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THE DIDACTIC PRINCIPLES AND PEDAGOGICAL CONDITIONS OF TEACHING AI DESIGN TO STUDENTS IN THE ART AND DESIGN FIELDS

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This study explores the pedagogical conditions and didactic principles required for the effective teaching of AI design to students in art and design fields. The research was conducted at Abai Kazakh National Pedagogical University and Almaty Technological University, involving 60 second year bachelor's ctudent divided into experimental and control groups. A quasi-experimental strategy was combined with qualitative techniques like focus groups, interviews, and content analysis of student projects in a mixed-method design. Access to AI design infrastructure, interdisciplinary collaboration with computer science students, project-based learning with real cases, and methodological support with ethical guidelines were among the specially created pedagogical conditions that were used to teach the experimental group. Interactivity, practice orientation, tool variability, reflexivity, and ethical transparency were all highlighted in the didactic principles. Students' creative and professional skills significantly improved as a result of quantitative analysis (Torrance Tests, project evaluation, statistical methods). Higher levels of motivation, ethical consciousness, and preparedness to incorporate AI tools into artistic practice were found in qualitative data. The results demonstrate that integrating AI design education into art and design curricula can be accomplished successfully with well-crafted pedagogical conditions and principles.

Keywords: AI design, art and design education, pedagogical conditions, didactic principles, creative competencies, interdisciplinary learning.

ӨНЕР ЖӘНЕ ДИЗАЙН САЛАСЫНДАҒЫ СТУДЕНТТЕРГЕ AI ДИЗАЙНЫН ОҚЫТУДЫҢ ДИДАКТИКАЛЫҚ ПРИНЦИПТЕРІ МЕН ПЕДАГОГИКАЛЫҚ ШАРТТАРЫ

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Бұл зерттеу өнер және дизайн саласындағы студенттерге AI дизайнын тиімді оқыту үшін қажетті педагогикалық шарттар мен дидактикалық принциптерді зерттейді. Зерттеу Абай атындағы Қазақ Ұлттық педагогикалық университетінде және Алматы технологиялық университетінде жүргізілді, оған эксперименттік және бақылау топтарына бөлінген 60 екінші курс бакалавриат студенттері қатысты. Квази-эксперименттік стратегия фокус-топтар, сұхбаттар және аралас әдістерді жобалаудағы студенттік жобалардың мазмұнын талдау сияқты сапалы әдістермен біріктірілді. жасанды интеллектті жобалау инфрақұрылымына қол жеткізу, информатика студенттерімен пәнаралық ынтымақтастық, нақты жағдайлармен жобалық оқыту және этикалық нұсқаулармен әдістемелік қамтамасыз ету эксперименттік топты оқыту үшін пайдаланылған арнайы жасалған педагогикалық жағдайлардың бірі болды. Дидактикалық принциптерде интерактивтілік, тәжірибеге бағдарлану, құралдардың өзгергіштігі, рефлексивтілігі және этикалық ашықтығы ерекше атап өтілді. Сандық талдау (Torrance Тесттері, жобаларды бағалау, статистикалық әдістер) нәтижесінде студенттердің шығармашылық және кәсіби дағдылары едәуір жақсарды. Сапалы деректерде мотивацияның, этикалық сананың және жасанды интеллект құралдарын көркемдік тәжірибеге енгізуге дайындықтың жоғары деңгейлері анықталды. нәтижелер жасанды интеллект дизайны бойынша білім беруді көркемдік және дизайнерлік оқу бағдарламаларына біріктіру жақсы әзірленген педагогикалық шарттар мен принциптерді сақтай отырып, сәтті жүзеге асырылуы мүмкін екенін көрсетеді.

Кіріспе сөз: AI дизайны, көркемдік және дизайнерлік білім, педагогикалық жағдайлар, дидактикалық принциптер, шығармашылық құзыреттер, пәнаралық оқыту.

ДИДАКТИЧЕСКИЕ ПРИНЦИПЫ И ПЕДАГОГИЧЕСКИЕ УСЛОВИЯ ОБУЧЕНИЯ ИИ-ДИЗАЙНУ СТУДЕНТОВ В ОБЛАСТИ ИСКУССТВА И ДИЗАЙНА

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В данном исследовании рассматриваются педагогические условия и дидактические принципы, необходимые для эффективного обучения ИИ-дизайну студентов, обучающихся в области искусства и дизайна. Исследование было проведено в Казахском национальном педагогическом университете имени Абая и Алматинском технологическом университете с участием 60 студентов второго курса бакалавриата, разделенных на экспериментальную и контрольную группы. Квазиэкспериментальная стратегия была объединена с качественными методами, такими как фокус-группы, интервью и контент-анализ студенческих проектов, в рамках смешанного метода проектирования. Доступ к инфраструктуре проектирования искусственного интеллекта, междисциплинарное сотрудничество со студентами, изучающими информатику, проектное обучение с использованием реальных кейсов и методическая поддержка с соблюдением этических норм были одними из специально созданных педагогических условий, которые использовались для обучения экспериментальной группы. Интерактивность, практическая ориентация, вариативность инструментария, рефлексивность и этическая прозрачность - все это было выделено в дидактических принципах. Творческие и профессиональные навыки студентов значительно улучшились в результате количественного анализа (тесты Торранса, оценка проектов, статистические методы). Качественные данные показали более высокий уровень мотивации, этического сознания и готовности к внедрению инструментов искусственного интеллекта в художественную практику. Результаты показывают, что интеграция обучения дизайну с использованием искусственного интеллекта в учебные программы по искусству и дизайну может быть успешно реализована при наличии хорошо продуманных педагогических условий и принципов.

Ключевые слова: AI-дизайн, художественно-дизайнерское образование, педагогические условия, дидактические принципы, творческие компетенции, междисциплинарное обучение.

Introduction

Under the influence of digitalization and the introduction of artificial intelligence technologies, modern art and design education is currently in the process of undergoing an active transformation. Among the most promising fields is AI design, which employs neural network models and machine learning algorithms to generate, optimize, and visualize artistic design solutions. The utilization of artificial intelligence tools has the potential to expand the scope of creative endeavors; however, it also necessitates a greater commitment to the professional development of future specialists. The relevance of the research is determined by the necessity of establishing pedagogical conditions and didactic principles that guarantee the effective teaching of AI design to students in the art and design fields. The lack of scientifically sound approaches to organizing the educational process that consider the specifics of art and design education is a contradiction to the practical demands of the labor market, which is exacerbated by the rapid growth in demand for specialists with AI tools.

In the art and design fields, the relevance of the research is determined by the necessity of establishing pedagogical conditions and didactic principles that ensure the effective teaching of AI design to students. A contradiction to the practical demands of the labor market is the absence of scientifically sound approaches to organizing the educational process that consider the specifics of art and design education. This contradiction is further exacerbated by the rapid growth in demand for specialists with AI tools. The scientific literature has not yet sufficiently developed issues related to the didactic principles and pedagogical conditions of teaching AI design in the context of art and design specialties, despite the increasing interest in the problem of digitalization of education. This necessitates targeted research that is designed to identify and validate effective pedagogical strategies.

In recent years, there has been a significant increase in the development of research on the digitalization of education, the integration of artificial intelligence into the pedagogical process, and the development of students' digital competencies [1]. The

introduction of new visualization technologies, 3D modeling, generative algorithms, and neural network tools that expand the boundaries of creative search is a particular focus in the field of art and design education [2]. Modern research indicates that the integration of AI into design presents opportunities for the rapid prototyping, automation of routine operations, and creation of innovative artistic solutions [3]. Nevertheless, the authors observe that the effective implementation of AI in the educational process necessitates a methodological framework and specifically designed pedagogical conditions [4].

The development of artistic thinking, creativity, and imaginative perception are traditionally linked to the issues of designer training in pedagogy. The need to transition to integrative learning models, where artistic and technological elements work in tandem, is also emphasized by current research in the field of digital education pedagogy [5]. Scientists conducting experiments on the introduction of AI in higher education inform teachers and suggest ways to use AI in art education [6]. To date, systematic reviews show that the United States is in the leading position in terms of the number of published studies, but over the past year the trend has shifted towards China. Language learning is the most common subject area of research. Based on the data obtained, five usage codes were recorded: (1) Assessment, (2) Forecasting, (3) Artificial Intelligence Assistant, (4) Intelligent Learning System, (5) Student Management.

In this study, we aim to identify and substantiate the pedagogical conditions and didactic principles that ensure the effectiveness of teaching AI design to students of art and design, contributing to the formation of professional competencies. We analyzed the current state of AI integration in art education, identified the prevailing models and paradigms of AI design education, and also identified pedagogical conditions and didactic principles in AI design education. After analyzing the methods and tools of experimental research of AI design courses, we identified tangible results and evaluated the feedback from students and teachers. In particular, our research is aimed at solving an urgent scientific and pedagogical problem that is important for the development of art education in the context of digital transformation.

1 Theoretical foundations of the study

1.1 Current state of AI design research in art education

In art education, the promise of AI is obvious and guarantees the transformation of students' creative potential [7]. AI-powered technical capabilities, AI-powered tools provide real-time feedback, enabling students to improve their work instantly. By integrating AI with design training, we combine theoretical understanding with practical implementation [8]. An obvious example is the Open AI DALL-E program, which generates images based on text input.

An example of this potential is a program that generates images based on text input. Along with this, tools such as Autodesk Generative Design are used to create various design results, and gives students an insight into the boundaries of creativity. Meanwhile, it can be argued that the integration of AI not only develops students' creativity, but also makes their critical thinking and problem-solving abilities clearer.

In pedagogical science, the conceptual foundations of the use of AI in art education are considered as a cognitive structure and an integral element for understanding the role of creativity in art education. It is appropriate to consider several theories here, one of them is Gardner's theory of multiple intelligence, which highlights spatial intelligence and emphasizes its importance for visual thinking [8]. This statement largely coincides with the approach of design thinking, based on which creativity is a significant part of innovative problem solving and will include such stages as empathy, idea generation, and experiment. Considering the constructivist theory of learning from a pedagogical point of view, it can be noted that students actively master theoretical knowledge through experience, and thus emphasize the role of applied tasks in mastering the principles [9].

The flow hypothesis of Csikszentmihalyi deepens this statement and examines how full immersion in creativity leads to increased innovation and learning. The Torrance paradigm highlights a step-by-step approach to creativity, which is 1-preparation, 2-incubation, 3- lighting, 4- verification. All stages are essential for achieving innovation in creativity. However, ethical difficulties arise, such as the potential bias of algorithms and the theory that AI will replace designers, raising concerns about the integrity and authenticity of the design profession [10]. Based on the above, the integration of AI into art education is fraught with both difficulties and advantages. Teachers need to understand problems and develop curricula that combine strengths.

Consequently, an examination of the literature reveals that the issue of teaching AI design in art design education is not sufficiently investigated. The definition of pedagogical conditions and didactic principles that guarantee a harmonious integration of the artistic and technological components of specialist training is of particular importance.

1.2. Definition of Essential Concepts

It is advisable to disclose the primary categories in order to elucidate the scientific research apparatus.

• AI design is the process of utilizing artificial intelligence technologies (generative algorithms, neural networks, and machine learning) to create artistic and design products that automate individual design stages and enhance creative search capabilities.

• Pedagogical conditions: a collection of factors and circumstances that are specifically organized to facilitate the successful integration of knowledge and the development of competencies in the educational process. In the context of AI design, these include the organization of the learning environment, the use of digital platforms, the application of project-based learning methods, and interdisciplinary integration.

• Didactic principles: these are the key clauses that specify the subject matter, approaches, and structures of training. Principles like practice-orientation, integrativity (fusing art and technology), variability (using different AI tools), and visibility (visualizing processes) are pertinent to AI design.

1.3. The specifics of art and design education

Future designers are trained with a focus on developing their creative skills, artistic taste, and critical perception of visual information. The unique characteristics of students' creative thinking, such as their propensity for figurative associations, their need for authorial self-expression, and their use of visual sign systems, should be taken into consideration when integrating AI technologies into the educational process.

However, it's crucial to stress that AI is a tool to enhance the artist-designer's abilities rather than a replacement, freeing him up to concentrate on the creative and conceptual aspects of the work.

Therefore, teaching AI design should be structured in such a way that students recognize AI not as a mechanical tool, but as a partner in the creative process.

The example of how machine learning can help design students think more creatively is used to examine this strategy [10]. During the experiment, scientists used the didactic principles of visibility and interactivity to teach AI-based animation design. Because AI is always evolving, they discovered a vast amount of room for innovation in the fields of digital painting and art. Digital art and AI technologies work together to create new avenues for self-expression and creativity. The introduction of AI into art education is called the synergy of technology and creativity, which combines human creativity and AI analytics, and students receive tools to create innovative projects, and this collaboration encourages students to explore and expand creative opportunities. Let's emphasize the potential of AI in removing the often frightening barriers inherent especially in the initial stages of creativity. With the help of AI, students create abstract concepts and visual effects faster and better, thereby effectively developing their creative abilities [11]. The Wombo Dream AI tool, which aimed to help students learn artistic concepts and compositions, was used to study textures, shapes, and colors. The students also created innovative projects largely using the power of AI tools [12]. The integration of AI into the design learning process goes beyond traditional learning and requires a more interactive strategy [13]. AI technologies require the development of critical thinking, ethical awareness, and deliberate application. In the latest research, scientists have outlined the prospects for further improvement of the design process through the introduction of AI [14, 15].

2 Overview of Kazakhstan practice

In Kazakhstan, the practice of introducing AI tools into art and design education has intensified over the past 2-3 years, in some cases these are separate seminars and elective modules in curricula [16]. Leading universities have demonstrated the implementation of generative AI services in project assignments. For example, the hackathons "Step into the future: Creative Industry and AI" were held on the basis of the Kazakh National Pedagogical University named after Abai, where students not only studied generative models, but also participated in applied cases such as posters, clothing, and identity. Modules on AI technologies and generative algorithms are being added to the educational programs of universities. For example, in the educational program "6B02101 Graphic Design", Almaty Technological University, the discipline Modern Design and artificial intelligence was introduced, and the analysis also showed that the specifics of the discipline include the formation of a scientific approach to the use of creative and imaginative thinking and the study of new theoretical design concepts. The educational program 6B02120-Graphic Design, developed by the L.N. Gumilyov Eurasian National University, includes modules in the disciplines of the cycle - Digital Painting. Students create electronic images using computer simulations using generative AI tools. The Temirbek Zhurgenov Kazakh National Academy of Arts presents the educational program 6B02190 Design, analyzing subjects aimed at developing computer competencies, we examined the disciplines Modeling and visualization and Design drawing aimed at working in graphic programs to master design thinking and task execution algorithm. After analyzing the educational program 0602120 Graphic Design of the Kazakh National University named after Abai, we found that the new course is the Basics of artificial intelligence. The course introduces students to AI and reveals the content of AI concepts such as machine learning, neural networks and deep learning, robotics

and autonomous systems. In practical cases of the design industry (fashion design, textiles), industry research shows the use of AI in prototyping and image generation.

Problems and limitations.

There is a lack of educational materials and techniques adapted for art and design training. Even if there is, most of it is technical literature. Limited access to powerful computing resources and paid services, subscriptions to generative AI tools. Ethical and legal issues, rules for the use of AI – generative content in scientific papers and diplomas are actively discussed recommendations. Domestic practice shows that there is interest in pilot cases, but systematic methodological work is required to create pedagogical conditions, such as infrastructure, a project environment and interdisciplinary teams. To develop didactic principles, it is necessary to integrate artistic and technological principles, focus on authorship, critical and creative thinking. Universities need developed methodological complexes and teaching aids adapted to the capabilities and needs of higher education.

Materials and research methods

Purpose. To test and methodologically evaluate the proposed pedagogical conditions and didactic principles of teaching AI design to students of art and design fields and to measure the impact on professional and creative competencies.

Research design

Mixed methods: quasi experiment (control and experimental groups), qualitative analysis (interviews, focus groups, content analysis of students' projects).

Sample and research base

The experiment took place in the 2024-2025 academic year on the basis of:

• Kazakh National Pedagogical University named after Abai (Faculty of Arts);

• Almaty Technological University (Department of Design).

The participants are students of the 2nd year of bachelor's degree, 60 people (experimental group – 30 people, control group - 30 people).

Table 1. Sample composition.

Group	Number of students	Characteristics
Experimental	30	Training according to the developed methodology (AI-design)
Control	30	Training according to the traditional program (without AI)

Selection criteria: curriculum without prior AI training.

Pedagogical conditions:

1. Infrastructure: a computer lab with access to generative models, a set of basic tools, and licensed access to Midjourney, Stable Diffusion, Runway, and AI4Design.

2. Interdisciplinary team: a joint project with computer scientists and programmers.

3. Project-oriented training: real orders, cases.

Methodological support: educational literature on theory, instructions on practical exercises, ethics checklists.

Didactic principles:

• Integrativity, combining aesthetics and technology.

• Practice-oriented approach, the project as the main method.

• Variability of tools, familiarization with different generative AI.

• Reflexivity and critical thinking, author's reports at every stage.

• Ethical transparency.

Practical tasks and the project

During the experiment, the students completed individual projects and a group project, created a series of visual works, namely a poster composition. The report clearly indicated the role of AI, which tools were used, and which part was performed by humans. The format of submitting the portfolio to PDF, the source code (screenshots of promts, versions of images from AI, sketches by hand).

Evaluation category:

1. The concept and idea – 20 points, originality, depth of conception, correspondence to the brief.

2. Technical implementation – 25 points, image quality, post-processing skills, use of tools.

3. AI integration – 20 points, conscious and reasoned use of AI, quality of experiments, variability of approaches.

4. Presentation and justification – 15 points, the ability to explain the process, demonstrate the stages, the ethics of using AI.

5. Reflection and documentation – 10 points, reflective essay, indication of sources, rights to materials.

6. The deadline is 10 points.

Total – 100 points final score.

Resources: required online tools: Stable Diffusion (web-UI), Runway, Midjourney, DALL E (Open AI)/ Graphic editors: Photoshop/GLMP/Krita. Platforms for storing and sharing projects: Google Drive/GitHub (for versions) / Miro (briefs). Educational materials: reviews and case studies. Ethical instructions: templates for the design of sources, indicating the degree of participation of AI and tools.

Recommendations to the teacher: To increase motivation, start with simple visual practices so that students can quickly see the result; prepare checklists and product templates for the first classes; organize presentations and evaluations during the work process for intermediate feedback; it is important to pay attention to copyright discussions, it is necessary to develop rules for the course; involve IT specialists for short master classes.

Research methods and tools

-Quantitative methods: creativity tests before and after the experiment (Torrance Test), project evaluation category (creativity, quality of execution, use of AI tools).

-Qualitative methods: interviews with teachers and students, portfolio analysis.

-Content analysis: analysis of projects by parameters.

-Statistical methods: t-tests, ANOVA for comparing indicators between groups.

Stages of the experiment

1. Preparatory stage

• An input diagnosis of the level of creativity (the Torrence Test) was performed.

• The initial portfolio of students has been formed.

• Motivational attitudes are determined through a questionnaire.

2. Organizational stage

• Laboratory equipment and licensing of software products.

• Teaching teachers basic methods of working with generative models.

• Development of an educational and methodical complex (course program, manuals, checklists).

3. The main (formative) stage

• Week 1-2: introduction to the basics of AI design, introduction to interfaces.

• Week 3-4: mini-projects in mixed teams (designers + IT specialists).

• Week 5-6: designing real cases (posters, logos, clothing concepts).

• Week 7-8: discussions and reflection, analysis of authorship, analysis of ethical dilemmas.

• Week 9-10: final projects (brand identity, visual style, packaging).

4. The final stage

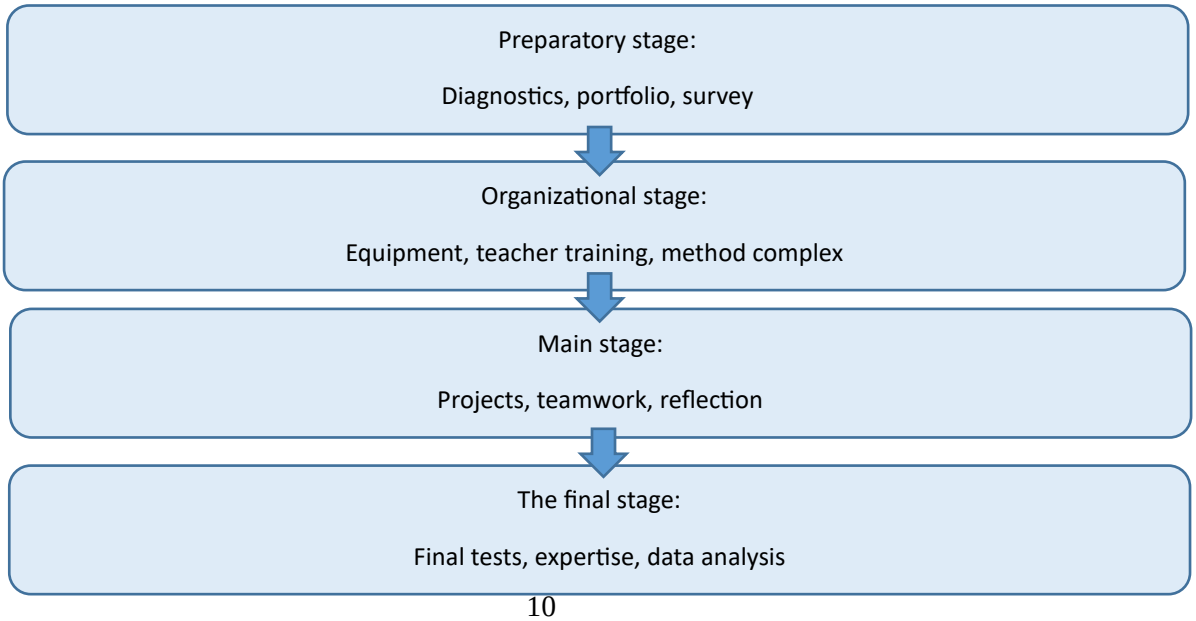
• Repeated testing (Torrence Test).

• Expert evaluation of projects (originality, aesthetics, competent use of AI).

• Interviews and focus groups with students and teachers.

• Statistical data processing (t-test, ANOVA).

Table 2. The scheme of the pedagogical experiment



Results and discussion

-Improvement in creative competencies: students in the experimental group demonstrated statistically significant growth in creativity indicators measured by the Torrance Test compared to the control group (p<0/05). Portfolio and project evaluations showed higher levels of originality, aesthetic quality, and integration of AI tools.

-Development of professional skills: Participation in project-based tasks with real cases led to improved teamwork, problem-solving, and applied design competencies. Exposure to multiple AI platforms (Midjourney, Stable Diffusion, Runway, AI4Design) assisted students in gaining technological literacy alongside artistic expression.

-Role of pedagogical conditions: The presence of adequate infrastructure (labs, licensed AI tools) proved essential for effective experimentation. Working with computer science students from different fields made design projects more technically complex and encouraged new ways of thinking creatively. Guides and ethics checklists helped students deal with problems like authorship, plagiarism, and moral choices.

-How didactic principles affect things: The integrative principle (aesthetics + technology) was successful in connecting traditional art education with new digital technology. Reflexivity and critical thinking, bolstered by reports and peer discussions, enhanced students' capacity to articulate design decisions and evaluate the ethical implications of AI utilization. Ethical transparency as a constant condition led to more responsible use of generative tools.

-Qualitative insights: Interviews with students showed that they were more motivated and interested in learning, especially because of real-world projects. Teachers noted a shift in students' perception of AI: from viewing it as a "threat" to recognizing it a collaborative creative partner.

Table 3. Average indicators of creativity (according to the Torrence test)

The group)	Before the experiment (cf. score	After the experiment (cf. score)	Δ
Experimental	48.3	72.6	+24.3
Control	47.9	52.1	+4.2

The results of the t-test showed the statistical significance of the differences ($p < 0.05$).

The projects of the students of the experimental group received higher marks for originality, compositional solutions and technological literacy (diag. 1).

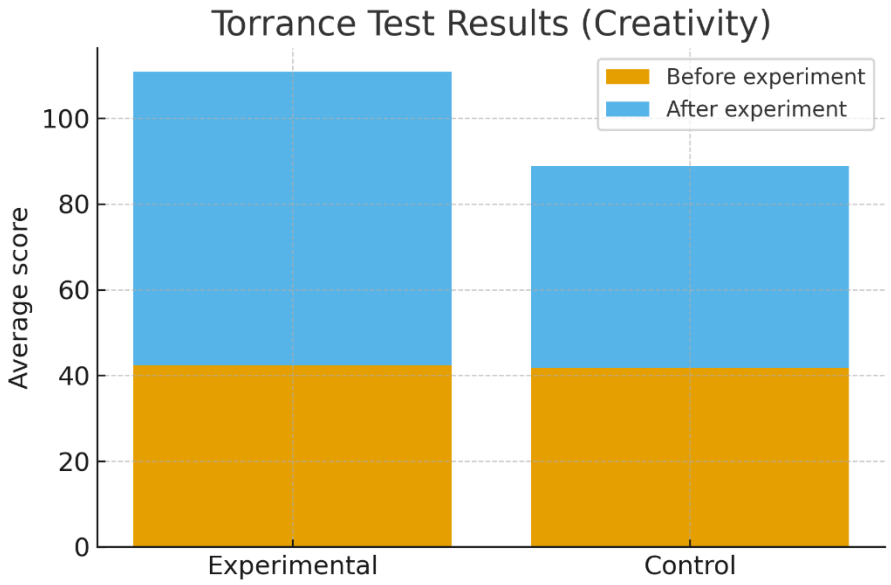


Diagram 1. Torrance test results.

The experiment confirmed the hypothesis that the creation of special pedagogical conditions and the application of didactic principles significantly increases the level of creative and professional competencies of design students (diag. 2).

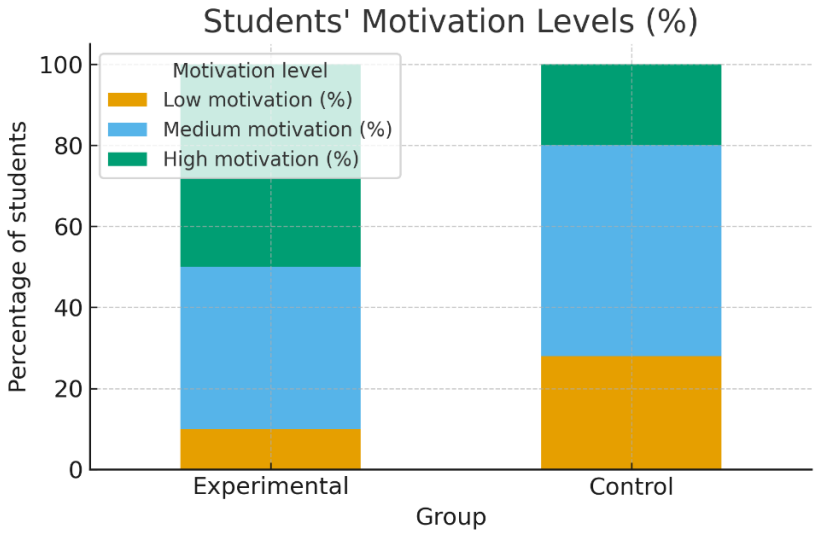


Diagram 2. Students motivation levels

Qualitative conclusions

The students of the experimental group noted an increase in motivation and confidence.

Teachers have recorded an improvement in students' ability to reflect and ethically comprehend their work.

No such changes were observed in the control group (diag. 3)

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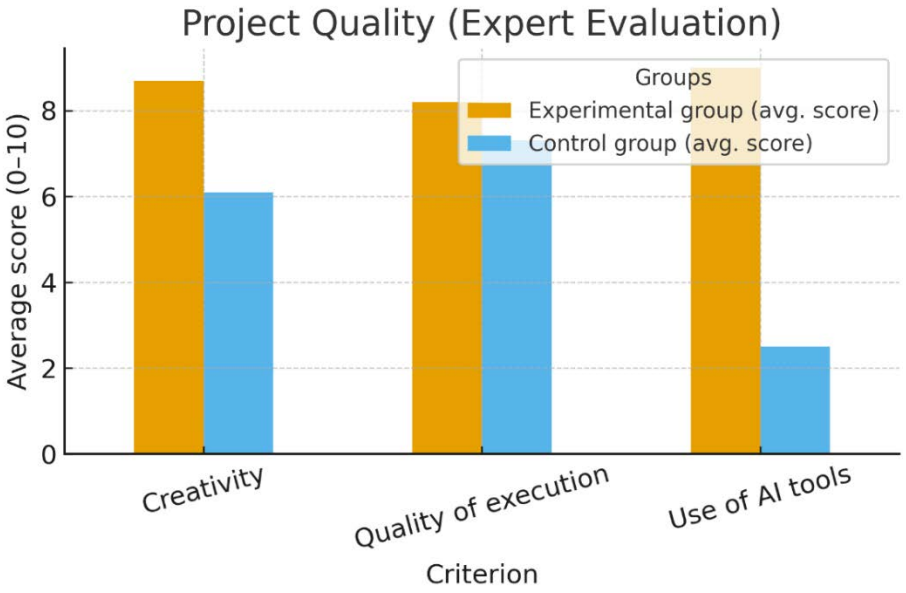

Diagram 3. Project quality

Conclusion

The study validates that the suggested pedagogical conditions (technological infrastructure, interdisciplinary collaboration, project-based training, and methodological support) alongside didactic principles (integrativity, practice orientation, tool variability, reflexivity, and ethical transparency) substantially improve the efficacy of instructing AI design to art and design students. The mixed-method evaluation demonstrated quantifiable enhancement in creative and professional competencies, whereas qualitative data underscored heightened motivation,

ethical awareness, and preparedness to implement AI tools in professional practice. So, when AI design education is part of a well-planned teaching environment, it not only helps students improve their artistic and technical skills, but it also encourages them to be responsible and critical when it comes to new ideas in the creative industries.

Useful Suggestions

1. Add AI modules to the main curriculum. AI design tools should be a required part of art and design students' courses at universities. This will make sure that students get a balanced education in both artistic creativity and technological literacy.

2. Set up platforms for interdisciplinary collaboration. For example, set up joint studios and workshops where art students work with computer science and engineering students to encourage new ideas and ways of thinking.

3. Put money into infrastructure and licensed access. For example, make sure that computer labs have access to the latest generative AI platforms (like Midjourney, Stable Diffusion, and Runway) and that students can get help with technical issues and legal and ethical questions.

4. Use project-based learning with real-world cases. Get students involved in solving real design problems from industry partners so they can test AI tools in real-world situations and build portfolios.

5. Ensure ethical and reflective practice. Introduce mandatory modules on ethics, authorship, and intellectual property in the age of AI. Require students to maintain reflective journals or author's reports to critically assess their creative process.

6. Encourage ongoing professional development for educators. Provide faculty with training in AI design tools and pedagogical strategies so they can confidently assist students in embracing cutting-edge technologies.

7. Create standards for assessments. To ensure objective evaluation of AI-driven projects, clearly define evaluation criteria that cover creativity, technical execution, efficient use of AI tools, and ethical compliance.

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