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Formation of professional competence of future teachers of fine arts through futuristic design creativity

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Abstract

This study aims to explore the effectiveness of integrating futuristic design creativity into the professional training of future art and design educators, with the goal of enhancing their professional competence in response to rapidly changing technological and societal demands. A quasi-experimental research design was employed involving 58 third-year students from two Kazakhstani universities. Participants were randomly divided into experimental and control groups. The experimental group participated in an eight-week instructional program based on project-based learning, speculative design tasks, and collaborative activities centered on real-world challenges. Data were collected through pre- and post-intervention questionnaires, thematic analysis of open-ended responses, and expert evaluations of final design projects. Results indicate that the experimental group demonstrated significant improvements in understanding futuristic design concepts, applying interdisciplinary approaches, and showing increased motivation and professional identity. Expert assessments confirmed that student projects in the experimental group surpassed those of the control group in originality, relevance, feasibility, and aesthetic quality. **Conclusion:** The integration of futuristic design creativity into the curriculum supports the holistic development of professional competence in art and design education. The proposed instructional model can be effectively applied in teacher training programs to better prepare students for addressing future-oriented, interdisciplinary challenges in creative and educational fields.

Keywords: Professional competence, Futuristic design, Art and design education, Creative thinking differentiated, Teacher preparation.

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Transparency: The authors confirm that the manuscript is an honest, accurate, and transparent account of the study; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.

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1. Introduction

In the modern conditions of society development, the requirements for the training of future teachers of fine arts are increasing; they must have not only professional knowledge and skills but also the ability to adapt to rapidly changing socio-cultural and technological conditions. An important role in this process is played by the formation of professional competence, understood as an integrative quality of the individual, including cognitive, project-creative, motivational, and communicative components, allowing one to successfully perform professional functions [1, 2].

Modern research emphasizes that the pedagogical competence of a teacher cannot be formed outside the context of new cultural and technological realities, including the digitalization of education, virtualization, and global challenges [3]. In particular, an important area of training for creative professionals is mastering the concepts of futuristic design a specialized approach aimed at developing new ideas and products that can meet the needs of future society [4].

Futuristic design creativity involves the ability to design innovative objects, processes, and environments focused on promising socio-cultural and environmental development scenarios. In foreign studies, futuristic design is considered not only as a technological tool but also as a cultural strategy that forms a new vision of the world and promotes the development of critical and creative thinking [5]. However, in domestic pedagogy and methods of training fine arts teachers, this approach has not yet been sufficiently developed and is rarely integrated into educational programs.

A number of authors note that the priority tasks of training fine arts teachers are the development of design thinking, the ability to artistically interpret modern and futuristic images, and the ability to use digital and multimedia technologies [6, 7]. However, research shows that future teachers often have a superficial understanding of future design concepts, which reduces their readiness to implement innovative approaches in the educational process [8].

Thus, there is a need to develop and test a methodology for developing the professional competence of future fine art teachers based on futuristic design creativity. Such a methodology should take into account not only the specifics of the subject area but also modern challenges sustainable development, digitalization of culture, interdisciplinarity, and globalization. Within the framework of this study, an attempt was made to substantiate the effectiveness of the author's methodology based on the integration of futuristic design projects into the process of professional training of students.

The purpose of the work is the scientific substantiation, development, and experimental verification of the methodology for developing professional competence of future fine art teachers through futuristic design creativity. To achieve the goal, the following tasks were solved: to determine the level of knowledge and understanding of students about futuristic design; to identify interest in its application in professional activities; to develop and conduct a cycle of author's classes in the experimental group; to compare the results of the control and experimental groups to test the effectiveness of the methodology.

The relevance of the study is determined by the need to train specialists who are able to creatively and responsibly approach the solution of professional problems in the context of cultural transformation and technological progress. The novelty lies in the fact that a methodology aimed at the formation of students' holistic professional competence using futuristic design creativity as a pedagogical tool has been proposed and tested.

2. Materials and Methods

2.1. Participants

The study involved 58 third-year students enrolled in the Design education programs at two higher education institutions in Kazakhstan: The Central Asian Innovative University (Educational Program 6B02103 – Design) and the South Kazakhstan Pedagogical University named after O. Zhanibekov (Educational Program 6B02101 – Design). Participants were randomly assigned to two groups: an experimental group ($n = 29$) and a control group ($n = 29$). The experimental group received instruction based on the author's methodology, incorporating elements of futuristic design creativity, while the control group followed the standard curriculum. Participation was voluntary, and all students provided informed consent.

2.2. Procedure

The research was carried out over the course of the 2024-2025 academic year and consisted of three consecutive stages: the diagnostic (pre-test) stage, the formative (intervention) stage, and the evaluative (post-test) stage. All stages were conducted on the premises of the two participating higher education institutions during scheduled class hours to ensure maximum participation and authenticity of the learning environment.

At the diagnostic stage, both the experimental and control groups were administered an initial questionnaire developed by the authors. This instrument aimed to assess the students' baseline level of professional competence in design, their familiarity with the concept of futuristic design, their ability to identify its applications in various fields, their creative thinking skills, and their motivation and readiness to engage with innovative design practices. The questionnaire included multiple-choice questions as well as open-ended questions that allowed students to express their understanding and attitudes in their own words.

During the formative stage, the experimental group participated in a specially designed instructional intervention, which spanned eight weeks. The intervention consisted of a series of classes structured around the principles of project-based learning and focused on fostering futuristic design creativity. Students worked on projects aimed at solving real-world social and cultural problems through innovative and sustainable design solutions. Instructional methods included group discussions, brainstorming sessions, design thinking exercises, development of digital prototypes, and analysis of case studies from global practice. The learning activities were designed to develop cognitive, creative, motivational, and communicative aspects of professional competence. Meanwhile, the control group continued their regular coursework

without any modifications to the curriculum.

At the evaluative stage, the same questionnaire was administered again to both groups to measure changes in the targeted indicators of professional competence. Students' project work completed during the intervention was also assessed by a panel of experts against a set of predefined criteria that reflected the components of professional competence.

2.3. Data Collection and Analysis

Data collection was carried out at two points: at the beginning of the study (pre-test) and after the intervention (post-test). The main instrument of data collection was the structured questionnaire, which contained seven main sections corresponding to the research objectives. The questionnaire included both quantitative and qualitative items: multiple-choice questions to quantify knowledge and attitudes, as well as open-ended questions to capture deeper insights into students' understanding of futuristic design and their creative approaches.

In addition to questionnaire responses, the study collected and analyzed students' project works developed during the formative stage of the intervention. These projects were evaluated based on criteria such as originality of the concept, relevance to future societal needs, feasibility, and aesthetic quality.

All quantitative data were entered into a statistical software package (e.g., SPSS) for analysis. Descriptive statistics, such as frequencies, means, and percentages, were calculated to summarize the responses. Comparative analysis between the experimental and control groups was conducted to identify significant differences in the development of professional competence before and after the intervention. Where applicable, inferential statistical tests were applied to determine the significance of observed differences at the $p < 0.05$ level.

Qualitative data from the open-ended questionnaire responses and students' project descriptions were analyzed using thematic content analysis. Responses were coded into categories corresponding to the key components of professional competence. This allowed the researchers to capture nuanced changes in students' conceptual understanding, creativity, and motivation that were not fully reflected in the quantitative data.

Together, the triangulation of quantitative and qualitative data provided a comprehensive view of the effectiveness of the intervention and its impact on the professional development of future art and design educators.

3. Results

A survey of students was conducted to measure their level of involvement in physical education classes, as well as to assess the pedagogical conditions that influence their participation. The survey included several blocks of questions covering aspects such as students' motivation, their attitude toward the individualization of classes, preferences in sports activities, and perceptions of the existing conditions for physical education at the university. The survey results are presented in Table 1.

The results of the study are presented in accordance with the three main stages of the research: the diagnostic (pre-test) stage, the formative (intervention) stage, and the evaluative (post-test) stage. Findings include outcomes of the administered questionnaires, students' engagement during the intervention, and expert evaluation of the students' project work.

Diagnostic (pre-test) stage. At the beginning of the study, both the experimental and control groups completed a baseline questionnaire to assess their knowledge of the concept of *futuristic design*, their understanding of its applications, creative thinking skills, and motivation to engage in innovative design activities.

Analysis of the pre-test data showed that students' initial familiarity with the term *futuristic design* was limited in both groups. As shown in Table 1 and Figure 1, 48.3% of all respondents reported having only a superficial understanding of the term, 43.1% claimed to know it well, while 8.6% admitted to having no knowledge of it at all. There were no statistically significant differences between the experimental and control groups at this stage ($p > 0.05$), confirming that the groups were comparable at baseline.

Table 1.

Knowledge of the term *futuristic design* before and after the intervention (%).

Level of knowledge	Experimental group (pre-test)	Experimental group (post-test)	Control group (pre-test)	Control group (post-test)
No knowledge	8.6	0	9.3	8.6
Superficial understanding	48.3	14.3	46.7	43.7
Good/deep understanding	43.1	85.7	44.0	48.0

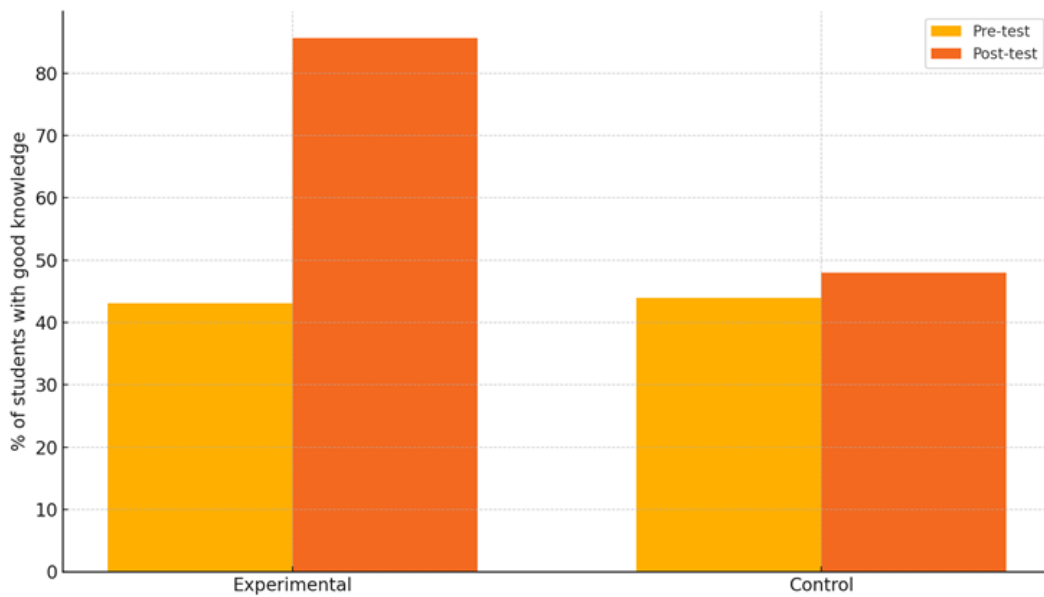


Figure 1.

Knowledge of the term *futuristic design* before and after the intervention in the experimental and control groups.

Regarding their conceptual understanding of the term, 42.1% of respondents associated *futuristic design* with the creation of future products and services, 38.6% linked it to the development of innovative ideas and concepts for the future, and 19.3% described it merely as a vision of the future.

When asked about domains where futuristic design is most relevant, the majority of students (43.9%) indicated *culture and art* including digital art, virtual reality, and cultural heritage preservation as the primary area of application. About 35.1% identified urban planning (smart city technologies and sustainable infrastructure), while smaller proportions mentioned transportation and other fields.

When asked whether they believed futuristic design could positively impact the quality of life, approximately half of the respondents agreed it would have a strong effect, 35% considered the effect to be moderate, and about 15% were undecided or skeptical.

Regarding motivation to pursue a career in design, a slight majority expressed positive intentions (56.9%), although motivation levels varied and some students indicated uncertainty. These findings justify the need for targeted pedagogical interventions to improve students' knowledge, creative skills, and motivation.

Formative (intervention) stage. During the formative stage, the experimental group participated in an instructional program designed to integrate futuristic design creativity into the curriculum. Over the course of eight weeks, students engaged in weekly sessions that combined lectures, workshops, project-based assignments, and collaborative discussions.

Students in the experimental group worked on projects addressing real-world societal and cultural challenges through futuristic design concepts. Project topics included designing sustainable urban spaces, creating culturally sensitive virtual reality experiences, and conceptualizing innovative transportation solutions. Activities emphasized design thinking, problem-solving, creativity, and teamwork. Students presented their projects visually and verbally, justifying the relevance and feasibility of their solutions.

Observations during the intervention showed that the experimental group became more engaged, confident, and creative in applying futuristic design principles. In contrast, the control group continued with the standard curriculum, which did not include futuristic design concepts or future-oriented project work.

Evaluative (post-test) stage. At the end of the intervention, both groups completed the same questionnaire administered at baseline, and the experimental group submitted their final projects for evaluation.

The post-test questionnaire revealed significant improvements in the experimental group compared to the control group across all measured dimensions of professional competence. As seen in Table 1 the proportion of students in the experimental group reporting a good or deep understanding of *futuristic design* increased from 43.1% to 85.7%, while the control group showed only marginal improvement, from 44% to 48%.

Similarly, the ability to identify application domains of futuristic design improved substantially in the experimental group. As presented in Table 2, 79.3% of students in the experimental group correctly identified multiple application areas, compared to 45.2% in the control group.

Table 2.

Ability to identify applications of futuristic design (%).

Applications correctly identified	Experimental group (pre-test)	Experimental group (post-test)	Control group (pre-test)	Control group (post-test)
Yes	42.1	79.3	41.3	45.2
Partially	39.3	16.7	40.0	42.3
No	18.6	4.0	18.7	12.5

Motivation to pursue a design career also increased significantly in the experimental group, as shown in Table 3. The proportion of students expressing strong motivation increased from 56.9% at pre-test to 86.2% at post-test, whereas in the control group, the increase was minimal (from 58% to 61%).

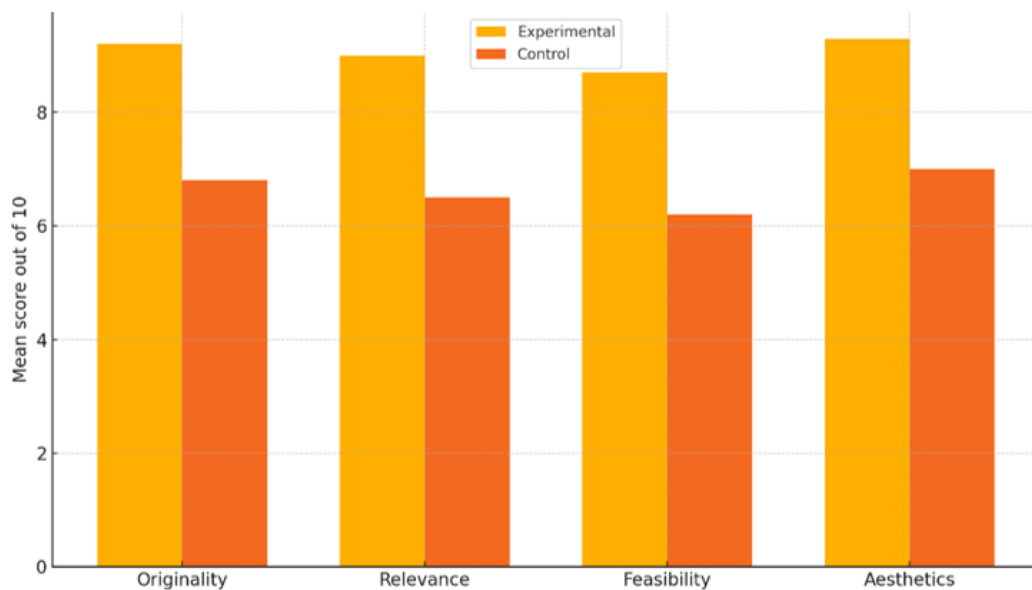
Table 3.

Motivation to pursue a career in design (%).

Motivation level	Experimental group (pre-test)	Experimental group (post-test)	Control group (pre-test)	Control group (post-test)
Strong motivation	56.9	86.2	58.0	61.0
Moderate/uncertain	34.5	11.1	35.7	32.7
No motivation	8.6	2.7	6.3	6.3

Qualitative analysis of open-ended questionnaire responses showed that students in the experimental group described their experience as “eye-opening,” “inspiring,” and “challenging in a positive way.” They reported increased confidence in using futuristic design to address societal and cultural problems. The control group, on the other hand, continued to demonstrate mostly general or superficial ideas about design.

The final projects of the experimental group were evaluated by an expert panel using criteria such as originality, relevance, feasibility, and aesthetics. As illustrated in Figure 2, the experimental group significantly outperformed the control group on all criteria, with mean scores above 9 out of 10 across most dimensions.

**Figure 2.**

Expert evaluation of students' final project work on originality, relevance, feasibility, and aesthetics.

Overall, the results demonstrate that the author's methodology, integrating futuristic design creativity into the curriculum, effectively enhanced students' professional competence. Students in the experimental group showed significant gains in knowledge, creative and project skills, motivation, and ability to apply design to future-oriented challenges. These improvements were statistically and practically significant compared to the control group.

4. Discussion

The present study explored the effectiveness of integrating futuristic design creativity into the curriculum to enhance the professional competence of future art and design educators. The findings of the research demonstrated significant improvements in the experimental group across multiple dimensions of professional competence, including knowledge, creative and project-oriented skills, motivation, and the ability to apply design principles to future-oriented societal challenges. This section discusses the findings in the context of existing literature, elaborates on their implications, and highlights the contributions and limitations of the study.

The significant increase in students' knowledge and understanding of futuristic design observed in the experimental

group aligns with prior findings that underscore the importance of integrating innovative and forward-looking concepts into teacher education. Shulman [1] seminal work on teacher knowledge emphasized the need for pedagogical content knowledge that evolves with societal needs [1]. Similarly, Darling-Hammond et al. [2] argue that teacher education must adapt to the rapidly changing demands of the 21st century by equipping future educators with skills relevant to new social, technological, and cultural contexts [2].

The intervention described in this study successfully addressed these demands by exposing students to real-world problems and encouraging them to generate solutions that anticipate future developments. This approach is consistent with the design-based learning (DBL) paradigm, which has been shown to foster deep conceptual understanding and creativity among students [9, 10]. Moreover, Candy and Dunagan [5] highlighted that *futures thinking* and speculative design help learners imagine possible scenarios, critically assess them, and design innovative solutions that are critical for modern educators and designers alike [5].

The high scores achieved by the experimental group in project originality and relevance to societal needs resonate with the findings of Voogt et al. [3] who showed that students engaged in authentic, meaningful tasks develop higher-order thinking skills and greater creative capacity [3]. Similarly, Ruberg and Owens [8] noted that exposure to future-focused educational tasks enhanced students' engagement and fostered a sense of agency in addressing complex challenges [8].

One of the most notable findings was the increase in students' motivation to pursue a career in design and apply futuristic design concepts. This outcome aligns with research indicating that meaningful and contextually relevant tasks enhance intrinsic motivation and professional identity [11]. Students in the experimental group frequently described their experience as "inspiring" and "eye-opening," suggesting that the intervention not only equipped them with knowledge and skills but also shaped their attitudes toward their future profession.

This finding is particularly relevant given concerns in the literature about declining motivation and professional commitment among students in creative disciplines [12]. By providing students with opportunities to engage in future-oriented, impactful projects, the intervention appeared to mitigate these concerns and strengthen students' identification with their chosen profession.

The students' improved ability to identify diverse application areas of futuristic design, including culture, urban planning, transportation, and environmental sustainability, reflects the interdisciplinary nature of design as a field of practice. According to Johannessen et al. [4] design education must prepare students to engage with problems that cut across disciplines and scales, from personal experiences to global issues [4]. The experimental group's recognition of the relevance of futuristic design in multiple contexts suggests that the intervention effectively broadened their perspective and encouraged them to think beyond traditional boundaries.

This interdisciplinary outlook is crucial in light of global challenges such as climate change, social inequality, and technological disruption, which require innovative, cross-cutting solutions [13]. The ability to apply design thinking to such challenges is increasingly viewed as a hallmark of professional competence in creative and educational professions [14, 15].

Methodologically, the study demonstrates the value of combining quantitative and qualitative approaches to evaluate complex educational outcomes. The use of both questionnaires and expert evaluations provided a comprehensive assessment of students' development, capturing both measurable gains and nuanced changes in attitudes and thinking. This triangulated approach aligns with recommendations from educational research to use mixed methods for studying competence development [16].

Pedagogically, the study contributes to the growing body of evidence supporting project-based and design-based learning as effective strategies for developing professional competence. The intervention's focus on authentic, socially relevant projects mirrors the principles of experiential learning [17] which emphasize learning through doing, reflecting, and applying knowledge in real-world contexts.

The findings have several practical implications. First, they suggest that teacher education programs, particularly in art and design, should incorporate elements of futuristic and speculative design to better prepare students for the demands of a rapidly changing world. This aligns with the call by Voogt et al. [3] for education systems to focus not only on what students know but also on what they can do with that knowledge in complex, unpredictable situations [3].

Second, the study illustrates how embedding creative, future-oriented projects into the curriculum can enhance students' motivation, creativity, and professional identity. This is particularly relevant in disciplines where students may feel disconnected from the societal relevance of their work.

Third, the study underscores the importance of interdisciplinary education. By encouraging students to consider the cultural, social, technological, and environmental dimensions of design, educators can help students develop the holistic perspective necessary for addressing complex, real-world problems.

While the findings are encouraging, the study has several limitations. The sample was limited to two universities in Kazakhstan, which may affect the generalizability of the results. Future research could replicate the study in different cultural and institutional contexts to validate and extend the findings. Additionally, the study focused on short-term outcomes measured immediately after the intervention. Longitudinal studies are needed to assess the sustainability of the observed gains over time and their translation into professional practice.

Finally, the study primarily relied on self-reported data and expert evaluations, which, while informative, may be influenced by subjective biases. Future research could incorporate more objective measures of competence, such as performance-based assessments or observational data.

In conclusion, the study demonstrates that integrating futuristic design creativity into the curriculum can significantly enhance the professional competence of future art and design educators. The findings highlight the potential of project-

based, future-focused pedagogies to foster knowledge, creativity, motivation, and interdisciplinary thinking—qualities that are essential for professionals in the creative and educational fields. By aligning educational practices with the challenges and opportunities of the future, such interventions can better prepare students to contribute meaningfully to society and their professions.

5. Conclusions

This study investigated the effectiveness of an instructional methodology that integrates futuristic design creativity into the professional preparation of future art and design educators. The findings provide robust evidence that such an approach significantly enhances students' professional competence, encompassing knowledge, creative and project-oriented skills, motivation, and the ability to apply design principles to future-oriented societal challenges.

At the diagnostic stage, the results revealed that students' initial understanding of the concept of futuristic design was limited, with the majority of respondents reporting only superficial knowledge. Furthermore, their ability to identify its applications across different societal domains was constrained, and their motivation to pursue a career in design, while present, lacked a strong professional identity and confidence. These findings underscore the necessity of targeted pedagogical interventions aimed at addressing these gaps.

During the formative stage, the experimental group engaged in an eight-week program that incorporated futuristic design principles into the curriculum through project-based learning, creative exercises, and collaborative discussions. This intervention exposed students to authentic, meaningful, and interdisciplinary tasks, enabling them to conceptualize and develop innovative solutions to real-world problems with a future-oriented perspective. The control group, which followed the standard curriculum, did not receive this additional training and consequently showed minimal improvement in the same competencies.

At the evaluative stage, the experimental group demonstrated substantial gains across all assessed dimensions. Quantitative data showed that the proportion of students with a good or deep understanding of futuristic design nearly doubled, and their ability to correctly identify diverse applications of the concept and articulate its societal relevance improved dramatically. Furthermore, students in the experimental group exhibited significantly higher levels of motivation and stronger professional identity, viewing themselves as capable and responsible designers of the future. The expert evaluation of students' final projects confirmed these outcomes: the experimental group consistently outperformed the control group in originality, relevance to societal needs, feasibility, and aesthetic quality.

These results validate the hypothesis that integrating futuristic design creativity into the professional preparation of art and design educators is both effective and pedagogically valuable. The study contributes to the growing body of evidence supporting future-focused, project-based, and interdisciplinary approaches in higher education. It also demonstrates that fostering students' ability to envision and design for the future not only enhances their knowledge and skills but also inspires a deeper sense of professional purpose and engagement.

Practically, the findings suggest that teacher education programs, particularly in the arts and design, should actively incorporate futuristic and speculative design concepts into their curricula. This will help ensure that graduates are better prepared to navigate and shape the complex, rapidly evolving cultural, social, and technological landscapes they will encounter in their professional practice. Moreover, the study highlights the importance of interdisciplinary education, as students who engaged with problems that spanned cultural, environmental, and technological dimensions developed a more holistic and adaptive approach to design.

Nonetheless, the study has limitations that warrant consideration. The sample was limited to two universities in Kazakhstan, and the findings may not be directly generalizable to other cultural or institutional contexts. Additionally, the outcomes were measured immediately after the intervention, leaving open the question of their long-term sustainability and impact on actual professional practice. Future research could address these limitations by replicating the study in diverse settings and employing longitudinal designs to assess the durability of the observed effects.

In conclusion, the study affirms that the deliberate integration of futuristic design creativity into teacher education fosters not only the cognitive and technical components of professional competence but also the motivational and ethical dimensions, enabling students to embrace their roles as designers of meaningful, innovative, and sustainable futures. Such pedagogical innovations hold significant promise for preparing art and design educators who are not only proficient in their craft but also equipped to contribute responsibly to the cultural and societal transformation of the 21st century.

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