ART AND DESIGN
Journal homepage: https://art-design.com.ua/en
8(1), 2025

Received 24.10.2024 Revised 12.02.2025 Accepted 26.03.2025

UDC 7.05.001.891 DOI: 10.30857/2617-0272.2025.1.1

Creative experimentation and the generation of innovative ideas in artistic design

Sviatoslav Berdynskykh*
PhD in Technical Sciences, Associate Professor
"KROK" University
03113, 30-32 Tabirna Str., Kyiv, Ukraine
https://orcid.org/0000-0003-2911-7504

Mykola Yakovliev
Doctor of Technical Sciences, Professor
The National Academy of Arts of Ukraine
01054, 20 Bulvarno-Kudryavska Str., Kyiv, Ukraine
https://orcid.org/0000-0002-3977-0374

Kalyna Pashkevych
Doctor of Technical Sciences, Professor
Kyiv National University of Technologies and Design
01011, 2 Nemyrovycha-Danchenka Str., Kyiv, Ukraine
https://orcid.org/0000-0001-6760-3728

Abstract. The creative component of the design process is fundamental, as it is associated with the search for innovative solutions. In the creative process, the designer's imagination plays a leading role – it serves as the foundation for shaping and transforming the vision of the functional and aesthetic image of the future object. This study was aimed to identify and systematise the main strategic directions and techniques that stimulate the creative process in generating innovative solutions within modern design practice. The research methodology included the analysis of information sources on design methods; tools for form development in architectural, industrial, and environmental design; structural and systematic analysis; and synthesis of research results. It has been demonstrated that human imagination operates on the basis of previously formed visual images through perception. The strategic approach to creativity development is shaped by visual-operational experience. It has been established that the main method of generating new ideas is creative experimentation. To stimulate the creative process during the ideation stage, it is advisable to apply techniques such as decomposition, alteration of visual modelling tools, combinatorics, the use of simple and flexible tools, references and analogies, brainstorming, and design heuristics. The practical significance of these findings lies in their application to design practice, the education and training of specialists in artistic and creative fields, and further research in art history, cultural studies, architecture, and design

Keywords: project visualisation; form development; artistic modelling; visual image; imagination

INTRODUCTION

Innovative activity is one of the main objectives of design, and it has become increasingly significant in the modern era of automation, technical progress, and the advancement of computer technologies. The issue of idea generation remains insufficiently studied, particularly at the form-development stage, having been examined only from specific perspectives in various fields of creative activity. Thus, a comprehensive study is required to establish a complete picture of the methodology and principles of creativity design.

Suggested Citation:
Berdynskykh, S., Yakovliev, M., & Pashkevych, K. (2025). Creative experimentation and the generation of innovative ideas in artistic design. *Art and Design*, 8(1), 11-22. doi: 10.30857/2617-0272.2025.1.1.

*Corresponding author

Among the studies of the 2020s, it is worth considering the most relevant publications by foreign authors. For example, in an article by J. Boudier *et al.* (2023), the authors examined how experts assessed ideas and overcame cognitive fixation to create new directions for product and service development. The importance of idea evaluation was highlighted as a process aimed at identifying ideas with the highest potential for organisations while filtering out less valuable ones. The article also addressed challenges related to idea evaluation, which included the high level of uncertainty faced by evaluators, partially stemming from the unfinished nature of early versions of ideas and the originality of the concepts. The research provided insight into combining different theoretical perspectives to understand how ideas emerge through the gradual development of fragments.

B. Bucur *et al.* (2023) explored the generation of creative ideas in toy design, emphasising the importance of play as a method to stimulate creative thinking. The role of motivation in the creative process was also emphasised. The article proposed a creative approach to idea generation for toy design – specifically, a children's toy set in the form of a cup. The research drew upon creativity stimulation techniques adapted through play. During the process, a gradual transition took place from the initial idea to a manual sketch, digital modelling, and eventually, the physical creation of the entire set. The study introduced a new approach to creativity and idea generation, aimed at enhancing socialisation among both children and adults of various age groups, with potential applications in professional education.

An article by J.W. Lee *et al.* (2021), examined the challenges faced by both novice and experienced engineers in generating new ideas. The practical skills of students in idea generation, development, and selection were explored through "think-aloud" experimental sessions and post-session interviews. This study demonstrated that specific sessions focusing on learning blocks grounded in scientifically established design practices could help students develop clear approaches and goals at each stage of idea generation, development, and selection. The authors argued that supporting student design practices could equip them with the skills necessary to develop innovative solutions for solving complex openended design problems.

R. Bender-Salazar (2023) explored design thinking as a methodology for solving complex problems. This research used an enhanced version of design thinking, built on key themes of inspiration, ideation, and implementation, which was applied within the social sciences, specifically in systems thinking, organisational learning, and action research. S. Wu *et al.* (2024) highlighted the primary role of inspiring examples and references in design tasks intended to create visual properties that elicit the expected emotional response from the consumer.

Among the research conducted by Ukrainian scholars on the topic, the article of Professor O. Bodnar (2023) is noteworthy, as they investigate experimental directions in the design of architectural environments that emerged in the second half of the 20th century in Ukraine. This research clarifies the significance of experimentation and its forms of implementation in architecture and design, focusing on experimental directions such as rethinking geometrical-spatial concepts, applying geometry in design and architectural form development, the development of kinetic design practices, the spread of experimental design, and the development of bionics in experimental creativity and research from the 1960s to the 1980s. This study aimed to study methods of stimulating the creative process at the stages of conceptual development and sketching in design, as well as the role of creative experimentation in solving artistic design problems and developing professional skills for innovative thinking.

The theoretical and methodological basis of the study was shaped by the research of Ukrainian and foreign scientists specialising in the composition of architectural objects, design, and plastic arts, as well as by the work of architects, design practitioners, and teachers. The research drew upon developments in the fields of psychology of visual perception and creativity, technical aesthetics, applied geometry, information systems, machine intelligence, and the theory of inventive problem-solving. Theoretical studies on the generation of innovations, analysis of specific aspects of the creative process in engineering and design, and systematisation of innovative approaches to solving complex engineering problems were analysed. Particular emphasis was placed on research aimed at creating tools for effective idea generation based on scientific knowledge and technology. The methodological tools used included citation analysis, keyword search, search operators, machine learning algorithms for literature recommendations, and specialised databases such as Scopus, Web of Science, and Google Scholar.

IDEA-SEARCH STRATEGIES IN INTERNATION MIC DISCOURSE

In modern design practice, the creative component is the primary element that enables the generation of solutions characterised by originality and novelty. The process of creation is distinguished by the fact that it does not follow a fixed logical sequence, as in many other forms of activity, and the results of creativity are often associated with the so-called "insight". Most psychologists agree that a truly breakthrough creative solution to a problem is not accidental or merely a manifestation of giftedness but rather the result of prolonged work on the problematic situation (Kaufman & Sternberg, 2020).

A well-known example that supports this is the use of artificial intelligence in areas where creativity is crucial. A notable case is the historic match in 2016, where

the world champion of the Korean national game Go, Lee Sedol, lost to the AlphaGo programme, developed by DeepMind (owned by Google). AlphaGo won 4-1, marking a significant milestone in AI development, as Go is considered much more complex for computers than chess due to the enormous number of possible moves and strategies. This drew attention to the "creative approach" of the machine, capable of deep learning. The creative potential of artificial intelligence is being realised in traditionally artistic fields such as painting, architecture, music, and literature, proving that, while complex to describe and formalise, the creative process has a certain structure and can be analysed. This was discussed in the study by N. Leach (2023). Research on the issue of idea generation is actively progressing in scientific discourse across multiple areas (Fig. 1).

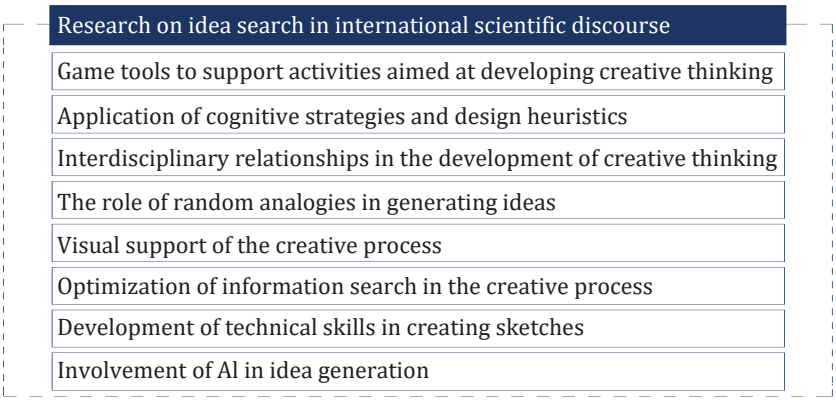

Figure 1. Directions of scientific research into idea generation in the 2020s
Source: created by the authors'

Research on various idea-search strategies is actively progressing in international academic discourse. Researchers M. Samaniego *et al.* (2024) identified and analysed characteristics related to creative thinking, particularly in the field of art and design education. The authors concluded that the most common or recommended educational method for fostering creative thinking is hands-on learning. Educational methods and practices most frequently used to support creative thinking emphasise interdisciplinary projects. Technological tools supporting activities aimed at fostering creativity include game-based applications or platforms, which motivate and facilitate learning by providing contexts rich in sensory stimuli. The identified skills associated with creative thinking include originality, fluency, flexibility, and elaboration.

Modern studies confirm the primary role of cognitive strategies that can be implemented by individual designers for successful concept creation. Design heuristics – mental shortcuts or empirical rules that significantly accelerate decision-making processes – facilitate the generation of new concepts at the early, conceptual stage of the design process and throughout idea development, according to many researchers. For design and engineering students, having a repertoire of design heuristics can enhance the diversity and creativity of concepts generated (Yilmaz *et al*., 2015).

Authors X. Jin & H. Dong (2020) identified ten specific design heuristics (Adding Drone Technology, Changing Functions via Turning, Utilising Display Technology, Utilising Lights and Sounds, Utilising Foldable Structure, Adding Sharing Service, Adding Smart Function, Manage and Control Remotely, Shaking Product for Novel Effects, Smart Reminder) that helped designers create innovative ideas during the conceptual design stages. The results demonstrated the potential of design heuristics. The new DHS (Design Heuristics System) proved useful in generating concepts with diverse "new" features, illustrating the potential of new design heuristics for supporting rapid and varied concept generation in industrial design.

Research by X. Gu *et al*. (2023) sought to develop a creativity course for university students, incorporating STEAM activities to practice and strengthen creative thinking skills. STEAM-based education – science, technology, engineering, arts, and mathematics – emphasises building connections across different disciplines and is considered by the authors a promising approach to developing general creative thinking skills in design and related fields. The findings indicate that integrating creativity education with practical activities can be an effective approach to fostering creativity.

S.M. Hassan (2023) examined the use of SCAMPER to generate ideas and enhance students' creative potential. SCAMPER – an acronym for seven techniques: Substitute, Combine, Adapt, Maximise or minimise, Put to other uses, Eliminate, and Rearrange or reverse – is a unique brainstorming and creativity tool designed to facilitate active idea generation. It can be used to generate a continuous flow of ideas or offer a fresh perspective on a problem; it is especially effective in overcoming creative blocks. SCAMPER employs a set of structured questions to modify the task being considered, exploring various aspects for improvement. This widely

recognised learning tool promotes perception, viability, fluency, flexibility, and originality. The process is stimulated by posing questions that are not typically considered. Hassan's study results demonstrated that using SCAMPER positively influenced graphic design students, accelerated idea generation, and fostered a stimulating environment for practising creative thinking.

Large language models (LLMs) present new opportunities and challenges for involving AI agents directly in brainstorming sessions. M. Muller *et al.* (2024) developed an AI agent to act as an interactive participant in online conversational brainstorming sessions for a distributed workforce. Humans and AI collaborated in developing, evaluating, refining, and selecting numerous ideas using five different development models. Authors K. Ma *et al.* (2023) found that, with brief training, LLMs could generate design solutions comparable to crowdsourced solutions; however, limitations were identified regarding the diversity of solutions that LLMs were capable of generating.

H. Li *et al*. (2022) proposed a Generative Design Approach (GDA), which was considered an effective method for exploring an extensive design solution space by transforming the design problem into a configuration problem. Thus, the design solution space could be explored more effectively by adjusting variable design elements through iterative design processes.

In his study, researcher J. Grigg (2020) examined the ability of visual materials to dynamically express the properties of what is depicted, thus shaping the language of graphic design. The article highlighted the importance of understanding graphic techniques, carefully selecting tools, and implementing them appropriately. Materials and tools were analysed as catalysts for conceptual invention in graphic design. Accordingly, modifying tools or graphic techniques can influence the creative search process and idea generation. Researchers M. Žujović *et al.* (2022) argued that integrating 3D printing (3DP) technology into the design process can stimulate creative thinking, leading to more complex design solutions than those produced through traditional teaching methods. Compared to conventional approaches, 3DP technology enables the creation of physical models that are conceptually and geometrically more intricate. A. Al Ruheili & S. Al Hajri (2021) demonstrated the feasibility of using 3DP methods in the teaching and learning of landscape architecture, noting increased student engagement in projects and improved comprehension and representation of spatial and design concepts.

According to C. Chavula *et al.* (2022), information searching is an integral component of the creative thinking process. Their study sought to identify the creative thinking processes and search strategies students employ to generate new ideas in academic and everyday life. The article outlined four distinct yet interconnected processes of creative thinking: planning creative search tasks, seeking new ideas, synthesising search results, and structuring ideas. Based on the findings, the authors advocated for the development of search systems that support creative thinking processes. The researchers suggested that additional features in search systems could enable users to explore information from multiple perspectives and synthesise ideas more effectively.

The article by Y. Zhang *et al.* (2020) also examines information search. The authors identified six types of information crucial for creative projects related to design: procedural information, domain knowledge, ready-made examples, advice/opinions/recommendations, topic-specific information, and inspiring/motivating information. The researchers argued that enhancing search support during creative tasks can lead to results that extend beyond traditional understandings.

S. Sinha & B.K. Chakravarthy (2023) refer to the theory of synectics, which suggests that triggers for creative thinking arise from analogies that create connections between rational and irrational perspectives on a problem. To create a structured mechanism for creative production, the researchers explored the role of ideas triggered by random analogy as a means of embedding potential solutions to catalyse the creative process. J.C. Kaufman & R.J. Sternberg (2020) emphasised the role of motivation in creativity in their book. Drawing on a substantial body of research, the authors demonstrated that intrinsic motivation and the positive effect associated with it correlate with greater creativity. The findings of this study generally align with previous research, consolidating and expanding existing knowledge in this field.

STRUCTURE OF THE CREATIVE AND SEARCH PROCESS IN DESIGN

The unconventional thinking often attributed to the exceptional talents of a designer is more likely the result of in-depth professional mastery (What are the stages of creativity, 2021). Without undermining the role of individual abilities, it is important to acknowledge that experience plays a central role in generating creative solutions. The breadth of project scenarios designer has encountered shapes their ability to evaluate various factors and manage the structural components of a project across' all levels. A product is considered truly if it performs a new function that no existing product currently fulfils. This was discussed in the article by S. Jagtap (2018), which examined methods for measuring novelty as a means of assessing creativity.

Methods of activating the creative process are well known and widely applied in many areas of fields (including science, business, and engineering design). These methods are founded on analysis, synthesis, and evaluative decision-making and include stages such as divergence (expanding the boundaries of the project situation'), transformation (developing principles and

concepts), and convergence (refining and selecting the most effective solution for the given project context). The authors M-D. González-Zamar & E. Abad-Segura (2021) affirmed that the importance of creative thinking in young students lies in the fact that it encompasses both divergent and convergent processes. Motivation also plays a significant role in creativity. The data presented in the article by J. Kaufman *et al.* (2023) further indicated that both convergent and divergent thinking are integral to creativity. Researchers P. Childs *et al.* (2022) proposed a structure called the creativity diamond – a tool consisting of a divergent phase (focused on developing a wide range of ideas) and a convergent phase (centred on refining and selecting the most viable ideas).

The creative process in design practice, aimed at creating innovative products, is generally cyclical, with each cycle involving the reassessment of project factors, the refinement of tasks, and the progressive enhancement of the design object's model. At many stages, this process can branch out, potentially leading to alternative solutions (Fig. 2).

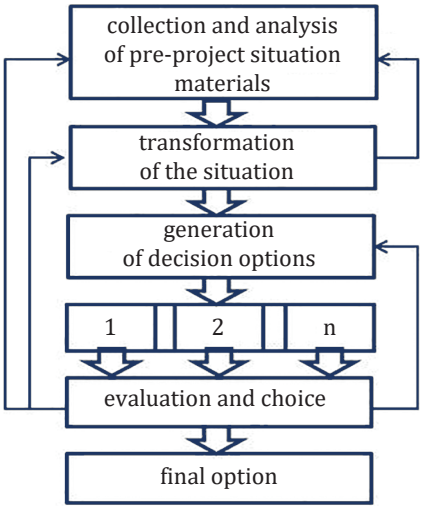

Figure 2. Cyclical process of idea generation in design
Source: created by the authors'

Certain stages of the design process (conceptual exploration) occur both through mental visualisation and by manipulating concepts and logical units, which involves the formation of abstract representations. However, the form-development process itself depends on visual aids, as its ultimate goal is the tangible representation of the object.

Professor M.I. Yakovlev (2007) determined that one key aspect of professionalism in design is the ability to use existing visualisation tools and capitalise on the visual resources embedded within them. The most significant qualities of the object being designed are typically conveyed through drawing, modelling, or computer graphics. A key characteristic of human perception's is that the visual representation of an object, unlike a textual description, is immediately subject to aesthetic evaluation. According to psychologists, intuition plays a fundamental role in recognising the value of a solution, preceding the logical analysis that follows in assessing the relationships and properties of the depicted object.

The role of the sketch as a visualised design concept remains consistently significant. The sketching process itself serves as the primary strategy for design planning, facilitating the search for the optimal solution through the use of visual resources at all stages of the design process. The tools used in sketch-based exploration are highly varied, ranging from the traditional pencil sketch to artificial intelligence-based technologies described by M. Mazzone & A. Elgammal (2019). Authors B. Kim & E.-C. Jung (2023) asserted that sketching is about exploring concepts and transforming their components to reinterpret existing ideas.

An essential aspect of stimulating the creative process is the communicative interplay between the designer and the visual images that accompany the entire process of form creation. Imagination, which enables the formation and transformation of these images, is the key mechanism behind most design transformations. For the designer, it functions as the principal tool for cognition and modelling (Kaufman & Sternberg, 2020). The concept of the model, conceived during the thought process, often takes precedence in shaping the design and directs the designer's work at all subsequent stages. Fixing an idea into a specific visual image during the early stages of development typically reflects only its key characteristics (such as the general configuration of the form, the nomenclature and quantity of elements, and their spatial relationships). The author's inherent subjectivity and the highly generalised nature of the image provide the basis for an objective evaluation and further imaginative transformation and modelling of the project scenario.

During the design process, sketching documents the entire sequence of conceptual transformations, where the evaluation of each preceding image serves as the starting point for the next iteration of the idea. The conversion of concepts into a different visual form depends on the designer's intended objectives. Subsequent crucial compositional and structural tasks may include refining the geometric parameters of the form, searching for colour solutions, developing compositional frameworks, resolving the form's plasticity, and addressing its structural integrity. It is well established that any design situation can be divided into simpler, interconnected tasks that reflect the various aspects of creative development. Each visual modelling technique has its own method for describing and editing elements, shaping the overall transformation process and occasionally generating unexpected alternative branches in the idea's development. These deviations can sometimes lead to groundbreaking innovative discoveries.

VISUAL EXPERIENCE AS A FACTOR IN THE EFFECTIVENESS OF CREATIVE THINKING

Since imagination relies on sensory images derived from previously perceived objects and phenomena, it can be concluded that one of the key strategies for developing creative capabilities involves expanding the scope of imagination by consciously engaging with renowned architectural structures, design objects, and other visual artworks. In his book, R.W. Weisberg' (2020) examined how creative innovation depends on thinking outside the box. According to the author, creativity is rooted in prior knowledge and the ability to repurpose existing ideas to generate new ones.

An illustrative example of this is the formation of professional creative thinking in future design specialists. During their education, significant attention is paid to the compositional analysis of wellknown architectural and design objects. The morphological composition of a form is studied to understand the relative importance of key factors that effectively influence the user experience, situate the work within a socio-cultural context, and integrate other relevant aspects. These considerations ultimately play a crucial role in expanding the designer's repertoire of imagery. Both practical experimental experience and theoretical knowledge of form-development tools are essential prerequisites for effective creative exploration during the sketching stage (Denysenko *et al*., 2022).

Historical developments demonstrate the evolutionary progression of spatial and plastic structures within material culture. Spatial thinking emerged through the imitation of natural forms, the use of available modelling tools, experience with various materials, and advancements in processing new technologies (Fig. 3). Similarly, R. Burrows (2018) explored the evolution of geometry, its impact on technological innovations, and its role in shaping contemporary worldviews. The transformation of intellectual paradigms led to a reinterpretation of the "magical" context of form, while shifting perceptions of the universe's structure aligned with the creative pursuits of artists across historical periods. Architects' and designers' mastery of geometric tools enhanced form-development methods and enabled the depiction of complex spatial surfaces. Developments in physics and engineering necessitated the invention of new structural systems and material configurations that fulfilled functional requirements. The advent of computational modelling tools further facilitated the diversification of spatial structures, allowing for more sophisticated design approaches.

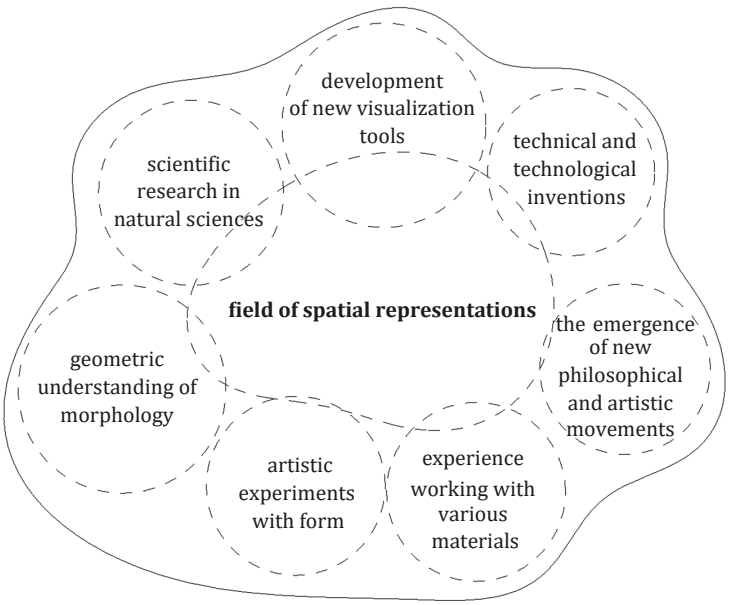

Figure 3. Factors influencing the expansion of spatial representations
Source: created by the authors'

Visual representations evolved and diversified with the advent of new philosophical knowledge that reshaped the aesthetics of form and space, manifested in the experiments of leading artists. The early 20th century witnessed avant-garde movements whose representatives actively employed varied and in-depth research methods in their exploration of form, extending their experimentation across all creative disciplines. The artistic techniques pioneered by the avant-gardists served as a catalyst for the emergence of a new aesthetic culture (Bodnar, 2023).

According to researchers, three-dimensional images in the imagination are constructed through the geometric perception and analysis of form morphology.

Architectural design prior to the early 19th century can be regarded as the result of modelling forms through planar or axonometric representations. Orthogonal projections, a highly effective tool for form modelling, were fully developed by the late 18th century when the accumulated rules and methods of image construction were systematised by the French scientist Gaspard Monge in his book Géométrie Descriptive. This paved the way for further advancements in geometric methods of form construction, which eventually evolved into geometric modelling and the generation of complex surfaces.

A renewed interest in geometry as the conceptual foundation of form development among architects and designers emerged during the post-war period of the 20th century, building upon new concepts of spatial comprehension. Many leading professionals focused on mastering novel sources and tools for shaping forms. The projects of Eero Saarinen from the 1950s and 1960s exemplify architects' and designers' ability to manipulate complex forms with precision (Foxe, 2018).

The late 20th century saw creative explorations of form at the intersection of mathematics, projective geometry, crystallography, combinatorial theory, and computational form development (Bodnar, 2023). The development of geometric analyses of bionic forms, later brought to fruition through 3D computer modelling technologies, significantly gained traction. These innovative approaches to form development were reflected in the works of renowned designers and architects. A radical departure from the concept of orthogonality is evident in the works of Zaha Hadid, who actively employed new parametric design technologies to develop intricate "organic" forms. Fundamentally, she demonstrated the practical application of multidimensional geometry (Arch2O, 2020). Contemporary form-development approaches are often rooted in parametric design principles, where design elements are interconnected through mathematical or logical relationships. This framework facilitates the creation of complex and adaptive forms that can be efficiently modified and optimised based on specific tasks or conditions.

The development of visual representations is also evolving alongside advancements in visual communications, which have recently been rapidly integrated into the socio-cultural environment and have a strong influence on design processes, as comprehensively studied by N.V. Sklyarenko (2023).

In art and architectural education, one of the key approaches to developing creative potential and visual thinking involves experiments with abstract graphic and volumetric-plastic images, particularly at the initial stages of training. These fundamental exercises involve points, lines, shapes, planes, volumes, and spaces. Material and graphic technique experiments aim to develop an understanding of how to achieve a harmonious balance and expressiveness by comparing their formal properties and analysing the impact of changes in the qualitative indicators of the components on the perception of the whole.

STRATEGIES FOR ACTIVATING CREATIVITY IN DESIGN PRACTICE

The authors J.C. Kaufman & R.J. Sternberg (2020) argued that the primary condition for creativity is a focus on thinking in novel, unexpected, and compelling ways. Beyond the historical and educational context, when examining the structure of the modern design creativity process, several methods of activating the creative process can be identified (Fig. 4).

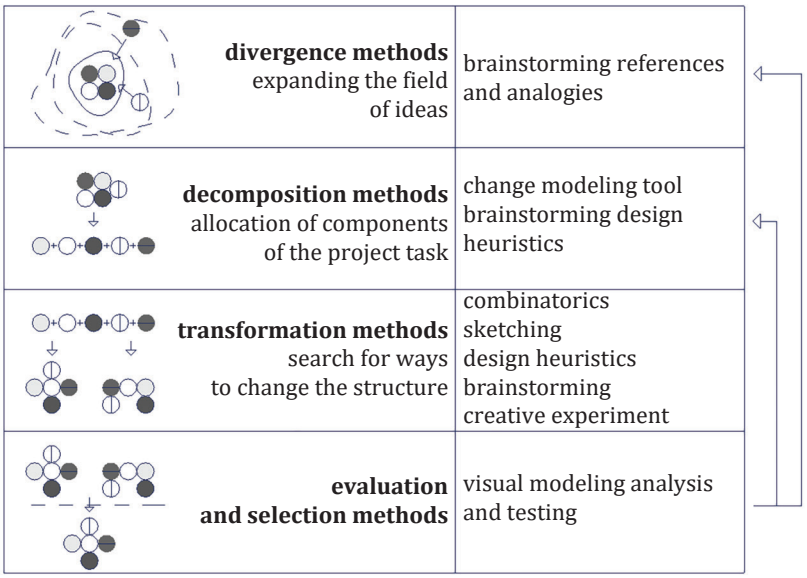

Figure 4. Application of tools to stimulate the creative process at the stages of creative exploration
Source: created by the authors'

One effective method for stimulating creative thinking is decomposition. The essence of decomposition lies in breaking the model into component parts to identify new relationships between them. By analysing various characteristics, a certain number of units can be isolated from the same object, such as structural blocks, functional zones, groups of objects, or typological units.

Indeed, the decomposition stage is present at all stages of the creative process, serving as the foundation for the next transformation of the design image. However, the methods and levels of decomposition can differ significantly depending on the visualisation tool employed. For instance, collage utilises shapes, vector graphics incorporate lines and shapes, modelling involves constructive blocks, and 3D modelling manipulates objects, elements, or polygons. The number of components should be moderated, as an excessively fragmented object does not yield the desired result, ultimately leading to the near-complete destruction of the image. Occasionally, changing the visual modelling tool (from drawing to sketch, from sketch to 3D modelling, etc.) can stimulate creativity, as each visual design tool operates according to its own principle of composition and decomposition. Thus, altering the tool can reveal new relationships in the design task.

Combinatorics is another method closely related to decomposition in achieving creative solutions. It involves finding optimal ways to position elements and the best combination of their characteristics by exploring possible arrangements. Combinatorics, as a transformation tool, often outpaces the imagination in predicting potential outcomes, as it generates a multitude of design alternatives, significantly expanding the scope of visualisations. Experimentation forms the basis of the combinatorial approach to form development, introducing heuristic methods for solving design and compositional problems. The application of combinatorial principles became possible with the introduction of computer graphics technologies. The communication process between the designer and the computer has become much more efficient with the development of generative artificial intelligence technologies, which can produce diverse variations in form and colour based on human sketches. Although these technologies are not yet perfect, more progressive designers believe this field will soon become a priority in design and exploratory processes. Research by A. Arias-Rosales (2022) offers insight into the promising functions of artificial intelligence in design, using their own development as an example.

One combinatorial method for enhancing creative thinking flexibility and breaking away from conventional thinking patterns is the use of heuristics. Design heuristics constitute a specific set of pre-developed rules that reflect cognitive strategies for creating new concepts. For example, design heuristics offer methods for altering functions (enlarging or reducing scale, dividing continuous surfaces, mirroring forms, etc.). The authors X. Jin & H. Dong (2020) found that using multiple design heuristics can lead to interesting potential design options.

The use of simple and flexible visualisation tools stimulates the search for innovative solutions. The speed and technological simplicity of creating images enable the mind to work continuously and effectively engage the imagination, promoting the generation of creative solutions. Freeing the mind from storing unnecessary information and logic allows creative resources to be utilised more efficiently. Quick sketches from imagination, for example, help activate creative intuition, a crucial component of professional design thinking. In a study by T. Leblanc (2015), it was determined that generating a high quantity of ideas allows for the rejection of less interesting concepts, paving the way for creativity to emerge. Not only are drawing tools effective in the creative search process (although some authors, such as T. Page (2019), have suggested that the traditional design environment promotes a greater diversity of ideas, design strategies, and solutions than the digital design environment). Simple computer modelling tools that allow for rapid modification of the form and properties of the depicted object are also flexible instruments. Research by J.D. Camba *et al*. (2018) and W. Zhang & C. Ranscombe (2021) has shown that digital sketches can help create higher-quality results than those made using traditional methods. One such tool is the SketchUp 3D modelling application, which is noted for its ease of learning and use. Based on the intuitive paradigm of geometric modelling (where the primary constructive elements in 3D space are the plane and line), this application has gained significant popularity among architects and designers.

Brainstorming is a method for generating ideas, generally involving a group of people who aim to express as many solutions to a problem as possible, even if some ideas seem highly unconventional. In visual solutions for design tasks, this adapted method involves generating numerous images through quick sketch explorations. This process facilitates the creation and expansion of an idea bank, which is later organised systematised.

A related method to brainstorming in design activity is clausura (design sketches), which includes not only data about the objective properties of the future object but also images that show associative analogies – natural objects, artistic works, or fantasy images that the author relies on when developing the project concept. Clausura can also include explanations, diagrams, etc. Completing clausura within a set time frame helps develop the ability to think unconventionally.

The use of references or analogies for inspiration, analysis, and synthesis often helps overcome design crises and identify alternative directions for idea development. A reference does not have to be a direct analogue of the object being researched but can also include

visual images and forms unrelated to the project, which, due to their properties, can offer clues for further idea exploration. One effective tool for working with references is creating mood boards. The primary function of a mood board is to convey the atmosphere and mood, as well as the main associative characteristics of the work. Using mood boards, a specialist develops and refines a holistic vision of the result, as proven by A.M. Velasquez-Posada (2019). An interesting perspective on the point of view of the feasibility of using collage in the creative process is presented in the article by M. Hua *et al.* (2019). The paper conducts an empirical study to examine the potential of combinational visual stimuli in enhancing the creative search processes of designers. The authors demonstrate that combined visual stimuli best support design creativity, which is expected to have important positive effects both for design education and for the development of design support tools.

CONCLUSIONS

The analysis of the evolution of spatial ideas demonstrates that innovation in artistic design is associated with experimental activities, stimulated by new philosophical and artistic movements, the mastery of geometric tools, the results of scientific research in the natural sciences, technological innovations, and the improvement of visual modelling instruments.

The methods for stimulating the creative process in modern design practice aim to create conditions for greater freedom of action in experimentation, breaking away from established templates, expanding the field of imagination, the ability to generate and identify possible connections faster, and evaluating potential alternatives. The foundation for creating innovative solutions is the visual experience gained through creative practice during educational processes, experimental creative tasks, the analysis of art and architecture, and practical experience.

The integration of scientifically based ideation practices into artistic and creative activities has the potential to significantly increase innovation. In this study, the scope of information has been expanded, and techniques and approaches for addressing design tasks associated with experimental methods of generating innovative solutions in the field of artistic form development have been outlined for the first time.

Findings indicate that the processes of convergence and divergence form the basis of creativity. Incorporating new knowledge, random analogies, and expanding the reference base within the design problem can significantly enhance the novelty of solutions. It has been established that most strategies for stimulating the creative process are based on combinatorial principles. The expansion of the spectrum of combinatorial operations occurs at the morphological, conceptual, and functional levels, including when using controlled question techniques, sets of heuristics, etc.

The method of decomposition of the design problem defines the field of idea transformation and influences the effectiveness of idea development. Decomposition parameters are associated with modelling tools; therefore, increasing the range of visualisation tools can enhance the originality of ideas. The creativity-enhancing methods identified in the study can broaden the designer's range of techniques.

Future research prospects in this field lie in developing methodologies for incorporating creative thinking stimulation methods into design processes and creating theoretical principles and practical recommendations for applying a comprehensive set of visualisation tools in artistic and design activities.

ACKNOWLEDGEMENTS

None.

FUNDING

None.

CONFLICT OF INTEREST

None.

REFERENCES

[1] Al Ruheili, A., & Al Hajri, S. (2021). The role of 3D printing technology in landscape architecture teaching and learning practices. *Educational Sciences: Theory & Practice*, 21(2), 13-26. doi: 10.12738/jestp.2021.1.001.

[2] Arch2O. (2020). *Zaha Hadid paintings: What can we learn about the architect's creative framework?* Retrieved from https://www.arch2o.com/zaha-hadid-paintings-what-can-we-learn-about-the-architects-creative-framework/.

[3] Arias-Rosales, A. (2022) The perceived value of human-AI collaboration in early shape exploration: An exploratory assessment. *PLoS ONE*, 17(9), article number 0274496. doi: 10.1371/journal.pone.0274496.

[4] Bender-Salazar, R. (2023). Design thinking as an effective method for problem-setting and needfinding for entrepreneurial teams addressing wicked problems. *Journal of Innovation and Entrepreneurship,* 12, article number 24. doi: 10.1186/s13731-023-00291-2.

[5] Bodnar, O. (2023). Experimental trends in the design of the architectural environment of Ukraine in the second half of the 20th century. *Bulletin of KNUKiM. Series in Arts*, (48), 117-124. doi: 10.31866/2410-1176.48.2023.282473.

[6] Boudier, J., Sukhov, A., Netz, J., Le Masson, P., & Weil, B. (2023). Idea evaluation as a design process: Understanding how experts develop ideas and manage fixations. *Design Science*, 9, article number 9. doi: 10.1017/dsj.2023.7.

[7] Bucur, B., Ban, A., Vlase, S., & Modrea, A. (2023). Creativity and generation of ideas in the design of children's toys. *Children,* 10(1), article number 129. doi: 10.3390/children10010129.
[8] Burrows, R. (2018). *3D thinking in design and architecture: From antiquity to the future.* London: Thames and Hudson.
[9] Camba, J.D., Kimbrough, M., & Kwon, E. (2018). Conceptual product design in digital and traditional sketching environments: A comparative exploratory study. *Journal of Design Research*, 16(2), article number 131. doi: 10.1504/jdr.2018.10014195.
[10] Chavula, C., Choi, Y., & Rieh, S.Y. (2022). Understanding creative thinking processes in searching for new ideas. In *Proceedings of the 2022 conference on human information interaction and retrieval* (pp. 321-326). New York: Association for Computing Machinery. doi: 10.1145/3498366.3505783.
[11] Childs, P., Han, J., Chen, L., Jiang, P., Wang, P., Park, D., Yin, Y., Dieckmann, E., & Vilanova, I. (2022). The creativity diamond – a framework to aid creativity. *Journal of Intelligence*, 10(4), article number 73. doi: 10.3390/jintelligence10040073.
[12] Denysenko, Yu., Omelchenko, A., & Makarchuk, J. (2022). Methods and techniques for finding creative solutions. *Culture and Contemporaneity*, 24(1), 106-110. doi: 10.32461/2226-0285.1.2022.262579.
[13] Foxe, D.M. (2010). Saarinen's shell game: Tensions, structures, and sounds. *Nexus Network Journal*, 12(2), 191-211. doi: 10.1007/s00004-010-0027-3.
[14] González-Zamar, M.-D., & Abad-Segura, E. (2021). Digital design in artistic education: An overview of research in the university setting. *Education Sciences*, 11(4), article number 144. doi: 10.3390/educsci11040144.
[15] Grigg, J. (2020). Materials and tools as catalysts of invention in graphic design ideation. *Design Studies*, 70, article number 100960. doi: 10.1016/j.destud.2020.100960.
[16] Gu, X., Tong, D., Shi, P., Zou, Y., Yuan, H., Chen, C., & Zhao, G. (2023). Incorporating STEAM activities into creativity training in higher education. *Thinking Skills and Creativity*, 50, article number 101395. doi: 10.1016/j.tsc.2023.101395.
[17] Hassan, S.M. (2023). SCAMPER as a creative idea generation method: Case study on graphic design students. *Information Sciences Letters*, 12(4), 1417-1426.
[18] Hua, M., Han, J., Ma, X., & Childs, P. (2019). Exploring the effect of combinational pictorial stimuli on creative design performance. *Proceedings of the Design Society: International Conference on Engineering Design*, 1(1), 1763-1772. doi: 10.1017/dsi.2019.182.
[19] Jagtap, S. (2018). Design creativity: Refined method for novelty assessment. *International Journal of Design Creativity and Innovation*, 7(1-2), 99-115. doi: 10.1080/21650349.2018.1463176.
[20] Jin, X., & Dong, H. (2020). New design heuristics in the digital era. In *Proceedings of the design society: DESIGN conference* (Vol. 1, pp. 607-616). Cambridge: Cambridge University Press. doi: 10.1017/dsd.2020.321.
[21] Kaufman, J.C., & Sternberg, R.J. (Eds.). (2020). *The Cambridge handbook of creativity* (2nd ed.). Cambridge: Cambridge University Press.
[22] Kaufman, J.C., Kapoor, H., Patston, T., & Cropley, D.H. (2023). Explaining standardized educational test scores: The role of creativity above and beyond GPA and personality. *Psychology of Aesthetics, Creativity, and the Arts,* 17(6), 725-734. doi: 10.1037/aca0000433.
[23] Kim, B., & Jung, E.-C. (2023). Three unique concept explorations in sketching based on conceptual combinations in associative extension and schematic structure. *Thinking Skills and Creativity*, 48, article number 101281. doi: 10.1016/j.tsc.2023.101281.
[24] Leach, N. (2023). Architecture in the age of artificial intelligence an introduction to AI for architects. *TECHNE – Journal of Technology for Architecture and Environment*, 25, 272-273. doi: 10.36253/techne-14769.
[25] Leblanc, T. (2015). Sketching as a thinking process. In *DS 82: Proceedings of the 17th international conference on engineering and product design education (e&pde15), great expectations: Design teaching, research & enterprise* (pp. 606-611). Loughborough: The Design Society.
[26] Lee, J.W., Daly, S.R., Huang-Saad, A., Rodriguez, G., DeVries, Q., & Seifert, C.M. (2021). A solution in search of problems: A cognitive tool for solution mapping to promote divergent thinking. *Journal of Engineering Design*, 32(6), 300-321. doi: 10.1080/09544828.2021.1887462.
[27] Li, H., Lu, Q., & Lachmayer, R. (2022). A modeling framework to support the implementation of engineering changes in designing complex products. *Research in Engineering Design*, 33(3), 249-271. doi: 10.1007/s00163-022-00388-x.
[28] Ma, K., Grandi, D., McComb, Ch., & Goucher-Lambert, K. (2023). Conceptual design generation using large language models. *ARXIV.* doi: 10.48550/arXiv.2306.01779.
[29] Mazzone, M., & Elgammal, A. (2019). Art, creativity, and the potential of artificial intelligence. *Arts,* 8(1), article number 26. doi: 10.3390/arts8010026.

[30] Muller, M., Houde, S., Gonzalez, G., Brimijoin, K., Ross, S.I., Moran, D.A.S., & Weisz, J.D. (2024). Group brainstorming with an AI agent: Creating and selecting ideas. In *International conference on computational creativity*. Denver: ICCC 2024.
[31] Page, T. (2019). A comparison of haptic sketching and digital sketching: Considerations of final year design students. *International Journal of Information and Communication Technology Education (IJICTE)*, 15(2), 146-161. doi: 10.4018/IJICTE.2019040109.
[32] Samaniego, M., Usca, N., Salguero, J., & Quevedo, W. (2024). Creative thinking in art and design education: A systematic review. *Education Sciences,* 14(2), article number 192. doi: 10.3390/educsci14020192.
[33] Sinha, S., & Chakravarthy, B.K. (2023). Role of random analogy as catalyst to creative idea generation in the early stage of new product design. In A. Chakrabarti & V. Singh (Eds.), *Design in the era of Industry 4.0, (Vol. 3)* (pp. 475-487). Berlin: Springer. doi: 10.1007/978-981-99-0428-0_39.
[34] Sklyarenko, N.V. (2023). Visual communications in design: Dynamic concepts of sustainable development. *Humanities Science Current Issues,* 3(69), 58-64. doi: 10.24919/2308-4863/69-3-8.
[35] Velasquez-Posada, A.M. (2019). How to be systematic with mood boards? In *2019 IEEE frontiers in education conference (FIE)* (pp. 1-4). Covington: IEEE. doi: 10.1109/FIE43999.2019.9028383.
[36] Weisberg, R.W. (2020). Rethinking creativity. In *Rethinking creativity: Inside-the-box thinking as the basis for innovation*. Cambridge: Cambridge University Press.
[37] What are the stages of creativity? (2021). *The interaction design foundation*. Retrieved from https://www.interaction-design.org/literature/article/what-are-the-stages-of-creativity.
[38] Wu, S., van den Hende, E., Hultink, E.-J., & Calabretta, G. (2024). Inspiration for styling tasks. *Design Studies*, 91-92, article number 101254. doi: 10.1016/j.destud.2024.101254.
[39] Yakovlev, M.I. (2007). *Composition + geometry*. Kyiv: Karavela.
[40] Yilmaz, S., Daly, S.R., Seifert, C.M., & Gonzalez, R. (2015). How do designers generate new ideas? Design heuristics across two disciplines. *Design Science*, 1, article number 4. doi: 10.1017/dsj.2015.4.
[41] Zhang, W., & Ranscombe, C. (2021). Embracing new visualisation tools in education: How the learning experience of digital sketching influences its use in design practice. *Proceedings of the Design Society*, 1, 1353-1362. doi:10.1017/pds.2021.135.
[42] Zhang, Y., Capra, R., & Li., Y. (2020). An In-situ study of information needs in design-related creative projects. In *Proceedings of the 2020 conference on human information interaction and retrieval* (pp. 113-123). New York, USA. doi: 10.1145/3343413.3377973.
[43] Žujović, M., Obradović, R., Rakonjac, I., & Milošević, J. (2022). 3D printing technologies in architectural design and construction: A systematic literature review. *Buildings*, 12(9), article number 1319. doi: 10.3390/buildings12091319.

Творчий експеримент та генерація новітніх ідей в художньому проєктуванні

Святослав Бердинських

Кандидат технічних наук, доцент
Університет економіки та права «КРОК»
03113, вул. Табірна, 30-32, м. Київ, Україна
https://orcid.org/0000-0003-2911-7504

Микола Яковлєв

Доктор технічних наук, професор
Національна академія мистецтв України
01054, вул. Бульварно-Кудрявська, 20, м. Київ, Україна
https://orcid.org/0000-0002-3977-0374

Калина Пашкевич

Доктор технічних наук, професор
Київський національний університет технологій та дизайну
01011, вул. Мала Шияновська, 2, м. Київ, Україна
https://orcid.org/0000-0001-6760-3728

Анотація. Творча складова в процесі проектування є основним розділом, оскільки пов'язана з пошуком інноваційних рішень. У творчому процесі провідну роль відіграє уява дизайнера – ключова сфера формування та трансформації бачення функціонального та естетичного образу майбутнього об'єкта. Метою даної роботи було визначення та систематизація основних стратегічних напрямів та прийомів стимулювання творчого процесу, спрямованого на генерування інноваційних рішень у сучасній дизайнерській діяльності. У дослідженні використано аналіз інформаційних джерел у галузі методів проектування; інструментів формоутворення об'єктів архітектурного, промислового та середовищного дизайну; структурно-системний аналіз; узагальнення результатів досліджень. Доведено, що людська уява працює на основі раніше сформованих візуальних образів через сприйняття. Стратегічний напрям розвитку креативності визначався через візуально-операційний досвід. Встановлено, що основним методом отримання нових ідей є творче експериментування. Для стимулювання творчого процесу на етапі пошуку доцільно застосовувати такі процедури, як декомпозиція, зміна інструменту візуального моделювання, комбінаторика, використання простих і гнучких інструментів, референцій та аналогій, мозковий штурм і проектна евристика. Практичне значення отриманих результатів може бути застосоване в дизайнерській практиці, в освітньому процесі підготовки фахівців мистецьких та креативних спеціальностей, а також у подальших дослідженнях в галузі мистецтвознавства, культурології, архітектури та дизайну

Ключові слова: проєктна візуалізація; формоутворення; художнє моделювання; візуальний образ; уява