DESIGN THINKING AS A CATALYST FOR INNOVATION IN THE DIGITAL BANKING ECOSYSTEM

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Abstract
The rapid digital transformation of the banking sector, intensified by FinTech competition and evolving customer expectations, has increased the need for innovation-oriented product development approaches. A persistent challenge for banking institutions is identifying methodologies that support the design of customer-centric digital services while minimizing implementation risks. Therefore, this paper addresses the problem of integrating user-centered innovation practices into traditional banking processes. The main aim of this research paper is to explain the applicability and effectiveness of the Design Thinking methodology in developing digital banking products, and to evaluate its contribution to improving customer experience and innovation capability within the banking ecosystem.
The study employs a qualitative exploratory research design, combining an extensive review of recent academic and industry literature with a conceptual case-based analysis of the five Design Thinking stages – Empathize, Define, Ideate, Prototype, and Test. During the Empathize stage, structured interview activities were conducted by student teams using predefined guiding questions to explore user expectations, concerns, behaviours, and perceived barriers related to in-car banking. The responses were organized through empathy mapping and subsequently used to inform the Define, Ideate, Prototype, and Test stages. The study is conceptual and exploratory in nature, with the workshop serving as an illustrative application of the Design Thinking methodology rather than as a representative empirical investigation of banking customers.
The results suggest that adopting Design Thinking enhances banks' capacity to identify latent customer needs, supports interdisciplinary collaboration, and improves the relevance, usability, and adaptability of digital financial services. Furthermore, the iterative approach contributes to reducing product development uncertainty and accelerates innovation cycles. The findings highlight that embedding Design Thinking

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into banking strategies strengthens customer-centric business models and supports long-term competitiveness in the digital economy.

Keywords
Digital Banking, Design Thinking, Innovation, FinTech.

JEL Classification
G21, O30, M20.

Introduction

In an era of rapid transformation, the banking sector is increasingly adopting on a user-centered approach as it expands its portfolio of products and services (Soyupak, 2025). The Design Thinking method provides a structured environment for innovation – a well-defined framework in which participants can empathize, collaborate across disciplines, generate creative ideas, and rapidly test proposed solutions (Dell'Era, 2025). The banking sector is facing increasing pressure on its traditional business model, as FinTech companies have risen to prominence *(Xuan, 2025)*. Traditional banks, on the other hand, can benefit from Design Thinking, a method that serves as a reliable tool in the transformation process, becoming a key driver in redefining the banking DNA through process redesign, customer-centricity, and agility *(Chia, 2019)*.

In recent years, the Design Thinking methodology has seen a sharp rise in popularity, becoming a trusted approach to problem-solving. Specifically, Design Thinking can be described as an iterative, user-centered process aimed at solving complex problems by generating creative solutions. Analytical thinking is combined with creativity, facilitating an understanding of user needs as well as the creation of suitable products and services *(Li, 2026)*. Existing literature has consequently examined Design Thinking primarily as an innovation and problem-solving approach, while its relevance to financial services and digital transformation has also received increasing attention. However, the existing literature provides limited insight into how Design Thinking can be operationalized in the context of digital banking innovation, particularly through structured, practice-oriented applications that translate its conceptual stages into concrete banking solutions.

This is the research gap addressed by the present study. Rather than examining Design Thinking solely as a theoretical innovation framework, this paper explores its application as a structured process for identifying and addressing innovation challenges within the digital banking ecosystem. The novelty of the study lies in the practical application of the Design Thinking stages to a digital banking context and in the systematic translation of user needs into potential banking solutions through a workshop-based approach. In this way, the study connects the conceptual foundations of Design Thinking with its practical use in exploring digital banking innovation.

Accordingly, the study addresses the following research question: *How can Design Thinking be applied as a structured approach to identifying and developing innovative solutions in the digital banking ecosystem?*

By addressing this question, the paper contributes to the literature by providing a practice-oriented perspective on the application of Design Thinking in digital banking and by illustrating how the method can facilitate the transition from identifying user needs to generating and evaluating potential innovation solutions. The study also provides implications for banking institutions seeking to strengthen customer-centric innovation and for researchers investigating the intersection between Design Thinking, digital transformation, and financial services.
In this regard, the structure of this paper is organized as follows. Section 2 reviews the conceptual foundations and core stages of Design Thinking. Section 3 describes the research methodology applied in the study. Section 4 presents the conceptual application and the main findings derived from the Design Thinking workshop. Section 5 discusses the implications of the results within the context of digital banking innovation, while Section 6 concludes the paper and outlines directions for future research.

1. Review of the scientific literature

The standard Design Thinking model comprises five stages: Empathize, Define, Ideate, Prototype, and Test, which can be carried out using various methods *(Li, 2026)*. Although each stage of Design Thinking has distinct objectives and methods, they function as interconnected and iterative components of a broader innovation process *(Waidelich, 2018)*. Rather than operating sequentially in a rigid manner, the stages continuously inform and refine one another, ensuring that solutions remain closely aligned with users' evolving needs and expectations *(Sakama, 2018)*.
Empathizing aims to understand the users, their needs, grievances, and desires. This objective can be achieved by directly collecting detailed information about the user, with the goal of developing an objective and comprehensive perspective of their experience with a product or service. The key to this stage is communication. The more information gathered about the user and their perception of the product or service in question, the better one can understand what they want *(Cunha, 2026)*. Among the methods used are interviews, empathy maps, and participant observation (shadowing). Interviews consist of conversations with users, preferably face-to-face, in which clearly formulated open-ended questions are asked to fully understand their needs and problems. Potential users can also be interviewed to determine from the outset what their expectations are regarding a specific product or service *(Liedtka, 2015)*. Their responses can be grouped into several categories to gain a deeper insight into the meaning behind their words – *thinking, doing, feeling.* Empathy maps are visual models that represent users' responses, grouped by meaning – what they think, feel, and say *(Beckman, 2007)*.
For the development of banking products and services, empathy maps are used to identify users' emotional expectations regarding a digital process, a communication method, or the online banking platform interface *(Siricharoen, 2020)*. Participatory observation, on the other hand, consists of analyzing the users' behavior while using a product or service *(Paracha, 2019)*. In the banking sector, participant observation can be used to track how a customer reacts when using the online banking platform. More

specifically, their reactions can be analyzed to inform platform improvements or test versions of mobile apps.

Once a comprehensive understanding of users has been achieved, the collected information must be transformed into actionable insights. Consequently, the process moves beyond observation and enters a stage of interpretation and synthesis aimed at identifying the underlying issues affecting customer experience.

Problem definition focuses on the responses and information gathered during the Empathize stage. These are analyzed, synthesized, and reinterpreted to clearly define the core problem as perceived by the user *(Watanabe, 2017)*. This stage is fundamental, as only by correctly formulating the problem can we help solve it. It is crucial to identify users' actual needs, which become the main benchmark of the Design Thinking methodology. Therefore, an ideally formulated problem must position the user as the main subject; it must be specific, open to innovation, and based on real information. Among the most frequently used methods are Affinity Diagramming, creating Personas, and formulating synthetic ideas derived from the Empathy stage. Affinity Diagramming involves grouping information with common themes into specific categories. This method aids in gaining a deeper understanding of user responses *(Remy, 2021)*. Through persona creation, detailed user profiles can be developed, which contribute significantly to understanding the overall context and the motivation behind a response *(Köppen, 2014)*. Thus, this method goes hand in hand with the creation of the Affinity Diagram. The method of formulating synthetic ideas involves extracting relevant ideas or keywords from the previously obtained responses. At the same time, the banking system is characterized by multiple challenges, which can be multidimensional and constantly changing, and users may face problems that are not immediately obvious, of which they are unaware, or which they do not communicate to the bank. This highlights the strategic importance of the Define stage, as its primary objective is to avoid developing solutions that fail to address customers' fundamental needs.

Following the identification and formulation of the core user problem, attention shifts toward exploring possible solutions. At this stage, the focus is no longer placed on understanding customer difficulties, but rather on generating innovative alternatives capable of addressing those needs effectively.

The Ideation stage is the stage through which the working team sketches out a large number of ideas. These are not initially evaluated, but merely developed. It is important to generate as many varied ideas as possible, while encouraging creative thinking. At this stage, participants step outside conventional problem-solving patterns *(Wolniak, 2017)*. Furthermore, collaborative, even interdisciplinary, involvement is desirable, so that solutions can be generated from multiple perspectives. The most popular method used at this level is brainstorming. Whether it is guided brainstorming or classic brainstorming, this method involves the spontaneous generation of ideas within a structured environment. Another method used is Crazy 8s, which involves sketching eight ideas in eight minutes *(Alvarez, 2025)*. Again, creative thinking is encouraged, and the limited time of one minute per idea does not allow for complex reasoning but promotes spontaneity. In the banking sector, these methods could be applied to find solutions for improving the online banking platform interface or launching a new banking product available only in digital format.

The generation of multiple ideas alone is insufficient unless these concepts are transformed into tangible representations. Therefore, the Design Thinking process progresses toward experimentation, enabling teams to visualize and materialize selected solutions in a simplified form.

Prototyping is the fourth stage of the Design Thinking methodology. This step involves translating solution ideas into tangible representations of potential solutions. The goal is not to create a perfect product or service, but to simulate it in a way that accurately reflects the user experience *(Dam, 2020)*. In practice, prototyping brings the ideas generated in the previous step to life. This iterative process serves to reduce uncertainty. Prototyping methods vary depending on the solution being developed and may include sketching or creating simplified models. If prototyping a bank's website, one can use a website wireframe to digitally sketch the website's interface. On the other hand, interactive prototypes are simplified models that are functional and allow users to simulate various digital actions *(Luchs, 2015)*. At the same time, a prototype can also be created simply by drawing it on paper, if the product or service being developed allows for this. While prototypes provide an initial representation of proposed solutions, their true value emerges only through direct interaction with end users. Consequently, the process advances toward validation, where assumptions and design choices are evaluated under realistic usage conditions.
Testing is the final stage of the Design Thinking methodology, which involves collecting feedback from users. The goal is to evaluate the solution's effectiveness and suitability. In practice, the prototypes created in the previous step are presented to end users, who then express their opinions *(Micheli, 2019)*. Although the feedback may be negative, this does not necessarily mean the elimination of the prototyped product or service; rather, it is an important step in the learning process, fueling a new phase of refinement and a fresh start to the entire process. One of the most important benefits of testing is the reduction of risks associated with launching an unsuitable product or service. Thus, costs associated with launch and market withdrawal can be reduced. In the banking sector, this stage contributes positively to validating trust and security and providing objective feedback regarding the user experience. Testing becomes a fundamental pillar of Design Thinking, as banks can accelerate and expand innovation and personalization in their day-to-day operations.

2. Research methodology

This study adopts a qualitative, exploratory, workshop-based research design with a conceptual application of the Design Thinking methodology in the context of digital banking innovation. The participants were students and potential users of the proposed in-car banking service.
The workshop was conducted within the Financial-Banking Information Systems course at the Faculty of Economic Sciences, Lucian Blaga University of Sibiu. It involved 57 third-year students enrolled in the Finance and Banking programme during the second semester. The workshop was integrated into a 12-week seminar, with Design Thinking activities implemented over seven weeks. The students were organized into 10 teams that functioned as simulated banking innovation units. Participants resulted from their

enrolment in the course rather than from a specific research sampling procedure. No personal or demographic data were collected, and all workshop materials were treated anonymously.

The workshop focused on the development of banking functionalities integrated into vehicle infotainment systems, a scenario inspired by developments in embedded finance, connected mobility, and in-car payment technologies. The five-stage Design Thinking framework – Empathize, Define, Ideate, Prototype, and Test – was used to structure the activities. Table 1 summarizes the workshop protocol.

Table no. 1. Design Thinking workshop structure

Stage	Time Allocation	Activities	Outcome
1. Empathize	60 minutes	Teams design at least 10 predefined guiding questions for the structured interview exercise; cross-team interview activities; recording of responses; extraction of keywords; grouping responses into *saying, thinking, doing,* and *feeling* categories; feedback discussion.	Structured qualitative insights into user needs, behaviors, concerns, and emotional expectations regarding in-car online banking usage.
2. Define	30 minutes	Teams analyze collected data; formulate key user problems; presentation of challenges; voting on the most relevant problem.	Clear definition of the core user-centered problem to be addressed.
3. Ideate	55 minutes	Brainstorming of multiple solution ideas; visual representation of concepts; peer feedback.	Generation of diverse and creative solution concepts for improving infotainment-based banking access.
4. Prototype	45 minutes	Development of a simplified interface prototype; peer feedback session.	Initial functional model of an in-car banking interface.

5. Test	80 minutes	Team preparation; prototype presentations; peer evaluation; synthesis of feedback.	Validation of prototype usability and identification of improvement areas.

Source: Authors' contribution

During the Empathize stage, the students interviewed one another rather than actual banking customers. Each team developed its own interview questions and interviewed representatives of all other teams, with students alternating between the roles of interviewer and simulated user. The responses were recorded anonymously in written form on paper; no audio or video recordings were made. The resulting qualitative material was synthesized by extracting keywords and recurring themes and organizing them according to the *saying*, *thinking*, *doing*, and *feeling* dimensions. These insights were subsequently used to formulate and prioritize user-centered problems, generate solution concepts, and develop prototypes.

In the Test stage, the prototypes were evaluated by a representative of the business environment who had not participated in the student teams and was a graduate of another faculty. This external evaluation was used as an additional feedback mechanism rather than as a formal usability test or empirical validation with banking customers. The final outputs therefore represent student-generated, simulated user insights and workshop-based innovation concepts rather than evidence of actual customer preferences or behaviors.

The complete procedure followed a predefined sequence: development of interview questions, reciprocal team interviews, anonymous written recording of responses, qualitative synthesis, problem definition, ideation, prototyping, and external evaluation. This protocol provides a reproducible framework for applying Design Thinking to a digital banking innovation scenario while maintaining a clear distinction between conceptual application and empirical research involving real banking users.

3. Results and discussion

To demonstrate the practical applicability of Design Thinking within banking innovation, a conceptual case inspired by current industry practices was developed.

Taken together, the five stages of Design Thinking represent a flexible and user-centered innovation framework capable of addressing complex and dynamic challenges. Particularly within digital banking ecosystems, where customer expectations and technological developments evolve rapidly, the iterative nature of Design Thinking enables organizations to continuously adapt products and services while maintaining a strong focus on customer value creation.

The case concerns the creation of an infotainment-based banking service integrated into a vehicle dashboard ecosystem. This scenario was selected because embedded finance and connected mobility ecosystems represent emerging areas of digital transformation where banking services increasingly extend beyond traditional platforms. Recent developments in embedded finance demonstrate that vehicles increasingly become

digital environments where users can perform activities beyond transportation, including payments, subscriptions, and financial operations. In this context, banking and payment functionalities can be embedded directly into the vehicle ecosystem, allowing users to access selected financial services through the infotainment system. Recent research highlights the potential of embedded finance to expand access to financial services by integrating financial functionalities into digital platforms and leveraging emerging technologies such as AI, blockchain, and digital payment systems (Rismawati, 2026). To illustrate how Design Thinking can support innovation in this context, a workshop simulation was conducted following the five stages of the methodology. The activities undertaken, key outputs generated, and their implications for banking innovation are summarized in Table 2.

Table no. 2. Application of Design Thinking stages in the development of an infotainment-based banking service

Stage	Activities	Key outputs	Innovation implications
Empathize	Structured interview activities conducted by student teams, followed by empathy mapping of responses regarding customer expectations and concerns about in-car banking.	Identified concerns included cybersecurity, distraction, trust, and authentication, while perceived user priorities included convenience, security, and speed.	Revealed user expectations and barriers to adoption.
Define	Analysis and synthesis of collected responses.	Problem statement: *How might banks provide safe and intuitive in-car banking without distracting drivers?*	Positioned customer needs at the center of innovation.
Ideate	Brainstorming and collaborative idea generation.	Proposed ideas: AI voice assistant, biometric authentication, dashboard widgets, predictive	Converted customer needs into solution concepts.

		notifications. Selected solutions: voice assistant, quick actions and contextual recommendations.	
Prototype	Development of a simplified dashboard interface.	Integrated voice activation, facial recognition, payment shortcuts, and financial notifications.	Created a user-centered prototype with reduced interaction complexity.
Test	Prototype presentation and peer feedback sessions.	Strengths: simplicity and usefulness. Improvements: stronger security, privacy, reduced distraction.	Validated solution relevance and improvement opportunities.

Source: Authors' contribution

As shown in Table 2, the Design Thinking process facilitated the transformation of qualitative insights generated during the workshop simulation into structured solution concepts. The Empathize stage identified several recurring themes – convenience, security, authentication, trust, privacy, and driver distraction – which were subsequently reflected in the problem definition and the proposed functionalities. Importantly, these insights were generated through simulated peer interviews and therefore represent student-produced representations of user expectations. The iterative progression from empathy to testing enabled participants to identify practical functionalities while continuously refining proposed solutions according to the simulated user insights and external feedback.

Building upon these findings, the next phase of the process focused on translating identified user needs and concerns into concrete service functionalities. In line with the user-centered nature of Design Thinking, the insights obtained throughout the previous stages served as the foundation for generating practical and innovative banking solutions adapted to the emerging context of infotainment-based financial services.

During the Ideation stage, participants were encouraged to generate a broad range of solutions without initially evaluating their feasibility. Using brainstorming and collaborative discussion techniques, teams translated the needs, concerns, and expectations identified during the previous stages into potential functionalities for an

infotainment-based banking ecosystem. The proposed ideas reflected users' preferences for convenience, personalization, security, and minimal cognitive effort while driving. Following peer discussions and refinement, several recurrent solutions emerged. Table 3 summarizes the principal functionalities identified by participants during the Design Thinking workshop simulation.

Table no. 3. Functionalities proposed for the infotainment-based banking interface

Functionality	Description	Banking customer value
Account balance verification	Allows users to access real-time information regarding account balances directly from the vehicle interface.	Provides convenience and immediate access to financial information.
Voice-assisted payments	Enables users to initiate banking transactions and payments through voice commands.	Reduces manual interaction and supports hands-free operation.
Parking payments	Allows users to pay for parking or other mobility-related services directly through the infotainment system.	Simplifies transactions and improves user experience during travel.
Customized quick-access shortcuts	Allows users to personalize frequently used banking actions according to individual preferences.	Improves usability and reduces interaction time.
Financial notifications	Sends real-time alerts regarding account activity, payments, or financial events.	Improves awareness and supports financial control.

Source: Authors' contribution

The identified functionalities demonstrate how Design Thinking transforms qualitative user insights into concrete solution concepts. Rather than beginning with technological

capabilities, participants developed ideas directly from customer expectations revealed during the Empathize and Define stages. This finding supports the user-centered nature of Design Thinking and illustrates its potential contribution to the development of innovative banking services integrated into emerging digital environments.

At the same time, the workshop highlighted that convenience and reduced interaction effort need to be balanced against security, privacy, authentication, and driver distraction. For example, voice-assisted payments may reduce manual interaction, but their implementation requires appropriate authentication and protection against unauthorized transactions. Similarly, financial notifications and dashboard-based information may improve accessibility while potentially increasing cognitive or visual distraction. These considerations indicate that the application of Design Thinking in digital banking should incorporate security, privacy, and safety requirements from the early stages of the innovation process rather than treating them solely as technical implementation issues.

The findings support previous studies arguing that Design Thinking contributes significantly to customer-centric innovation in financial services. Unlike traditional product development models that begin with technological possibilities, Design Thinking starts from human needs and emotional expectations. In the present workshop, this orientation was reflected in the identification of convenience, security, authentication, trust, privacy, and driver distraction as recurring considerations during the Empathize stage. These considerations were subsequently reflected in the problem definition and in the functionalities proposed during the Ideate and Prototype stages.

Thus, the workshop findings suggest three important implications. First of all, customer expectations increasingly extend beyond traditional banking channels toward embedded and contextual financial experiences. Second, interdisciplinary collaboration facilitates broader perspectives regarding customer problems. Third, rapid prototyping allows the early identification of usability issues before costly implementation stages. These findings are consistent with the broader role attributed to Design Thinking in supporting iterative, user-centered innovation, particularly in environments characterized by rapidly changing technologies and customer expectations.

The proposed in-car banking scenario also reflects the broader transition toward embedded finance ecosystems in which banking services become integrated into non-banking environments. Although conceptual in nature, the case demonstrates how Design Thinking may reduce uncertainty and support innovation capabilities in digital banking. At the same time, the workshop indicates that innovation in an in-car banking environment involves a trade-off between convenience and safety. Voice-assisted payments, financial notifications, and quick-access functionalities may reduce interaction effort, but they also raise concerns regarding authentication, privacy, cybersecurity, and driver distraction. Consequently, these aspects should be considered from the early stages of service design rather than addressed only during technological implementation.

The study also has important methodological limitations. First, the qualitative insights were generated through peer interviews among 57 students rather than through a separately recruited sample of banking customers. Although the participants may also

be users of banking services, banking-customer status was not used as a selection criterion and was not independently verified. Therefore, the findings cannot be generalized to the broader population of banking customers. Second, the workshop represents a conceptual and educational application of Design Thinking rather than a technical implementation or empirical usability test of an operational in-car banking service. The proposed functionalities should consequently be interpreted as innovation concepts requiring further testing with actual users and under real-world conditions.

Despite these limitations, the workshop provides a practical illustration of how Design Thinking can connect customer-oriented considerations with emerging embedded finance opportunities. The contribution of the study therefore lies not in validating specific in-car banking functionalities, but in demonstrating a structured process through which user needs, perceived risks, ideation, prototyping, and external feedback can be integrated into the early stages of digital banking innovation.

Conclusion

The increasing digitalization of financial services requires banks to adopt innovation approaches that extend beyond technological implementation and focus directly on customer needs. This paper explored the potential applicability of Design Thinking as a structured and user-centered methodology for supporting innovation in banking ecosystems.

Using a conceptual workshop and an infotainment-based banking scenario, the study illustrated how Design Thinking can be used to translate workshop-generated customer insights into functional solutions through iterative development processes. The findings suggest that this approach may contribute to reducing uncertainty, improving customer experience, and supporting long-term competitiveness in the digital economy. However, these findings should be interpreted in light of the conceptual and workshop-based nature of the study and should not be considered evidence of the effectiveness of Design Thinking in real banking environments.

An important limitation of the study is that the qualitative insights were generated through peer interviews among 57 students participating in the workshop. Although the participants may also be users of banking services, they were not specifically recruited or screened as banking customers, and the study does not provide a representative assessment of customer preferences. In addition, the proposed functionalities were developed and evaluated within a workshop setting and were not implemented or tested as operational banking services. Therefore, the results primarily illustrate the potential of the Design Thinking process rather than demonstrate the effectiveness of specific banking solutions.

Future research could extend the present conceptual approach by implementing empirical validation and usability testing within real banking environments. More specifically, the Design Thinking framework could be applied in collaboration with an actual banking institution to identify and address real organizational and customer-related challenges. Such an approach could involve multiple stakeholder groups, including customers, employees, and management teams, allowing researchers to capture diverse perspectives regarding operational inefficiencies, customer experience issues, and strategic innovation needs. Through interviews, empathy mapping, and

prototype testing, future studies could generate practical solutions grounded in real banking contexts and evaluate their effectiveness. This broader perspective would contribute to a more comprehensive understanding of how Design Thinking can support organizational transformation and innovation across different levels of the banking ecosystem.

References

[1] Alvarez, P. S. (2025). Using Design Thinking and Agile methodologies to enhance learning in European Vet Systems. *ICERI2025 Proceedings*, 7765-7772, DOI 10.21125.iceri.2025.2161.

[2] Beckman, S. L. (2007). Innovation as a learning process: Embedding design thinking. *California Management Review, 50*(1), 25-56, DOI 10.2307/41166415.

[3] Chia, A. J. (2019). Banking outside-in: How design thinking is changing the banking industry. *Proceedings of The International Association of Societies of Design Research (IASDR)*, pp. 3-5.

[4] Cunha, A. C. (2026, March). Design thinking for organizational change: A systematic review of enablers and barriers. *Journal of Open Innovation: Technology, Market, and Complexity, 12*(1), DOI 10.1016/j.oitmc.2026.100742.

[5] Dam, R. F. (2020). Design thinking: Get started with prototyping. *Interaction Design Foundation*, website: https://ixdf.org/literature/article/design-thinking-get-started-with-prototyping, accessed: 20 September 2026.

[6] Dell'Era, C. M. (2025, September 23). Design thinking in action: a quantitative study of design thinking practices in innovation projects. *Journal of Knowledge Management, 29*(11), pp. 32 – 58, DOI 10.1108/JKM-04-2024-0424.

[7] Köppen, E. M. (2014). Empathy via design thinking: creation of sense and knowledge. *Design thinking research: Building innovators*, pp. 15-28, DOI 10.1007/978-3-319-06823-7_2.

[8] Li, J. G. (2026). Shaping maker education through design thinking: A lesson study perspective. *Thinking Skills and Creativity, 59*, DOI 10.1016/j.tsc.2025.101957.

[9] Liedtka, J. (2015). Perspective: linking design thinking with innovation outcomes through cognitive bias reduction. *Journal of Product Innovation Management, 32*(6), 925-938, DOI 10.1111/jpim.12163.

[10] Luchs, M. G. (2015). A brief introduction to design thinking. *Design thinking: New product development essentials from the PDMA*, pp. 1-12, DOI 10.1002/9781119154273.

[11] Micheli, P. W. (2019). Doing design thinking: Conceptual review, synthesis, and research agenda. *Journal of Product Innovation Management, 36*(2), pp. 124-148, DOI 10.1111/jpim.12466.

[12] Paracha, S. H. (2019). Co-design with children: using participatory design for design thinking and social and emotional learning. *Open Education Studies, 1*(1), pp. 267-280, DOI 10.1515/edu-2019-0021.

[13] Remy, C. H. (2021). Challenges and opportunities in the design of Digital distributed affinity Diagramming tools. *Proceedings of the 32nd European Conference on Cognitive Ergonomics*, pp.1-5, DOI 10.1145/3452853.3452871.

[14] Rismawati, R., Handayani, M., Elliyana, E., Pahala, I. Sustainable finance in the digital age: the function of embedded finance in eco-friendly investments. *Reshaping financial systems and fostering sustainability through embedded finance*, p. 34, DOI 10.4018/979-8-3373-2464-7.ch006.
[15] Sakama, N. M. (2018). Creative systems analysis of design thinking process. *Collaborative Innovation Networks: Building Adaptive and Resilient Organizations*, pp. 103-113, DOI 10.1007/978-3-319-74295-3_9.
[16] Siricharoen, W. V. (2020). Using empathy mapping in design thinking process for personas discovering. *International Conference on Context-Aware Systems and Applications, Springer International Publishing*, pp. 182-191, DOI 10.1007/978-3-030-67101-3_15.
[17] Waidelich, L. R. (2018). Design thinking process model review. *2018 IEEE International Conference on Engineering, Technology and Innovation (ICE/ITMC)* , pp. 1-9, DOI 10.1109/ICE.2018.8436281.
[18] Watanabe, K. T. (2017). Framework for problem definition–a joint method of design thinking and systems thinking. *INCOSE International Symposium, 27*(1), pp. 57-71, DOI 10.1002/j.2334-5837.2017.00345.
[19] Wolniak, R. (2017). The Design Thinking method and its stages. *Systemy Wspomagania w Inżynierii Produkcji*, pp. 247-255.
[20] Xuan, S. H. (2025). The role of FinTech in shaping urban innovation: A study of financial markets from the perspective of the patent renewal model. *Pacific-Basin Finance Journal, 91*, DOI 10.1016/j.pacfin.2025.102750.