

A Conceptual Framework for Creativity in Product Design Problem Solving Through Problem Framing, Ideation and Creative Form Development

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DOI: <https://dx.doi.org/10.47772/IJRISS.2026.100600330>

Received: 24 May 2026; Accepted: 29 May 2026; Published: 23 June 2026

ABSTRACT

Creativity in product design problem solving is often discussed through separate concerns such as problem framing, ideation and form development, resulting in limited conceptual clarity on how these processes interact. This conceptual paper aims to develop a framework that explains creativity as an integrated process through which designers interpret design problems, generate alternative ideas and transform abstract concepts into meaningful product forms. The study adopts a theory-driven, non-empirical methodology based on literature identification, conceptual analysis and synthesis of relevant theories, models and prior studies. The findings indicate that creativity becomes stronger when problem framing, ideation and creative form development are connected through iterative feedback, critical evaluation and attention to user meaning. The proposed framework contributes to design creativity literature by defining key constructs, specifying theoretical propositions and offering practical implications for product design education, studio practice and creativity assessment.

Keywords— Product Design Creativity, Design Problem Solving, Problem Framing, Ideation, Creative Form Development

INTRODUCTION

Product design today is increasingly positioned as a response to complex global problems rather than merely the production of functional or aesthetically pleasing artefacts. Designers are expected to address sustainability, circularity, digital transformation, shifting user behaviour, market uncertainty and rapidly changing socio-cultural needs through creative problem solving, as design thinking is increasingly linked to sustainable development, innovation and the implementation of the Sustainable Development Goals (Leal Filho et al., 2024; Magistretti et al., 2022). In this context, creativity in product design is not limited to the generation of attractive ideas. It also involves the ability to frame ambiguous problems, challenge assumptions, produce alternative concepts and transform abstract ideas into meaningful product forms (Magistretti et al., 2025; Dell'Era et al., 2025). Product form is also important because visual design can communicate aesthetic, semantic and symbolic meanings that influence how users interpret and respond to products (Crilly et al., 2004). Therefore, creativity in product design problem solving has become an important research concern, as the quality of the final product form is strongly influenced by how the initial design problem is interpreted, reframed, explored and developed into creative design alternatives.

In the Malaysian context, creativity in product design problem solving is increasingly relevant to the country's innovation agenda and the growth of its creative economy. Malaysia ranked 34th among 139 economies in the Global Innovation Index 2025, indicating the continuing need to strengthen national innovation capability, creative thinking and problem-solving capacity across education and industry sectors (World Intellectual Property Organization [WIPO], 2025). In addition, Malaysia's national innovation monitoring initiative has

identified the aspiration to improve the country's position towards the top 30 in the Global Innovation Index, further reinforcing the importance of developing creative and innovation-oriented capabilities within design-related fields (Ministry of Science, Technology and Innovation [MOSTI], 2025). This issue is particularly relevant to product design because Malaysia's cultural and creative industry contributed 6.8% to national Gross Domestic Product, equivalent to RM130.7 billion in 2024, while employment in the sector reached 763.1 thousand persons, representing 4.7% of total employment (Department of Statistics Malaysia [DOSM], 2025). These national indicators provide a strong justification for examining creativity in product design problem solving, particularly in understanding how problem framing, ideation and creative form development can support innovation capability, creative industry competitiveness and meaningful design outcomes in Malaysia.

The logic of the present article follows the movement from problem framing to ideation and then to creative form development. Problem framing is central because product design problems are frequently ill-defined, open-ended and shaped by user, technical, cultural and contextual factors. Rather than accepting the design brief as fixed, designers reinterpret the problem to identify more productive opportunities for action (Dorst, 2015; Magistretti et al., 2025). Ideation then translates the reframed problem into multiple visual, conceptual and functional possibilities through exploration, visualisation and critical selection (Dell'Era et al., 2025; Silk et al., 2021). Creative form development completes this movement by transforming abstract concepts into tangible product forms that communicate function, usability, aesthetics, identity and user meaning (Crilly et al., 2004; Yang et al., 2022).

Although previous studies have examined problem framing, ideation, creative product evaluation and form development, these areas are often discussed separately. This creates a conceptual gap in explaining how designers move from an ambiguous design problem to a reframed opportunity, from a reframed opportunity to alternative ideas, and from alternative ideas to meaningful product form. This paper addresses that gap by developing a conceptual framework that defines the core constructs operationally, explains the transitions among them, specifies the conditions under which the process becomes more or less creative, and proposes theoretical propositions for future empirical testing.

The objectives of this paper are to examine the role of problem framing in shaping creative product design thinking, to explain how ideation supports the generation and transformation of creative design alternatives, and to propose a conceptual framework that connects problem framing, ideation and creative form development as interrelated components of creativity in product design problem solving. Following this introduction, the second section reviews the relevant literature and theoretical foundations. The third section explains the methodology used for conceptual analysis and synthesis. The fourth section presents the proposed conceptual framework, key constructs and theoretical propositions. The final section discusses the conceptual claims, practical implications, limitations and directions for future research.

LITERATURE REVIEW

Problem Framing, Ideation and Creative Form Development in Product Design Problem Solving

Creativity in product design problem solving should be understood as an integrated and iterative process rather than as a single act of idea generation (Dorst & Cross, 2001; Dell'Era et al., 2025). Creative outcomes are shaped by how designers understand a problem, interpret its context and redefine its boundaries before developing possible solutions (Dorst, 2015; Magistretti et al., 2025). Product design problems are often ill-defined and influenced by user needs, technical constraints, cultural meanings, material possibilities, market expectations and functional requirements. For this reason, the early stage of design problem solving requires designers to move beyond the surface description of a design brief and examine the deeper conditions that shape the problem.

Problem framing can be operationally understood as the process through which designers construct a particular way of seeing, interpreting and approaching a design problem before deciding how it should be solved. It

involves identifying assumptions, clarifying user and contextual needs, exploring alternative interpretations and redefining the problem boundary. Magistretti, Pham and Dell’Era (2025) position problem framing as a creative process involving multiple problem representations, knowledge activation, stimuli and creative logics rather than as a simple linear activity. Silk et al. (2021) further show that innovative problem framings can increase perceptions of idea diversity and creativity. These studies indicate that creativity begins before sketching or concept generation, at the point where the designer questions what the real problem is and how it can be reframed into a more productive design opportunity.

Ideation is the process through which reframed problems are translated into possible design directions. Although ideation is often associated with brainstorming, sketching or generating multiple concepts, it involves more than the production of a large quantity of ideas. In product design, ideation requires visual reasoning, conceptual variation, exploration of alternatives, critical selection and the ability to connect user needs with formal and functional possibilities (Dell’Era et al., 2025; Yang et al., 2022). It therefore serves as a transition between problem interpretation and design development. Ideation becomes more creative when it is grounded in a clear but flexible problem frame, when alternative concepts are explored rather than prematurely selected, and when designers combine visualisation with critical evaluation.

Creative form development is the stage where creativity becomes materially and visually expressed. In product design, form is not merely the external appearance of a product; it communicates aesthetic, semantic and symbolic meanings that influence how users interpret and respond to design (Crilly et al., 2004). Product form therefore communicates function, usability, proportion, emotion, identity, material quality and user meaning (Crilly et al., 2004; Sunstrum et al., 2024). Creative form development requires designers to transform abstract ideas into visible and meaningful artefacts through sketching, modelling, proportion studies, material exploration, ergonomic consideration, functional integration and aesthetic refinement (Yang et al., 2022). In this stage, creativity is not only judged by novelty, but by the coherence between form, function, user meaning and contextual relevance.

The transition from problem framing to ideation occurs when a reframed problem is converted into design criteria, opportunity statements or exploratory directions. The transition from ideation to creative form development occurs when selected ideas are visualised, modelled, tested and refined into formal product qualities. These transitions are not linear checkpoints; they are iterative movements between interpretation, exploration and formal expression. The process becomes more creative when designers maintain openness to alternative frames, generate diverse design possibilities, critically evaluate concepts and refine form in relation to user meaning. Conversely, the process becomes less creative when designers accept the initial brief uncritically, converge too early on familiar solutions, prioritise visual novelty without functional or semantic coherence, or treat form development as final styling rather than as a continuation of design thinking.

Underpinning Theories and Models

Several theories and models provide a useful foundation for developing a conceptual framework for creativity in product design problem solving. The most relevant theoretical foundation is the co-evolution model of problem and solution proposed by Dorst and Cross (2001). This model explains that creative design does not progress through a simple linear movement from problem to solution. Instead, designers move repeatedly between the problem space and the solution space; as possible solutions emerge, the understanding of the problem also changes. This theory is central to the present article because it supports the argument that problem framing, ideation and creative form development should be understood as interconnected processes.

A second relevant theoretical lens is frame innovation, developed by Dorst (2015). Frame innovation explains how designers create new ways of approaching complex, open and dynamic problems. Rather than moving immediately towards solutions, designers construct new frames that allow them to see the problem situation

differently. This theory supports the problem-framing component of the proposed framework because it explains creativity as the ability to reinterpret a problem before generating solutions.

The Double Diamond model is also relevant as a supporting process model. The Design Council (2026) presents the Double Diamond as a visual representation of the design and innovation process, structured around the broad movement of discovering, defining, developing and delivering design outcomes. In the context of this article, the Discover and Define stages can be related to understanding, interpreting and reframing the design problem, while the Develop and Deliver stages can be associated with ideation, prototyping, evaluation and creative form development (Design Council, 2026.; Dell'Era et al., 2025). However, the Double Diamond is used here as a supporting model rather than as the main theoretical foundation because it explains the structure of the design process more than the cognitive and creative mechanisms behind product design problem solving.

Another useful theoretical model is the Creative Product Semantic Scale developed by Besemer and O'Quin (1989). This model shifts attention from creativity as a mental process to creativity as a quality of the final product. It conceptualises creative product attributes through dimensions such as novelty, resolution and elaboration or style. This is particularly important for creative form development because a product form cannot be considered creative simply because it is visually different. It must also demonstrate usefulness, appropriateness, refinement and meaningful integration of form, function and user experience (Besemer & O'Quin, 1989; Crilly et al., 2004).

Based on these theoretical positions, Dorst and Cross's co-evolution model of problem and solution serves as the main underpinning theory for this article. It is supported by frame innovation, the Double Diamond model and the Creative Product Semantic Scale (Dorst & Cross, 2001; Dorst, 2015; Design Council, 2026; Besemer & O'Quin, 1989). Together, these theories and models provide a coherent foundation for explaining how creativity develops from problem interpretation, through idea generation, towards visible and meaningful product form.

Research Gaps and Conceptual Synthesis

The literature indicates that creativity in product design has been widely discussed across design cognition, design thinking, product innovation, design education and product aesthetics. However, these discussions often remain fragmented. Studies on problem framing tend to focus on how designers interpret and redefine problems. Studies on ideation often emphasise idea generation, visualisation, brainstorming, prototyping or the role of digital tools. Studies on product form commonly discuss aesthetics, semantics, perception and user meaning (Crilly et al., 2004). Although each area contributes important knowledge, there is still limited integration of these components into a coherent explanation of how creativity operates across the complete product design problem-solving process.

A central gap concerns the transition from problem framing to creative form development. Existing studies show that problem framing influences ideation (Silk et al., 2021), while form development involves movement between problem and solution spaces (Yang et al., 2022). However, fewer studies explain how an initial problem frame shapes the formal qualities of a product, including shape, proportion, aesthetics, function and user meaning. The literature recognises that problem interpretation matters, but the pathway from a reframed problem to visible product form remains insufficiently theorised.

A second gap relates to the conditions under which creativity becomes stronger or weaker across the design process. Creativity is likely to be strengthened when problem frames are flexible, ideation remains exploratory and form development integrates novelty with usefulness and meaning. It is likely to be weakened when designers rely on narrow problem definitions, converge prematurely, reproduce familiar forms or separate formal styling from user and contextual requirements. Addressing this gap requires a framework that not only connects the constructs, but also explains the transitions and conditions that affect creative outcomes.

A third gap relates to product design education. McInerney (2023) found that creativity is widely recognised as an essential component of product design education, yet its development often remains implicit rather than systematically structured. A conceptual framework could therefore help make the creative process more explicit, teachable and assessable by clarifying how problem framing, ideation and creative form development operate together.

Table 1. Constructs, Operational Definitions, Propositions and Expected Outcomes

Construct	Operational definition	Transition logic	Theoretical proposition	Expected outcome
Problem framing	Understanding, interpreting, questioning and redefining the design problem before solution generation.	Moves from initial brief to reframed opportunity or design direction.	P1: Multiple and critically developed problem frames increase the creative potential of subsequent ideation.	Clearer opportunity definition; broader creative direction; reduced premature fixation.
Ideation	Generating, visualising, exploring and selecting alternative design possibilities based on the reframed problem.	Moves from reframed opportunity to multiple conceptual alternatives.	P2: Ideation becomes more creative when it is guided by a flexible problem frame and supported by visual exploration, iteration and critical selection.	Greater idea diversity; stronger conceptual variation; more coherent design alternatives.
Creative form development	Transforming abstract ideas into visible product qualities such as shape, proportion, aesthetics, function, material character and user meaning.	Moves from selected concepts to tangible and evaluable product form.	P3: Creative form development strengthens product creativity when novelty is integrated with usefulness, aesthetics, semantics and user meaning.	Meaningful product form; stronger usability, identity and innovation potential.
Iterative feedback	Returning between framing, ideation and form development to refine the problem, concept and form.	Moves backward and forward across problem and solution spaces.	P4: Iterative feedback among the three constructs increases the coherence and creative quality of product design outcomes.	Better alignment between design intent, user interpretation and product form.
Creativity conditions	Factors that make the process more or less creative.	Openness, diversity, evaluation and coherence strengthen creativity; narrow framing, premature convergence and surface styling weaken creativity.	P5: The process becomes less creative when any construct is disconnected from the others.	Reduced originality, weaker meaning, fragmented form or visually novel but poorly resolved outcomes.

Table 1, responds to the need for greater conceptual precision by defining each construct operationally, explaining the transition between constructs and identifying expected outcomes. The propositions are not presented as tested hypotheses, but as theoretically grounded claims that can guide future empirical research. Together, they clarify the logic linking problem framing to ideation and creative form development.

Table 2. Past Studies Related to Problem Framing, Ideation and Creative Form Development

Author (Year)	Title	Method	Findings
Magistretti, Pham and Dell'Era (2025)	The Creative Process of Problem Framing for Innovation: An Integrative Review and Research Agenda	Integrative literature review	Problem framing was conceptualised as a creative process involving problem representations, activated knowledge, influencing stimuli and creative logics.
Silk, Rechkemmer, Daly, Jablow and McKilligan (2021)	Problem Framing and Cognitive Style: Impacts on Design Ideation Perceptions	Experimental study with novice designers	Innovative problem framings were associated with higher perceptions of idea diversity and creativity.
Suk and Lee (2021)	Problem Framing Activities Carried Out by Student Design Teams to Enhance Creativity	Empirical comparative study using protocol analysis	High-creativity teams produced multiple frames, explored problems in greater depth and developed shared frames through collaboration.
Dell'Era et al. (2025)	Design Thinking in Action: A Quantitative Study of Design Thinking Practices in Innovation Projects	Quantitative survey of 221 innovation projects	Design thinking practices included discovering user needs, understanding the problem, challenging assumptions, visualising ideas and learning through prototypes.
McInerney (2023)	Insights into Product Design Students' Perception of, and Engagement with, Creativity in Design Education	Online focus groups analysed using reflexive thematic analysis	Creativity was recognised as essential in product design education, but its development often remained implicit rather than systematically structured.
Lin et al. (2024)	Comparing AIGC and Traditional Idea Generation Methods	Empirical comparative study using repeated-measures ANOVA	AIGC supported product design ideation but did not consistently outperform traditional idea-generation methods.
Kwon, Jung and Kim (2024)	Designer-Generative AI Ideation Process	Process development, workshop and interviews	Designer-generative AI processes helped align generated images with design intent, but designer judgement remained necessary.
Wang, Han, Zhao, Yin, Chen and Childs (2025)	Creative Combinational Design through Generative AI	Two empirical studies	Text, image and 3D representations supported combinational ideation differently, with stronger support for divergent than convergent thinking.
Chulvi (2025)	Effectiveness of the AI Using Different Typologies of Design Methods	Experimental AI-based study	AI-assisted design output varied according to method and problem complexity.
Yang, Lahti and Seitamaa-Hakkarainen (2022)	Creating New 3D Forms in Collaborative Product Design	Exploratory case study with video and sketch data	New three-dimensional forms were developed through reformulation, sketching,

			modelling and movement between problem and solution spaces.
Sunstrum, Demirbilek, Gardner, Viengkham and Spehar (2024)	Revealing the Synergy between Formal Aesthetics and Product Semantics	Empirical study using Gestalt theory and kettle designs	Visual form attributes such as height, shape and curvature influenced aesthetic judgement, semantic interpretation and symbolic meaning.

The studies in table 2, indicate that creativity in product design problem solving should not be treated as a single moment of idea generation. Problem framing studies demonstrate that the way designers initially understand and redefine a design problem has a strong influence on the creative direction of subsequent ideas. Magistretti et al. (2025) explain problem framing as a creative process, while Silk et al. (2021) show that innovative framings can increase perceived idea diversity and creativity. Suk and Lee (2021) further found that more creative student teams actively produced multiple frames, explored problems in depth and developed shared frames through collaboration.

The literature also suggests that ideation is increasingly understood as a structured, iterative and tool-mediated process. Dell'Era et al. (2025) identify ideating through visualisation and learning through prototypes as part of a broader design-thinking configuration that includes understanding the problem and challenging assumptions. Studies on artificial intelligence extend this discussion by showing that AI-supported tools can increase the quantity, variation and visual richness of design ideas, while still requiring human judgement, interpretation and concept selection (Chulvi, 2025; Kwon et al., 2024; Lin et al., 2024; Wang et al., 2025).

In relation to creative form development, Yang et al. (2022) demonstrate that the development of new three-dimensional forms is closely connected to reformulation and movement between problem and solution spaces. Sunstrum et al. (2024) further show that formal attributes influence product perception, aesthetic judgement, semantic interpretation and symbolic meaning. These findings support the view that creative form development involves transforming abstract ideas into visible product qualities such as shape, proportion, aesthetics, function and user meaning (Crilly et al., 2004).

METHODOLOGY

Research Design and Conceptual Orientation

This study adopts a conceptual research design to develop a theoretical understanding of creativity in product design problem solving through the interrelated processes of problem framing, ideation and creative form development. As a conceptual paper, the study is theory-driven and non-empirical in nature because it seeks to clarify, integrate and extend existing concepts rather than collect primary empirical data (Gilson & Goldberg, 2015; Jaakkola, 2020). Accordingly, it does not involve surveys, interviews, experiments or observation. Instead, the study develops conceptual clarity by examining, comparing and synthesising existing theories, models and scholarly discussions related to design creativity, product design problem solving, problem framing, ideation and form development.

The conceptual orientation of the study is grounded in the view that creativity in product design is not limited to idea generation alone. Rather, creativity is understood as a process that begins with the interpretation and reframing of a design problem, continues through the generation and exploration of ideas, and becomes visible through the development of meaningful product form. This orientation is aligned with the objectives of the study, which are to examine the role of problem framing in shaping creative product design thinking, to explain how ideation supports the generation and transformation of creative design alternatives, and to propose a framework that connects problem framing, ideation and creative form development as interrelated components of creativity in product design.

Literature Identification and Selection Process

The literature identification process was conducted to locate academic sources that provide conceptual, theoretical and empirical insights into creativity in product design problem solving. Relevant sources were identified from major academic databases and scholarly platforms, including Scopus, Web of Science, ScienceDirect, SpringerLink, Taylor & Francis Online, Wiley Online Library, Emerald Insight and Google Scholar. The search focused on keyword combinations such as product design creativity, design problem solving, problem framing in design, design ideation, creative form development, form giving in product design, design cognition, creative product evaluation, design thinking and conceptual framework in design research.

The screening process was guided by relevance to the study's title, objectives and conceptual scope. Sources were selected if they addressed at least one of the core areas of the study: problem framing, ideation, creative form development, product design creativity, design cognition or design process models. Priority was given to recent publications to reflect current debates in product design and creativity research. Foundational works were also included where they provided theoretical grounding, particularly in relation to co-evolution, frame innovation, design thinking and creative product assessment. This approach is consistent with literature-based conceptual research, where source selection is guided by theoretical relevance and conceptual contribution rather than by statistical representativeness (Snyder, 2019; Torraco, 2005).

The selected literature was not treated as a systematic review sample. Instead, it was approached as a theoretically relevant body of knowledge for conceptual synthesis. This distinction is important because the aim of the paper is not to provide an exhaustive mapping of all studies in the field, but to identify and integrate key concepts that can support the development of a conceptual framework. Review typologies differ in purpose and method, and conceptual or integrative reviews are commonly used to synthesise existing knowledge and generate new theoretical understanding (Grant & Booth, 2009; Torraco, 2005).

Conceptual Analysis and Synthesis Process

The conceptual analysis began by identifying the main constructs that shape creativity in product design problem solving. Three central constructs were established: problem framing, ideation and creative form development. Each construct was defined operationally to clarify its role in the proposed framework. Problem framing was analysed as the process through which designers understand, interpret, question and redefine the design problem before generating solutions. Ideation was examined as the process of generating, exploring, visualising and selecting possible design alternatives. Creative form development was analysed as the process through which abstract ideas are transformed into visible product forms, including shape, proportion, aesthetics, function, material expression and user meaning.

Following the identification of these constructs, relevant theoretical perspectives were compared to explain the relationships between them. The co-evolution model of problem and solution was examined to understand how designers move between the problem space and the solution space during creative design activity. Frame innovation was considered to explain how designers construct new ways of seeing complex design problems. The Double Diamond model was used as a supporting process model to clarify the movement between divergent and convergent thinking. The Creative Product Semantic Scale was considered to support the evaluation of creative product outcomes, particularly in relation to novelty, usefulness, elaboration and style. This process of comparing constructs and theoretical perspectives is important in conceptual research because theoretical contribution depends on clarifying what the key constructs are, how they relate to each other and why those relationships matter (Whetten, 1989; Jaakkola, 2020).

The synthesis process involved comparing the conceptual role of each construct and identifying how the constructs interact across the design process. Problem framing was positioned as the foundation of creative direction because it determines how the design situation is understood and what kinds of opportunities become visible. Ideation was positioned as the exploratory stage that translates reframed problems into possible design alternatives. Creative form development was positioned as the material and visual stage where ideas become

tangible, evaluable and meaningful as product design outcomes. Through this synthesis, creativity was conceptualised as an iterative movement from problem interpretation to conceptual exploration and finally to formal expression.

Development of the Conceptual Framework

The conceptual framework was developed by organising the synthesised constructs into a coherent structure that reflects the logic of product design problem solving. The framework begins with the product design problem context, which includes user needs, functional requirements, technical constraints, cultural meanings, material possibilities and market conditions. These contextual factors shape the initial design situation and influence how the problem is interpreted by the designer.

From this starting point, the framework moves into problem framing, where designers understand, interpret, challenge and redefine the problem before generating possible solutions. The second component is ideation, which represents the transition from reframed problem understanding to possible design alternatives. The third component is creative form development, where selected ideas are transformed into visible product forms through decisions related to shape, proportion, aesthetics, function, material character, usability and user meaning (Crilly et al., 2004). The final component is the creative product design outcome, which may be understood through originality, usefulness, meaningful product form and innovation potential.

Feedback loops are incorporated into the framework to reflect the non-linear nature of product design creativity. Designers may return from ideation to problem framing, from form development to ideation, or from evaluation to earlier stages of the process. This iterative structure is supported by the co-evolutionary view of design, which explains that designers move repeatedly between problem and solution spaces as their understanding of the design situation develops (Dorst & Cross, 2001).

Proposed Conceptual Framework and Theoretical Propositions

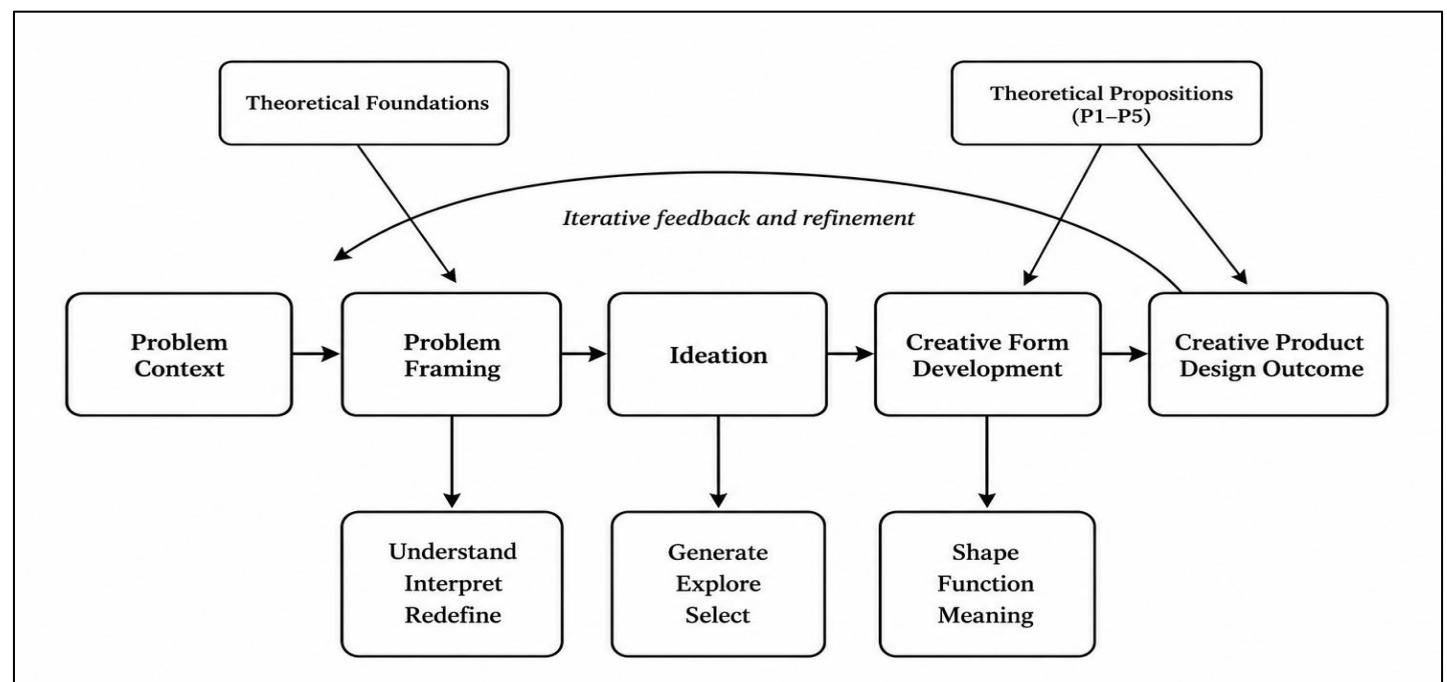


Figure 1. Conceptual framework for creativity in product design problem solving.

Figure 1, presents the proposed conceptual framework for creativity in product design problem solving. The framework explains creativity as a connected and iterative process that moves from problem context to problem framing, ideation, creative form development and finally to a creative product design outcome. It shows that creative product design does not begin only at the idea-generation stage. Instead, creativity begins when

designers understand the design situation, interpret the problem context and redefine the problem before developing possible solutions.

The framework begins with the problem context, which refers to the conditions that shape the design task. These may include user needs, functional requirements, technical constraints, cultural expectations, market conditions and material possibilities. This context provides the starting point for the designer, but it is not treated as fixed. Designers must critically examine the problem context before deciding how the design problem should be approached.

The next stage is problem framing, which involves three key activities: understand, interpret and redefine. At this stage, designers move beyond the surface meaning of the design brief and construct a clearer way of seeing the problem. A strong problem frame can open new creative directions, while a weak or narrow frame may limit the quality and originality of the final design outcome.

After the problem has been reframed, the process moves into ideation. Ideation involves generating, exploring and selecting possible design alternatives. This stage translates the reframed problem into visual, conceptual and functional possibilities. In this framework, ideation is not treated as random brainstorming. It is positioned as a structured stage that depends on the quality of the earlier problem-framing process.

The third core stage is creative form development, where selected ideas are transformed into visible and meaningful product forms. This stage involves decisions related to shape, function and meaning. It explains how abstract ideas become tangible through form, proportion, usability, aesthetics, material expression and user interpretation. Creative form development is therefore not merely the final visual presentation of a product, but an active design-thinking process where ideas are refined into meaningful product outcomes.

The framework ends with the creative product design outcome. This outcome refers to a product design solution that demonstrates originality, usefulness, meaningful form and innovation potential. The outcome is influenced by the quality of the previous stages, especially how well the problem was framed, how effectively ideas were explored and how meaningfully the form was developed.

The upper part of the diagram shows two important supporting elements: theoretical foundations and theoretical propositions. The theoretical foundations guide the conceptual logic of the framework, while the theoretical propositions provide a basis for future empirical testing. The curved arrow labelled iterative feedback and refinement indicates that the process is not linear. Designers may return to earlier stages to reframe the problem, refine ideas, improve form development or strengthen the final product outcome. Therefore, the framework positions creativity in product design problem solving as an iterative movement between problem interpretation, idea exploration and formal expression.

Theoretical Propositions for Future Testing

P1: Designers who develop multiple and critically informed problem frames are more likely to generate creative product design alternatives than designers who accept the initial brief as fixed.

P2: The relationship between problem framing and creative product outcomes is mediated by ideation quality, particularly idea diversity, conceptual variation and critical selection.

P3: Creative form development strengthens product design creativity when visual form integrates novelty, usefulness, aesthetics, semantics and user meaning.

P4: Iterative feedback between problem framing, ideation and creative form development increases the coherence of product design outcomes.

P5: The creative process becomes weaker when problem framing, ideation and form development are disconnected, resulting in solutions that are visually novel but poorly aligned with function, context or user meaning.

These propositions are intended to guide future empirical validation. They translate the conceptual framework into testable relationships that can be examined in product design studios, professional design projects or experimental design tasks.

DISCUSSION

This conceptual paper argues that creativity in product design problem solving should be understood as an integrated and iterative process rather than as an isolated act of idea generation. The central claim is that creativity begins with the way designers understand and redefine a design problem, develops through the exploration and selection of alternative ideas, and becomes visible through the development of meaningful product forms. From this perspective, creativity is shaped not only by originality, but also by the quality of problem interpretation, the depth of ideation and the ability to translate abstract concepts into tangible design outcomes.

The proposed framework is consistent with literature that positions design creativity as a movement between problem and solution spaces. Dorst and Cross's (2001) co-evolution model supports the view that designers move repeatedly between problem understanding and solution development, while Dorst's (2015) frame innovation perspective suggests that creative design begins when designers construct new ways of interpreting complex and open-ended problems. This view is further supported by Magistretti et al. (2025), who describe problem framing as a creative process involving problem representations, activated knowledge, stimuli and

creative logics. Collectively, these studies reinforce the argument that problem framing is a critical starting point for creativity in product design problem solving.

The framework also clarifies the role of ideation and form development. Ideation functions as a bridge between problem framing and creative form development because it translates reframed problems into alternative possibilities through visual reasoning, conceptual exploration and critical selection (Dell'Era et al., 2025). Creative form development then materialises those possibilities into product qualities that can be perceived, evaluated and used. Studies on product visual form show that form communicates aesthetic, semantic and symbolic meanings, while studies on three-dimensional form development show that form emerges through reformulation, sketching, modelling and movement between problem and solution spaces (Crilly et al., 2004; Yang et al., 2022; Sunstrum et al., 2024).

Theoretical and Practical Contributions

Theoretically, this paper contributes to product design knowledge by integrating problem framing, ideation and creative form development into a single conceptual structure. Previous studies have often discussed these areas separately, with problem framing addressed in design cognition, ideation examined in creativity and innovation studies, and form development explored in relation to aesthetics, semantics and product perception. By connecting these components, the proposed framework offers a clearer explanation of how creativity develops across the product design process. It also extends the understanding of creativity beyond idea generation by positioning form development as an essential stage where creative thinking becomes tangible, evaluable and meaningful.

Practically, the framework is relevant to product design education, studio practice and design assessment. For educators, it can be used to structure studio activities that guide students from problem interpretation to ideation and form development. Rather than assessing creativity only through the final appearance of a product, the framework encourages attention to how students frame the problem, generate alternatives and develop form-based solutions. For design practitioners, the framework offers a reflective guide for managing creative problem

solving in product development. It encourages designers to revisit the problem frame, evaluate the strength of their ideas and refine product form in relation to user needs, function, aesthetics and meaning.

LIMITATIONS

Several limitations should be acknowledged. First, as a conceptual paper, the study does not provide empirical evidence to test the effectiveness of the proposed framework. The framework was developed through literature-based conceptual synthesis and therefore remains theoretical in nature. Second, the selected literature was guided by conceptual relevance rather than systematic review procedures, which means that some related studies may not have been included. Third, the framework focuses specifically on product design problem solving and may require adaptation before being applied to other design fields such as communication design, service design, interaction design or architectural design.

The propositions presented in this paper require empirical validation. Future studies should examine whether multiple problem frames actually improve idea diversity, whether ideation quality mediates the relationship between problem framing and creative product outcomes, and whether creative form development strengthens the relationship between conceptual ideas and perceived product creativity. These questions can be investigated through design studio observation, protocol analysis, design experiments, quasi-experimental studies or expert evaluation of design outcomes.

FUTURE RESEARCH AND CONCLUSION

Future research should empirically examine the proposed framework in product design education and professional practice. Studies may investigate how students or designers move from problem framing to ideation and creative form development during studio-based projects. Experimental or quasi-experimental research could compare design outcomes produced through conventional ideation methods with those developed using the proposed framework. Future studies may also develop assessment rubrics to evaluate creativity at different stages of the design process, including problem interpretation, idea diversity, form exploration and product meaning. Further research may examine how digital tools, generative artificial intelligence, virtual reality or computer-aided design influence the relationship between problem framing, ideation and creative form development.

In conclusion, this paper proposes that creativity in product design problem solving should be understood as an integrated and iterative process. Problem framing shapes how the design situation is interpreted, ideation transforms reframed problems into alternative possibilities, and creative form development materialises those possibilities into visible and meaningful product outcomes. The proposed conceptual framework contributes to a clearer understanding of how creativity operates in product design and provides a foundation for future theoretical development, empirical validation and pedagogical application in design education and practice.

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