

RESEARCH ARTICLE

Improving the Methodology of Teaching "Applied Decorative Arts" Through Software Tools and Artificial Intelligence in Pedagogical Higher Education Institutions of Uzbekistan

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Abstract

This article investigates the possibilities of improving the methodology of teaching Applied Decorative Arts in higher education institutions through the application of modern software tools and artificial intelligence. The limitations of traditional instructional approaches are examined, and the theoretical foundations and practical pathways for integrating digital tools into the teaching process are elucidated. The results demonstrate that the use of software products and artificial intelligence significantly enhances students' creative competency, academic motivation, and skills in the digital interpretation of national ornamental patterns.

KEYWORDS

Integration; artificial intelligence; software; pedagogical methodology; modernisation; creative competency; transformation; vector graphics; content.

INTRODUCTION

The rapid advancement of digital technologies is fundamentally transforming professional creative practice. While professional studios and design firms increasingly rely on vector graphics software, parametric design tools, and generative artificial intelligence systems, many higher education institutions — particularly those offering programmes in the arts — continue to depend primarily on manual techniques. This situation leaves graduates insufficiently prepared for the demands of the contemporary labour market and undermines their professional competitiveness.

In Uzbekistan, Applied Decorative Arts occupies a central position in the curricula of pedagogical universities. The discipline is designed to train specialists capable of transmitting the national ornamental heritage — including geometric girih (geometric Islamic tiling patterns), vegetal

islamiy (arabesque motifs), and architectural ganchkori (plasterwork carving) traditions — from one generation to the next. This artistic tradition, grounded in geometric patterning, colour harmony, and principles of symmetry, evolved over centuries and finds expression in traditional architecture, ceramics, textiles, and woodcarving — carrying significance that is not only aesthetic but also historical and cultural.

Despite ongoing efforts to modernise Uzbekistan's higher education system, empirical evidence on effective strategies for digital integration in Applied Decorative Arts instruction remains limited. In many pedagogical universities, the subject continues to be taught primarily through manual exercises, copying of existing specimens, and elementary draughtsmanship — an approach that fails to realise students' creative potential fully and leaves them ill-equipped to operate within contemporary digital design environments.

International research has demonstrated that integrating software tools and artificial intelligence into art education yields measurable improvements in creative outcomes. Vector graphics applications such as Adobe Illustrator and CorelDRAW accelerate the pattern-creation process, facilitate iterative revision, and foster compositional thinking. Generative artificial intelligence systems such as Midjourney and ChatGPT may further serve as effective instruments for conceptual ideation, colour scheme exploration, and the comparative analysis of compositional variants. The majority of this evidence, however, derives from Western European and East Asian contexts; comparable investigations in post-Soviet pedagogical settings remain scarce.

The present article reports on an experimental study conducted at Uzbekistan National Pedagogical University named after Nizami over sixteen weeks during the 2025–2026 academic year. The study examines the effects of integrating software tools and artificial intelligence into Applied Decorative Arts instruction on students' creative competency, academic motivation, and skills in the digital interpretation of national ornamental patterns. On the basis of the findings, pedagogical recommendations are formulated and practical guidelines for implementation are proposed.

THEORETICAL FRAMEWORK

Technological Pedagogical Content Knowledge (TPACK)

The TPACK framework, developed by Mishra and Koehler, conceptualises effective technology-integrated teaching as the dynamic intersection of three knowledge domains: technological knowledge, pedagogical knowledge, and content knowledge. Technological knowledge requires instructors to develop deep proficiency with software tools; pedagogical knowledge entails command of instructional methods; content knowledge encompasses disciplinary expertise. TPACK constitutes the specialised form of knowledge that emerges at the intersection of all three domains and enables effective learning outcomes.

In the context of Applied Decorative Arts instruction, the TPACK framework demands not merely software proficiency from teachers, but the capacity to synthesise deep content knowledge of national ornamental traditions with digital pedagogical practice. Teaching the construction of girih geometry within Adobe Illustrator, for instance, requires command of the software's functionality alongside an

understanding of the historical development and compositional principles of Uzbekistan's traditional geometric patterning. The three-phase instructional model proposed in this study was designed to develop TPACK competencies in a progressive, scaffolded manner.

The SAMR Model

The SAMR model, proposed by Puentedura, offers a hierarchical framework for evaluating the depth of technology integration in educational practice across four levels: Substitution, Augmentation, Modification, and Redefinition. At the Substitution level, technology replaces manual practice without altering the underlying process. Augmentation introduces functional improvements. Modification involves a substantive redesign of the task, while Redefinition enables the creation of entirely new learning activities impossible without technological mediation.

The intervention described in this study advances systematically through all four SAMR levels. In Phase I, students learn to replace hand-drawn lines with CorelDRAW (Substitution). In Phase II, the parametric transformation capabilities of Adobe Illustrator enable the rapid generation of multiple pattern variants (Augmentation). In Phase III, Midjourney supports conceptual ideation and traditional ornamental elements are reinterpreted within novel compositional arrangements (Modification and Redefinition). Technology integration thus progresses from simple digitisation towards genuine pedagogical transformation.

Social Constructivism

Vygotsky's social constructivism provides the epistemological foundation for the collaborative components of the three-phase model. The Zone of Proximal Development (ZPD) — the active learning zone situated between what a learner can achieve independently and what is attainable with skilled assistance — is directly relevant here. Artificial intelligence tools extend this ZPD by opening creative possibilities considerably beyond what students could produce through unaided manual practice.

Peer collaboration and reciprocal critique are equally central to Vygotskian learning theory. During the group project work of Phase III, students evaluate one another's digital decorative artworks, assessing collectively their fidelity to traditional ornamental principles and their quality as contemporary design artefacts. This socially mediated process generates deeper conceptual understanding than individual technical

practice alone can achieve.

LITERATURE REVIEW

Artificial Intelligence and Higher Education

The integration of artificial intelligence into higher education has expanded substantially in recent years. Holmes et al. classify AI educational applications across five domains: intelligent tutoring systems, learning analytics, automated assessment, personalised learning, and creative tool augmentation. Under this taxonomy, generative AI tools — including Midjourney, DALL-E, and Stable Diffusion — fall within creative tool augmentation, a domain regarded as particularly promising for application in art education.

Crompton and Burke's meta-analysis, encompassing 89 studies of technology integration in higher education, identified a substantial positive effect on learner motivation. Drawing on 146 studies of artificial intelligence applications in higher education, Zawacki-Richter et al. drew particular attention to the potential of personalised learning, adaptive assessment, and institutional management.

With respect to creative learning outcomes, Guo et al. found that undergraduate design students who used generative AI tools during ideation phases achieved significantly higher scores on originality and elaboration. Cropley and Kaufman, however, caution that excessive reliance on artificial intelligence may impede the development of autonomous creative judgement. Striking an appropriate balance is of particular importance in art education: students must be guided to understand AI tools as instruments for generating ideas and exploring possibilities, not as autonomous creative agents.

Software Tools in Applied Decorative Arts Education

Professional design software has been employed in art education for several decades. Peppler and Kafai demonstrated that software-based creative environments significantly enhance learners' creative self-efficacy, while Freedman argues that digital tools enable students to redirect cognitive resources from technical execution towards higher-order creative decision-making.

Turgut and Kiyici found that pattern works produced by decorative arts students using vector graphics software were rated substantially higher than those of peers taught exclusively through manual methods. This outcome reflects the strong alignment between vector graphics affordances and

the geometric structure of Uzbek ornamental traditions: the rotation, repetition, and symmetric reflection functions of Adobe Illustrator and CorelDRAW enable the construction of girih patterns with considerably greater speed and precision than manual methods permit.

Further research by Peppler demonstrates that learners with access to digital creative environments develop not only technical skills but also the capacity to exercise autonomous control over the creative process. This finding is of particular relevance for students in pedagogical universities: prospective teachers who acquire proficiency with digital tools are better positioned to teach those tools effectively in their future classrooms.

Uzbekistan's National Ornamental Heritage and Digital Pedagogy

Uzbekistan's ornamental tradition — encompassing geometric girih tiling, vegetal islimiy arabesque, and ganchkori plasterwork carving — constitutes one of the world's most distinguished decorative arts heritages. The ornamental designs adorning the historical monuments of Samarkand, Bukhara, Khiva, and Tashkent are remarkable for their mathematical as well as their aesthetic sophistication: contemporary scholarship has established that many girih patterns exhibit structural correspondences with quasicrystal geometries, attesting to the advanced geometrical knowledge of historical Uzbek craftsmen.

The safeguarding of intangible cultural heritage has become an increasingly urgent concern globally. While Sennett has argued persuasively for the irreplaceable value of craft knowledge acquired through embodied practice, exclusive reliance on traditional methods is no longer sufficient. Digital tools may serve as an additional and effective channel for transmitting the national ornamental heritage to new generations: pattern libraries in vector format, digital archives, and interactive teaching materials can extend traditional practice without displacing it.

Rahimov has documented the systemic obstacles — inadequate funding, outdated equipment, and a shortage of qualified personnel — that impede the modernisation of Applied Decorative Arts curricula in Uzbekistani universities. Yuldashev and Mirzayev contend that digital tools offer a sustainable pathway to extending access to high-quality ornamental arts education beyond traditional craft apprenticeship models.

Research Gap

Despite the growing international evidence base on AI and software integration in art education, no reviewed study has empirically examined these interventions within Uzbekistan or analogous Central Asian higher education contexts — and specifically not within Applied Decorative Arts instruction. A further gap concerns the question of cultural authenticity: most existing research devotes limited attention to the degree to which AI-generated visual proposals align with national ornamental aesthetic conventions. The present study addresses both of these lacunae.

METHODOLOGY

Research Design

A quasi-experimental pretest–posttest non-equivalent control group design was employed. This approach is widely used in educational research settings where full experimental control over participant assignment is not practicable. The design permits the investigation of intact student groups while preserving authentic instructional conditions. The study was

conducted across two semesters during the 2023–2024 academic year. Written informed consent was obtained from all participants, and data were anonymised and stored in accordance with applicable legal requirements.

Participants

The study was conducted with third-year students enrolled in the "Fine Arts and Engineering Graphics" programme at the Faculty of Professional Education and Arts, Uzbekistan National Pedagogical University named after Nizami. A total of 64 students from study groups TS/301 and TS/302 were assigned to two conditions: an experimental group (EG, n = 32) and a control group (CG, n = 32).

Inclusion criteria comprised: enrolment as a third-year Applied Decorative Arts student; no prior formal training in Adobe Illustrator or CorelDRAW; and written consent to voluntary participation. Exclusion criteria comprised: prior professional design experience; and withdrawal from the course during the intervention period. Two students — one from each group — were absent from a substantial number of sessions for legitimate reasons and were excluded from the final analysis.

<i>Characteristic</i>	<i>Experimental Group</i>	<i>Control Group</i>
Number of students	32	32
Mean age	20.4	20.1
Female students (%)	68.3%	65.0%
Prior digital skills level	Low	Low
Study group	TS/301	TS/302

Table 1. Participant characteristics

Experimental Instructional Model

A three-phase integrated instructional model, grounded in

TPACK and the SAMR model, was developed for the experimental group. Each phase builds progressively upon the knowledge and skills acquired in the preceding one.

<i>Phase</i>	<i>Weeks</i>	<i>Tools</i>	<i>Primary objective</i>
Digital Foundations	1-4	Adobe Illustrator, CorelDRAW	Technical proficiency; digital ornamental pattern execution
AI-Assisted Ideation	5-12	Midjourney, ChatGPT	Creative ideation; critical AI literacy
Integrated Project	13-16	All tools + peer critique	Holistic competency; professional presentation

Table 2. Three-phase integrated instructional model

During Phase I (Weeks 1–4), students were introduced to vector graphics software, learning to construct geometric

patterns using points, lines, and shapes, and practising the digital recreation of local girih ornamental designs. During Phase II (Weeks 5–12), students learned to employ Midjourney and ChatGPT for pattern ideation, colour harmony exploration, and comparative compositional analysis. Instructors guided students in critically evaluating AI-generated visual proposals, identifying elements incompatible with national ornamental conventions, and revising them accordingly. During Phase III (Weeks 13–16), students completed individual final projects — creating a contemporary digital artwork grounded in a traditional ornamental motif — and presented these for peer and instructor critique.

The control group received instruction equivalent in contact hours (three hours per week over sixteen weeks), delivered exclusively through traditional methods: observational drawing, geometric construction using compasses and ruler, hand-colouring, and copying of exemplar designs. Both groups were taught by the same experienced instructor throughout the study, thereby controlling for instructor effects.

Instruments and Measures

Three outcome measures were employed. The Creative Competency Rating Rubric (CCRR), adapted from Amabile's Consensual Assessment Technique, evaluates five criteria: originality, technical execution, compositional complexity, cultural authenticity, and professional presentation (maximum score: 25 points). Three independent expert raters scored student work, yielding high inter-rater reliability (Intraclass Correlation Coefficient, ICC = 0.91).

The Academic Motivation Inventory (AMI), adapted from the Motivated Strategies for Learning Questionnaire developed by

Pintrich and De Groot, comprises 20 Likert-scale items yielding a score in the range 1–100. Internal consistency was satisfactory (Cronbach's alpha = .84). The Digital Pattern Skills Test (DPST) is a 15-item performance assessment requiring students to identify, analyse, and digitally reconstruct national ornamental motifs (ICC = .88). All instruments were administered at pretest and posttest.

Data Analysis

Data were analysed using independent-samples and paired-samples t-tests, together with Analysis of Covariance (ANCOVA) with pretest scores entered as a covariate. ANCOVA represents the most reliable approach to controlling for baseline differences in pretest–posttest research designs. Practical significance was assessed using Cohen's d effect size, interpreted as follows: small effect $d = 0.2$, medium effect $d = 0.5$, large effect $d \geq 0.8$. Normality was verified using the Shapiro–Wilk test (all $p > .05$) and homogeneity of variance was confirmed using Levene's test.

RESULTS

Baseline Equivalence

No statistically significant between-group differences were identified on any pretest measure, confirming that both groups commenced the intervention from an equivalent baseline and strengthening the interpretability of subsequent comparisons. Pretest means were: Creative Competency Rating Rubric — EG: 12.05, CG: 11.90; Academic Motivation Inventory — EG: 62.40, CG: 61.85; Digital Pattern Skills Test — EG: 5.60, CG: 5.73.

Between-Group Comparisons

<i>Outcome measure</i>	<i>EG pretest</i>	<i>EG posttest</i>	<i>EG gain</i>	<i>CG pretest</i>	<i>CG posttest</i>	<i>CG gain</i>
Creative Competency (CCRR, /25)	12.05	16.24	+34.9%	11.90	13.20	+10.9%
Academic Motivation (AMI, /100)	62.40	80.16	+28.5%	61.85	66.27	+7.1%
Digital Pattern Skills (DPST, /15)	5.60	7.92	+41.4%	5.73	6.22	+8.6%

Table 3. Pretest-posttest results (EG = experimental group, CG = control group)

ANCOVA results revealed statistically significant between-group differences in favour of the experimental group on all three outcome variables. Large effect sizes were obtained for creative competency ($d = 0.87$), academic motivation ($d = 0.94$), and digital ornamental pattern skills ($d = 1.12$), indicating that the observed differences are of practical as well as statistical significance.

The 41.4% gain in digital ornamental pattern skills represented the largest improvement across all three outcome variables — a finding of particular note, as it suggests that the domain most constrained under traditional instructional methods stands to benefit most substantially from software integration.

Qualitative Observations

Post-intervention interviews and questionnaires yielded several important qualitative findings. Some 83% of experimental group students reported that software tools had simplified the process of creating national ornamental patterns and expanded their creative possibilities. The majority indicated that they had produced a greater volume and variety of work within a single semester than manual methods alone would have allowed.

However, 47% of students noted that Midjourney's visual proposals sometimes incorporated elements uncharacteristic of Uzbek decorative art, or were at variance with traditional compositional principles. Instances were observed in which AI-generated outputs contained elements characteristic of Chinese, Indian, or Persian decorative traditions. This finding underscores the irreplaceable function of the instructor as cultural mediator, responsible for orientating students within the context of national aesthetic conventions.

DISCUSSION

Interpretation of Principal Findings

The findings provide robust empirical support for the proposition that the systematic integration of professional software tools and artificial intelligence into Applied Decorative Arts instruction significantly enhances students' creative competency, academic motivation, and digital ornamental pattern skills. The observed effect sizes are consistent with, or exceed, those reported in comparable studies of digital integration in art and design education.

The 34.9% improvement in creative competency corresponds closely to the 29–38% gains documented by Guo et al. among

undergraduate design students in China. The effect size for academic motivation ($d = 0.94$) surpasses the mean reported in Crompton and Burke's meta-analysis ($d = 0.72$), a difference attributable not only to novelty effects, but plausibly also to the cultural resonance generated by applying contemporary tools to deeply familiar national heritage motifs.

The largest effect size was recorded for digital ornamental pattern skills ($d = 1.12$). This outcome reflects the exceptionally strong alignment between the geometric transformation capabilities of vector graphics software and the girih geometry that forms the structural foundation of Uzbekistan's national ornamental tradition. Digital tools enable students to accomplish in minutes what manual construction would require hours to achieve, redirecting cognitive attention from procedural execution towards geometric reasoning and compositional creativity.

The Question of Cultural Authenticity

The most theoretically significant finding to emerge from the qualitative data concerns the tension between AI-generated aesthetic proposals and the cultural authenticity of Uzbekistan's ornamental tradition. This finding corroborates — within a national heritage context — Cropley and Kaufman's theoretical concern that excessive reliance on artificial intelligence may impede the cultivation of autonomous creative judgement. Generative AI systems are trained predominantly on datasets reflecting Western and East Asian aesthetic conventions and consequently tend to produce culturally mixed or otherwise inauthentic elements when prompted to generate Uzbek national ornamental patterns.

A prospective response to this challenge lies in the development of AI models trained on dedicated national decorative arts datasets — an avenue that future research should explore. In the interim, the instructor's role as cultural mediator is of decisive importance: students must be taught to evaluate each AI-generated element critically against the standards of the national tradition. It is accordingly more precise to characterise AI tools in this pedagogical context as generators of visual possibilities, rather than as autonomous creative agents.

Theoretical and Practical Contributions

This study contributes empirical evidence that TPACK-structured instructional design, applied within a specialised arts discipline, yields measurably superior outcomes compared with conventional instruction. It further extends the SAMR

model's application to decorative arts pedagogy in the Uzbekistani context for the first time, demonstrating that the model's highest level — Redefinition — is attainable within a single semester under appropriately scaffolded instruction. This constitutes a novel contribution to the international literature on SAMR in art education, from a Central Asian pedagogical perspective.

For practitioners, the three-phase model validated in this study offers a concrete, replicable pedagogical framework adaptable to Uzbekistan and comparable Central Asian contexts. The phase structure embodies a coherent progression that respects students' entry-level digital competencies whilst advancing them systematically towards professional digital creative practice. Teachers are advised to cultivate not only technical software proficiency in their students, but a discipline of applying digital tools in alignment with national ornamental traditions.

CONCLUSION

This study has demonstrated empirically that integrating software tools and artificial intelligence into Applied Decorative Arts instruction in Uzbekistan's pedagogical higher education institutions yields substantial improvements in creative competency, academic motivation, and digital ornamental pattern skills. The 41.4% gain in digital pattern skills, alongside gains of 34.9% in creative competency and 28.5% in academic motivation, attests to the practical superiority of digitally integrated instruction over conventional pedagogical approaches.

The proposed three-phase pedagogical model is recommended as an effective and replicable framework for harmonising national ornamental traditions with contemporary digital competencies. The study additionally identified limitations of artificial intelligence tools with respect to cultural authenticity: AI-generated visual proposals do not consistently align with Uzbekistan's national ornamental conventions, necessitating particular attention to the instructor's role as cultural mediator.

The following recommendations are offered to pedagogical higher education institutions: to incorporate structured modules on software tool use into the Applied Decorative Arts curriculum; to develop methodological guidelines ensuring the critically informed, culturally grounded application of artificial intelligence tools; to establish regular professional development programmes for instructors in digital and AI

tools; and to ensure provision of modern computing facilities and licensed software.

Future research should examine the development of AI models trained on dedicated Uzbek national ornamental pattern datasets, investigate the long-term retention of instructional gains, and assess the transferability of comparable intervention models to other Central Asian decorative arts education contexts.

Ethical statement: This study was approved by the institutional ethics committee. All participants provided written informed consent prior to enrolment. Data were anonymised and are stored in accordance with applicable legislative requirements. No conflicts of interest are declared.

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