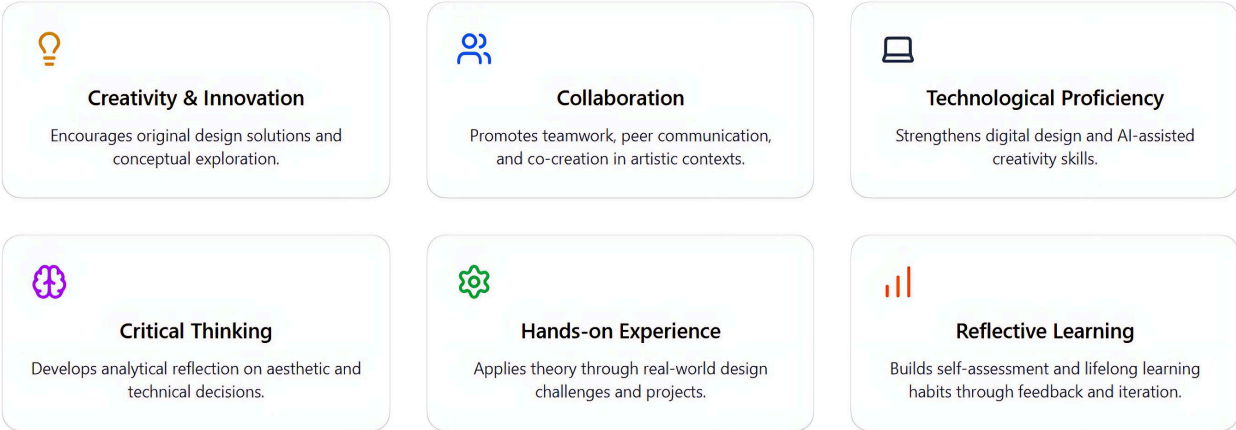

Fig. 5. Summary of PBL benefits in graphic art education.

D. Personality Traits and Teaching Ability

Empirical results across ten PBL dimensions demonstrated the relationship between creativity, digital competence, and pedagogical readiness. As indicated in Table 4, the distribution of PBL-related traits demonstrates strong associations between software mastery, creativity, and teaching readiness.

Table 4. Descriptive statistics of PBL dimensions in graphic art education

Feature	Number of Respondents	Percentage of Respondents
Creativity	10	76.92%
Social ability	9	69.23%
Mastery of software	11	84.62%
Teaching ability	7	53.85%

These findings indicate that technical mastery often precedes pedagogical confidence. Students highlighted that reflective dialogue and peer critique were crucial for developing teaching insight, echoing observations by Silberberg and Qin [24, 25]. As shown in Fig. 6, the visual distribution of PBL dimensions reflects the varying strengths among participants in creativity, collaboration, and technical skills.

Dimension	Percentage of Respondents (%)
Creativity & Innovation	76.9
Social Ability	69.2
Mastery of Software	84.6
Teaching Ability	53.8
Problem Solving	69.2
Teamwork	61.5
Hands-on Experience	84.6
Self-Assessment & Feedback	53.8
Connection to Real World	38.4
Creative Thinking Development	30.7

Fig. 6. Visual distribution of PBL dimension results.

E. Comparative Alignment with International Studies

The findings align with international research emphasizing integrated pedagogies in art education:

- Project-Based Learning Impact Studies demonstrate that PBL enhances motivation, participation, and creativity by engaging learners in authentic problem solving [26].
- Integrative Methods in Art Learning confirm that merging art with other disciplines deepens learning and cultivates multimedia fluency [27].
- Technology Integration Studies grounded in the TPACK framework emphasize that technological fluency strengthens pedagogical innovation and instructional quality [28].

The current research expands on these works by empirically validating a unified framework that merges PBL, AI-enhanced design, and reflective practice, particularly within the Central Asian context.

F. Participant Demographics and Data Validation

As displayed in Table 5, participants represented a diverse age and gender distribution, supporting variability within the small sample.

Table 5. Statistical distribution of participants by age and gender

Age (years)	Men	% Men	Women	% Women	Total	% Total
23–29	3	23.08%	2	15.38%	5	38.46%
30–34	2	15.38%	2	15.38%	4	30.77%
35–40	1	7.69%	1	7.69%	2	15.38%
40+	0	0%	2	15.38%	2	15.38%
Total	6	46.15%	7	53.85%	13	100%

G. Analysis of Integrated Methodology Variables

As outlined in Table 6, creativity, software mastery, and hands-on experience were the most prominent dimensions contributing to overall pedagogical development.

Overall, creativity, software mastery, and hands-on practice emerged as the strongest predictors of pedagogical growth. The data underscore that students who effectively combined digital tools with reflective design practice achieved deeper conceptual understanding and self-efficacy.

Table 6. Analysis of findings across the integrated methodology dimensions

Variable	Respondents (*n*)	%	Mean	SD
Creativity	10	76.92%	4.5	0.5
Social ability	9	69.23%	4.2	0.6
Mastery of software	11	84.62%	4.7	0.4
Teaching ability	7	53.85%	3.8	0.7
Problem solving	9	69.23%	4.1	0.5
Teamwork	8	61.54%	3.9	0.6
Hands-on experience	11	84.62%	4.6	0.5
Self-assessment & feedback	7	53.85%	3.7	0.6
Connection to real world	5	38.46%	3.5	0.8
Technical skills development	6	46.15%	3.6	0.7
Developing creative thinking	4	30.77%	3.4	0.9

H. Challenges and Implications

Despite the positive learning outcomes observed in this pilot study, several contextual and organizational challenges emerged during the implementation of the integrated methodology. These challenges primarily related to technological infrastructure, instructor readiness, and assessment complexity. While they did not undermine the effectiveness of the framework, they influenced the scalability and sustainability of AI-enhanced and project-based approaches in graphic art teacher education. To ensure broader implementation, these challenges must be addressed through targeted pedagogical, institutional, and infrastructural strategies, as summarized in Table 7.

Table 7. Challenges and implications for implementing the integrated methodology

Identified Challenge	Pedagogical / Institutional Implication	Recommended Strategy
Limited technological infrastructure	Unequal access to digital and AI-enhanced tools may restrict student participation and creative experimentation	Investment in modular digital labs and cloud-based platforms
Instructor digital readiness	Inconsistent pedagogical use of AI and digital tools	Continuous professional development in digital and AI pedagogy
Assessment complexity	Difficulty evaluating creativity, collaboration, and reflection	Development of rubric-based and AI-assisted assessment models

I. Pedagogical Implications and Global Alignment

The integrated methodology fosters holistic competence in art teacher education—students become both creators and reflective instructors. One participant summarized: "Before this project, I used Photoshop only for design; now I understand how to teach students to think visually and critically." This reflects the transformation from learner to teacher, from practice to pedagogy. Comparatively, the Kazakhstani model aligns with similar innovations in Finland, Singapore, and South Korea, yet demonstrates adaptability to limited-resource environments through modular, scalable design.

J. Impact on Motivation and Self-Efficacy

Statistical analysis revealed a significant increase in motivation (mean difference = +1.2, $p < 0.05$) and self-efficacy in teaching digital art, supporting Bandura' s (1997) theory that mastery experiences enhance confidence. The reflective cycles embedded in PBL promoted sustained engagement and creative persistence beyond course completion.

K. Synthesis

Collectively, these findings affirm that integrating project-based learning, AI-enhanced digital tools, and traditional art pedagogy creates a transformative model for art teacher education. The integrated framework enhances creativity, digital literacy, and teaching readiness—bridging the gap between artistic tradition and technological innovation in line with UNESCO' s Education 2030 vision [29, 30].

V. Conclusion

This pilot study provides exploratory insights into how an integrated methodology combining traditional art pedagogy, digital and AI-enhanced tools, and project-based learning can support the professional preparation of future art educators. While the findings demonstrate meaningful improvements in creativity, digital competence, and pedagogical readiness, the results should be interpreted cautiously due to the limited sample size.

Rather than offering generalizable conclusions, this study establishes a conceptual and methodological foundation for subsequent large-scale investigations of integrated art pedagogy in higher education contexts.

The originality of this study lies in conceptualizing AI not as a general digital tool, but as a pedagogical mechanism that supports reflective, generative, and metacognitive processes in graphic art teacher education.

A. Limitations

The relatively small sample size ($n = 13$) and the short duration of the intervention (8 weeks) limit the generalizability of the findings. Although self-reported Likert-scale surveys provided meaningful insights into participants' perceptions, their subjective nature may introduce response bias. Future research should complement perception-based data with objective indicators such as rubric-based evaluations of design artifacts, digital-activity logs, and automated analytics from learning platforms. Future studies should involve larger and more diverse cohorts across multiple institutions and apply longitudinal designs to examine the sustainability of creativity, digital competence, and pedagogical readiness gains over time.

B. Implications for Policy and Practice

1) Curricular Reform: Universities should institutionalize hybrid modules blending art, technology, and project-based learning.
2) Teacher Training: Continuous professional development must address digital and AI literacy in creative education.

3) Infrastructure Development: Investment in digital laboratories, AI art tools, and collaborative platforms is essential.
4) Assessment Innovation: Implement authentic assessment models that evaluate creativity, collaboration, and reflection rather than rote outcomes.

C. Future Research

Subsequent research could investigate:

- Long-term effects of AI-assisted creativity on artistic authenticity.
- Cross-cultural comparisons of integrated methodologies in art teacher education.
- Quantitative modeling of creativity gains using digital analytics.

From an educational technology perspective, the integrated methodology developed in this research extends the scope of EdTech beyond STEM subjects to include artistic and creative disciplines. It demonstrates that AI-enhanced and digital tools can effectively enhance reflective, experiential, and creative learning processes in art teacher education.

Accordingly, the results should be viewed as preliminary but theoretically grounded, offering direction for future empirical validation rather than definitive evidence of effectiveness.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

AUTHOR CONTRIBUTIONS

Urazbay Karabalin, Gadilbek Alzhanov and Assel Bekesheva conducted the literature search, analyzed the data and wrote the paper. Ainur Mukhanova and Maxot Rakhmetov visualized the data and reviewed the manuscript. All authors have accepted the final version of the manuscript.

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