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Exploring Theoretical Foundations and Data Collection Instruments in Design Thinking Methodology Through a Systematic Review

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Abstract - **Design Thinking (DT) is a rapidly emerging human-centered methodology aimed at encouraging creativity, innovation, and problem-solving in various fields. Nevertheless, fast adoption of DT has led to the emergence of a range of theoretical contradictions and inconsistencies with regard to the tools utilized for assessing DT practice. Such limitations reduce the possibility of cross-comparability and generalization of research findings. The goal of this study is to reveal and analyze the most prominent theoretical approaches and measurement instruments used in Design Thinking research in order to gain an insight into the existing methodology and facilitate future empirical studies. A systematic review has been conducted in accordance with the PRISMA 2020 guidelines. Studies devoted to the topic and published during the period of 2015-2025 have been obtained from three major academic databases – Scopus, Web of Science, and SciELO. A total of 19 studies were chosen for a thorough examination after going through the process of systematic search and eligibility screening. Three different reviewers were involved in conducting the process of study selection, data extraction and bias assessment with the use of bias assessment methods that have been widely used before. It is clear that there is much variation in terms of theories that have been adopted in these studies. There are 19 different conceptual frameworks identified among the chosen studies. Experiential Learning Theory was the most common one (8 papers, 24%), followed by Creativity Theory (5 papers, 15%) and Constructivism Theory (4 papers, 12%). In terms of the data collection instruments, questionnaires were the most commonly used ones, being used in 22% of cases. The second place is occupied by the semi-structured interviews (20%), with observation and workshops each being used in 12%, and focus groups in 10%. This review reveals the multi-disciplinary aspects of Design Thinking studies and the requirement for uniform theoretical models and validation tools in assessing the results of these studies in the future.**

Keywords: **Design Thinking, Systematic Review, Theoretical Frameworks, Data Collection Instruments, Innovation, Creativity, PRISMA 2020**

I. INTRODUCTION

The DT approach is now recognized as one of the most important tools for encouraging innovations in the contemporary world, and it has been successful in overcoming complicated problems in various spheres (Nunes et al., 2024). Nevertheless, along with such a rapid development of practice, there was one important contradiction revealed – DT's theoretical underpinning and inconsistency in the metrics used for evaluating its outcomes became obvious (Schlott, 2024). Inability to formulate a theoretical framework prevented DT from developing into a strong body of knowledge and, at the same time, hampered the comparison of results between different researches (Viviani et al., 2024).

The primary purpose of that work was to map out and structure the conceptual and methodological terrain that formed the foundation for the empirical research of DT and to provide the basis for the further development of knowledge about it (Holanda et al., 2024). One of the aims of the research was to provide, first of all, a review of the most frequently applied theoretical approaches and, secondly, a number of techniques for gathering information, following the foundational works in the field (Berglund, 2024; Nunes et al., 2024).

However, the research served the interest of three categories of people. To begin with, the academics since the research gave an explanation about fundamental ideas and identified the possibilities for future research (Leal Filho et al., 2024). Secondly, professionals and innovators were able to learn how to make the process effective since they were presented with a way to select the theories and evaluate tools (Leal Filho et al., 2024). Thirdly, policymakers realized the importance of DT as a way to design actions that really revolve around the citizen (Felmingham et al., 2023).

The major innovative point in the current review was that the authors managed to go beyond the one-dimensional perception of DT and its understanding as merely a process and a separate mindset dimension (Lubna et al., 2024); in other words, the authors presented a model that integrates theoretical backgrounds, instruments, and ways of impact evaluation.

Thus, a better, more grounded application of DT helped create important social value; namely, there were positive changes in terms of effectiveness of services provided, saving money on issues, such as healthcare (Ezeanaka & Tran, 2024), and, finally, promoting innovations in the sphere of education. Contemporary trends in the area of education imply the necessity of applying adaptive approaches to deal with individual needs of learners (Mukhammadieva et al., 2026; Balvad et al., 2026).

The purpose of the current paper is to comprehensively review the most popular theories and measurement tools used in the Design Thinking research field during 2015-2025 years. The purpose of the paper is to find out popular theories, review methodologies and pinpoint some gaps in relation to DT studies standardization and assessment.

The main findings of the study can be highlighted as follows:

- This study discusses and evaluates the main theoretical models behind Design Thinking research studies and the extent to which they have been utilized.
- Various tools for data collection such as questionnaire, interview, observation, and workshop are explored within the context of DT implementation and results measurement.
- The review identifies some of the existing problems associated with theoretical fragmentation and inconsistent assessment methodologies, giving directions on how to improve future DT research practices.
- The results offer guidance to scholars, practitioners, and policy makers about the appropriate theoretical framework and assessment techniques that can be used for conducting DT research.

The rest of the essay is structured in the following manner. In Section II, the systematic review methodology will be explained. In Section III, the results are outlined, comprising of theoretical perspectives, data collection tools, and assessment findings. In Section IV, the discussion, implications, limitations, and future directions are emphasized. Conclusion of the study is made in Section V.

II. Methods

2.1 Eligibility Criteria

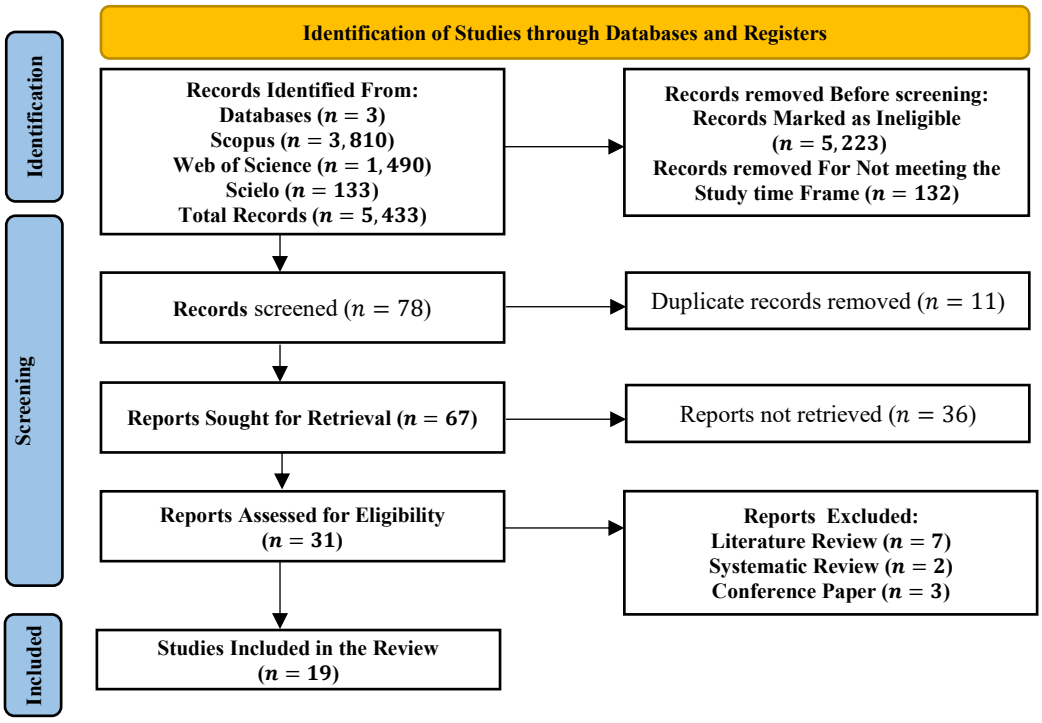


Fig. 1 PRISMA Flow Diagram for Study Selection Process

The criteria for the selection were created with a purpose to find studies relevant to the objective of conducting an analysis of theoretical frameworks and data collection instruments for Design Thinking (DT). Inclusion and exclusion criteria were set up prior to the screening stage to maintain methodological consistency.

Studies published from 2015 to 2025 have been considered eligible if they addressed the use of Design Thinking methodology and its theoretical background and/or data collection instruments in English, Spanish, or Portuguese. Criteria for exclusion of studies included duplication of results, non-relevance to DT theories or measurement tools, being outside the specified time frame, and being a literature review, systematic review, or conference paper.

Fig. 1 represents the process of selecting systematic studies in line with the PRISMA guide. This process entails identification, screening, eligibility and inclusion, whereby one sees the number of records found in various databases, as well as those that are selected in the end.

2.2 Information Sources and Search Strategy

Research was carried out in the most popular bibliographic databases such as Scopus, Web of Science, and Scielo. The last search was performed in September 2025.

Search Strategy

The searches were carried out in each database in the following way: Scopus. The search algorithm was: (TITLE ("design thinking" OR "pensamiento de diseño") AND TITLE-ABS-KEY ("instrument" OR "instrumento" OR "tool") AND TITLE-ABS-KEY ("theorie" OR "teoria" OR "model")) AND PUBYEAR > 2014 AND PUBYEAR < 2026. Web of Science. The search syntax was: "design thinking" OR "design thinking" (Title) and "instrument" OR "instrument" OR "tool" (Abstract) and "theorie" OR "theory" OR "model" (Abstract) and 2025 or 2024 or 2023 or 2022 or 2020 or 2019 or 2017 or 2014 (Publication Years). Scielo. The search query was: ((("design thinking" or "pensamiento de diseño") AND (ab:("instrument" or "instrumento" or "tool"))) AND (ab:("theorie" or "teoria" or "model")). From the above, it is clear that logical connectors such as AND and OR were utilized in all searches.

2.3 Study Selection Process

A two-step screening process was used in the selection of the studies. Titles and abstracts were first screened to find those studies which are associated with the theory and data gathering instruments of Design Thinking. Those studies which did not have relevance to the research objectives and which were literature review/conference papers were removed from the list. The three reviewers individually carried out the screening, and any divergent opinions were settled either by reaching consensus or through a fourth reviewer where necessary. All the other articles were reviewed in full text to check whether they met the predetermined criteria, and all of them were individually reviewed by the three reviewers.

2.4 Data Collection and Extraction

Data extraction was done using a structured database in Excel that included characteristics of the studies, such as authors and year of publication, title of the article, country, name of the journal, keywords, language of publication, theoretical models used, and tools for data collection. This framework of extraction was tested through piloting and completed independently by three reviewers. All discrepancies that arose were sorted out amicably through consensus.

2.5 Risk of Bias Assessment

The risk of bias of each article was analyzed using the Robins-i (Risk of Bias in Non-randomized Studies of Interventions) tool.

The following domains were examined:

D1: Confounding bias;

D2: Participant selection bias;

D3: Bias in intervention allocation;

D4: Bias due to deviation from the intervention;

D5: Bias due to missing data;

D6: Bias in outcome measurement;

D7: Selective reporting bias.

Criteria for each of these areas were classified as follows: low, moderate, serious, or critical.

The second criterion for assessing the level of bias of the reviewed articles was the MMAT (Mixed Methods Appraisal Tool) (Hong et al., 2018). Five areas and 25 criteria were identified. Each criterion was rated according to the following classification: yes, no, or cannot determine. Review was conducted by three specialists (J.Ll., M.Q., and R.G.), who worked blindly and reached a consensus on discrepancies.

2.6 Data Synthesis and Analysis

The results obtained from the extraction process were analyzed using qualitative and descriptive analyses. The theoretical frameworks and instruments used for data collection were classified based on their frequency of use in the studies that have been reviewed. The features of the selected studies, which include the publication year, focus of study, location, keywords, and language, are presented in table I. Findings were presented through tables and descriptive summaries in order to emphasize the methodology trends in Design Thinking research.

TABLE I CHARACTERISTICS OF INCLUDED STUDIES ON DESIGN THINKING RESEARCH

AUTHOR/YEAR	JOURNAL	KEYWORDS	LANGUAGE & COUNTRY
Delgado-Parada, (2025)	Computers & Education	Cross-cultural projects, Distance education and online learning	English & Spain
Lukitasari et al., (2025)	TEM Journal	CFA, CSTEM-DT, Design thinking, EFA, STEM	English& Indonesia
Gessala et al., (2025)	Cogent Education	Design thinking, self-assessment questionnaire	English& Thailand
Kiattibutra, (2025)	Kasetsart Journal of Social Sciences	Design thinking, innovation	English& Thailand
Indrianto et al., (2024)	Journal of Social and Environmental Management	Design thinking, innovative	English& Indonesia
Viviani et al., (2024)	Energies	Interdisciplinary design model for urban transport product innovation, double-diamond Design Thinking model, electric microvehicle	English& Italy
Holanda et al., (2024)	Library Research: Archival Science, Library Science, and Information	University library, Design thinking, Journey mapping	Portuguese& Brazil
Santa-Maria et al., (2022)	Surgery Open Science	Resident selection, Design thinking, surgical education	English& USA
Baxter et al., (2024)	Health Expectations	Co-design, design thinking, food insecurity, microlearning	English &Australia
Date & Chandrasekharan, (2025)	International Journal of Technology and Design Education	Engineering design thinking, sustainability, design problem formulation	English&India
McGrath et al., (2025)	Journal of Agricultural Education and Extension	Design thinking, digital agriculture, digital innovation, user-centered design	English& Ireland
Bawaneh & Alnamshan, (2023)	International Journal of Information and Education Technology	Design thinking in education, optimizing motivation	English& Bahrain
Bender-Salazar, (2023)	Journal of Innovation and Entrepreneurship	Design thinking, design process	English& Ireland
Gao & Yu, (2023)	Management Decision	Service innovation, Design thinking, knowledge exchange, SME	English & United Kingdom
Menon et al., (2023)	Cogent Business and Management	Entrepreneurship model, Design thinking, empathy, creativity	English &India
Msokera et al., (2023)	Journal of Global Health Reports	Design thinking, Human-centered design	English& Malawi
Fotaris & Mastoras, (2022)	Educational Sciences	Game-based learning, Design thinking	English& United Kingdom
Phanphairoj & Waleeittipat, (2022)	Kasetsart Journal of Social Sciences	21st century skills, Design thinking competency	English& Thailand
Santa-Maria et al., (2022)	Journal of Cleaner Production	Sustainable business model, Business model innovation, Design thinking	English& Austria

Source: Own Elaboration.

III. Results

3.1 Study Selection

Stage one of the identification process was performed by analyzing 3,810 papers in Scopus, 1,490 academic sources in Web of Science, and 133 papers in Scielo, making a total of 5,433 sources. The studies excluded from the screening process were: 5,223 papers with no direct reference to words such as: "design thinking," "design thought," "instrument," "tool," "theory," "theory," "model," and 132 papers unrelated to the search period (2015-2025); and thus there were 78 papers left for the screening phase.

In stage two, there was the screening process through which it was determined the following: 11 duplicate papers, 36 papers that have no connection with any theory or instrument, 7 literature reviews, 2 systematic reviews, 3 conference papers, and finally 19 papers were selected for the full-text evaluation stage.

3.2 Characteristics of the Studies

The DT approach research was based on different theoretical perspectives. The most common theory in the studies under review was Experiential Learning Theory, which was used in eight papers (24%), whereas Creativity Theory and Constructivism Theory were used in five (15%) and four (12%) articles correspondingly. Complex Problems Theory and Innovation Theory were applied in two articles (6% each). The rest of the theoretical perspectives included Cognitive Complementarity, Communication, Sustainable Mobility Technologies, Ergonomics and User-centered Design, Organizational Knowledge Management, Responsive Feeding, Distributed Cognition, Organizational Learning, Knowledge Exchange, Circular Economy, Tourism Sustainability, Community Empowerment, and Visual Thinking, and they were used in one study (3%) each. In some studies, more than one theory was utilized. Thus, one of the studies used Constructivism, Creativity and Experiential Learning Theory (Delgado-Parada, 2025), as well as other studies used two or more theoretical approaches (Gessala et al., 2025; Kiattibutra, 2025; Lukitasari et al., 2025). These findings reveal the interdisciplinary character of DT research, where multiple theories are used to describe learning, creativity, innovation and problem-solving processes as seen in table II.

TABLE II THEORETICAL FRAMEWORKS UNDERPINNING DESIGN THINKING RESEARCH

AUTHOR	THEORIES UNDERPINNING DESIGN THINKING RESEARCH
Delgado-Parada, (2025)	Constructivism theory.
	Creativity theory.
	Experiential learning theory.
Lukitasari et al., (2025)	Theory of experiential learning.
	Theory of cognitive complementarity.
Gessala et al., (2025)	Theory of complex problems.
	Theory of experiential learning.
Kiattibutra, (2025)	Constructivism theory.
	Theory of experiential learning.
Indrianto et al., (2024)	Community empowerment theory.
	Theory of tourism sustainability.
Viviani et al., (2024)	Theory of sustainable mobility technologies.
	Theory of ergonomics and user-centered design.
Holanda et al., (2024)	Theory of organizational knowledge management.
Santa-Maria et al., (2022)	Theory of creativity.
Baxter et al., (2024)	Theory of experiential learning.
	Theory of receptive feeding.
Date & Chandrasekharan, (2025)	Distributed cognition theory.
McGrath et al., (2025)	Innovation theory.
Bawaneh & Alnamshan, (2023)	Experiential learning theory.
	Constructivism theory.
Bender-Salazar, (2023)	Organizational learning theory.
Gao & Yu, (2023)	Knowledge exchange theory.
Menon et al., (2023)	Experiential learning theory.
	Theory of creativity.
Msokera et al., (2023)	Theory of innovation.
Fotaris & Mastoras, (2022)	Constructivism theory.
	Experiential learning theory.
Phanphairoj & Waleeittipat, (2022)	Creativity theory.
Santa-Maria et al., (2022)	Circular economy theory.
	Theory of creativity.

Source: Author's Own Compilation.

Table III provides an overview of the data collection instruments, design, instrument validation methods, measures of reliability, and sample features utilized in Design Thinking (DT) studies. According to the results, the most commonly used instruments were questionnaires and semi-structured interviews, with observations, workshops, focus groups, surveys, and tests following behind. A number of scholars used several types of instruments, including both in mixed-method research, where qualitative methods (such as interviews, observations, workshops, and focus groups) were combined with quantitative methods (questionnaires and surveys). The validation of instruments was done through expert evaluation, literature review validation, triangulation, and statistical analysis, such as CFA. The reliability of the

instruments was calculated by means of Cronbach's alpha and composite reliability, while construct validity by means of CFI, TLI, RMSEA, KMO, AVE, and factor loadings. In general, the reviewed literature shows that there are different techniques employed in developing DT research instruments.

TABLE III COMPARATIVE ANALYSIS OF DATA COLLECTION TOOLS AND PSYCHOMETRIC EVALUATION METHODS IN DESIGN THINKING STUDIES

AUTHOR	INSTRUMENT	STRUCTURE	DESIGN	CONTENT VALIDITY	CONSTRUCT VALIDITY	RELIABILITY	SAMPLE
Delgado-Parada, (2025)	Semi-structured interviews		Design process (4 representatives from European institutions (3 women, 1 man)). Structure and content (5 professionals (4 academics and 1 graphic designer))	Expert judgment (7) using the individual aggregate method			144 professionals in the field of education (111 women, 31 men, 2 non-binary individuals).
	Online questionnaire based on the UNE 71362:2020 standard	31 items, 2 dimensions: didactics (14 items) and technical aspects (17 items)			Based on the AENOR standard UNE 71362-2020	Cronbach's alpha = 0.97	
Lukitasari et al., (2025)	STEM-DT Questionnaire. Online	43 items, 5 components: empathize (6 items), define (5 items), ideate (11 items), prototype (11 items), test (10 items).	-	Expert judgment from STEM experts and teachers with experience in DT	KMO = 0.980, χ^2 = 15,691.508, $p < 0.001$. Goodness-of-fit indices (χ^2/df = 2.270, RMSEA = 0.046, GFI = 0.977, CFI = 0.931, TLI = 0.927).	Cronbach's alpha (IDL = 0.70, ICL = 0.72, IEL = 0.97)	603 participants (459 women, 144 men).
Gessala et al., (2025)	Self-assessment questionnaire on design thinking. Online	15 items, 5 dimensions: exploring the context (4 items), contextual awareness (2 items), open-ended discovery (3 items), hands-on model (2 items), and test & tune (4 items).	-	Expert judgment (3 specialists in measurement and evaluation). The 513lpha513s obtained IOCs between 0.667 and 1.000	Goodness-of-fit 513lpha513s (CFI = 0.962, TLI = 0.986, RMSEA = 0.030, SRMR = 0.022, χ^2/df = 120.229/85 = 1-41)	Cronbach's alpha by dimension (exploring the context = 0.900, contextual awareness = 0.772, open-ended discovery = 0.864, hands-on model = 0.824, test & tune = 0 0.898. Overall 513lpha = 0.976	448 participants
Kiattibutra, (2025)	Learning skills test (pre-test and post-test)	40 multiple-choice questions.	-	Expert judgment using the Item-Objective Congruence Index (IOC). Pre-test and post-test (IOC = 0.93 and 1.00).	-	Pre-test and post-test (Cronbach's Alpha = 0.8671)	70 participants (22 representatives from the Ban Toon community, 19 SAO staff members, 29 university students)
	Semi-structured interviews	Collects data on spatial aspects, duties, responsibilities, management styles, problems, and obstacles.	-		-	-	
	Opinion questionnaire	Best Scale, 12 questions (9 closed-ended, 3 open-ended)	-	Expert judgment using the Item-Item Congruence Index (IOC). Opinion questionnaire (IOC = 1.00).	-	Opinion questionnaire (Cronbach's alpha = 0.7891)	
Indrianto et al., (2024)	In-depth interviews				Triangulation of methods, verification with informants.	Transparent analysis process, systematic coding, citation of validated methodologies.	10 informants (6 university students majoring in tourism management and 4 local representatives involved in tourism development).
	Observation	-	-	-			
Viviani et al., (2024)	Semi-structured interviews	Open-ended questions		Literature review	-	-	27 participants (project experts, engineering design researchers, micromobility users)
	Questionnaire	Likert-scale and open-ended questions	Google Forms	Questions based on usability attributes	Evaluation of intuitiveness, efficiency, and stimulation	-	
	Observation	Direct observation of the use of roller skates and unicycles	Recording of interactions, postures, behaviors	Based on ergonomics and user experience	-	-	
	Focus groups	Guided discussion, guiding questions	Sessions with interdisciplinary teams and partners	Topics derived from the literature review	-	-	
	Co-design workshops	Participatory sessions using visual tools (Miro)	Ideation activities, brainstorming	Based on previous insights	-	-	
	Remote usability testing	Google Forms questionnaire, Likert scale	Evaluation of virtual prototypes	Questions validated in previous studies	Usability perception measurement	-	
	Prototype testing	-	Safety, comfort, and durability standards	-	-	-	

Holanda et al., (2024)	Structured questionnaire	Day-to-day mapping model co-designed by librarians	Google Forms questionnaire,	Collaboration between administrators and librarians	-	-	102 participants (undergraduate and graduate students, staff from 2 public university libraries)
Santa-Maria et al., (2022)	Focus groups	2 virtual sessions, 1 hour each	Based on the Design Thinking framework	Group discussion	Triangulation among residents from multiple institutions	-	16 participants (Collaboration Education Fellows-CoSEF), 12 academic institutions in the U.S., general surgery residents
Baxter et al., (2024)	Co-design workshops	4 workshops, 90 minutes each	Participation of parents and experts	Expert judgment on design and nutrition	Capturing the experiences of parents and child nutrition experts	-	9 fathers, 5 mothers, 9 child health experts
	Semi-structured interviews	Open-ended questions about feeding experiences, food insecurity, and intervention design	-	Questions on responsible feeding and food insecurity	Measuring feeding practices and intervention preferences	-	29 fathers with children aged 6 months and 3 years
	Direct observation of meals at home	Naturalistic observation, 3 videos per family	Qualitative analysis of verbal transcripts and observed behaviors	Responsible feeding framework	Actual feeding practices and mealtime environment	-	10 families
	Quantitative survey	Google Forms questionnaire with demographic questions and Likert-scale items	USDA Food Security Scale, dietary practices questionnaire, household chaos and dysfunction scale, parental stress scale	Instruments in similar populations	Measurement of food insecurity, feeding practices, household dysfunction, and stress	Food Practices Scale	213 parents
Date & Chandrasekharan, (2025)	Contextual observation	Unstructured, ethnographic	Holistic and longitudinal observation	The complexity of the process was captured	Distributed cognition framework	Triangulation with interviews	2 micro-hydro system designers and two expert engineering educators
	Semi-structured interviews	Interview script with broad, open-ended questions	Questions focused on the needs identification process	Questions derived from the literature review	Analysis of responses using thematic analysis and historical-cognitive analysis	Cross-analysis among researchers and comparison with observational data	
McGrath et al., (2025)	Co-design workshop	Group session with structured exercises	Based on the Design Thinking methodology		Data triangulation and the participation of multiple stakeholders	Audio recording and verbatim transcription, written materials	13 participants (6 livestock farmers, 2 veterinarians, 2 technology developers, 2 agricultural advisors, 1 animal health expert) selected through purposive sampling
Bawaneh & Alnamshan, (2023)	Instructor's guide	-	-	Expert judgment (5) with PhDs in education and biology	-	-	92 female second-year biology students (50 in the experimental group and 42 in the control group).
	Achievement test	30 multiple-choice questions	-	Expert judgment and pilot tests	-	Cronbach's alpha = 0.78	
	Motivation questionnaire	10 items	-		-	Cronbach's alpha = 0.77	
Bender-Salazar, (2023)	Observation	Unstructured	Longitudinal observation of 8 student teams	Observation of real behaviors and processes	Hybrid design thinking model	Field notes, triangulation with interview data	40 master's students divided into 8 teams in a course on the circular economy and entrepreneurship
	Semi-structured interview	Six individual interviews conducted one year after the course ended	Open-ended questions and a role-playing exercise	Questions derived from the theoretical framework	-	Interview transcript, thematic analysis	6 former students
	Workshop		World Café, adapted to a small-group format			Note-taking	
Gao & Yu, (2023)	Semi-structured interview	Structured script	-	Literature review	Methodological triangulation	Standardized case protocol	Managers and employees of three SMEs
	Focus groups	Collaborative sessions	-	Dimensions of the study	Observation of group interactions	Recording of sessions, cross-participation of internal and external stakeholders	
	Participant observation	-	-	Knowledge exchange	Interview narratives and documents	Recording of notes and photographs	

Menon et al., (2023)	Emotional intelligence questionnaire	44 items, Likert scale	-	Expert judgment, literature review	Confirmatory factor analysis (CFA); factor loadings > 0.4, convergent validity (AVE) > 0.5; discriminant validity (square root of AVE > squared correlations between constructs)	Cronbach's alpha = 0.84; composite reliability (CR) for each factor between 0.75 and 0.88	601 university students in India, aged 18 to 21
	Design Thinking Questionnaire	20 items, Likert scale	-		CFA > 0.40, AVE = 0.52	Cronbach's alpha = 0.79; composite reliability (CR) = 0.84	
	Entrepreneurial Attitude Questionnaire	18 items, Likert scale	-		AVE = 0.68	Cronbach's alpha = 0.75; composite reliability (CR) = 0.85	
	Semi-structured interview	Questions on entrepreneurial attitude and design thinking		Interviews that allowed for adjustments to the content of the three questionnaires	-	-	25 participants
Msokera et al., (2023)	Survey	Online questionnaire, 27 closed-ended and open-ended questions	Self-administered, voluntary, anonymous	-	-	-	11 participants, OSM staff, 2 Malawian clinicians, 5 international participants
	Participatory workshop	4 iterative questions	Qualitative ethnographic approach over 4 days	-	-	-	
Fotaris & Mastoras, (2022)	Surveys	10 statements, Likert scale	Four annual versions (2018–2022) with 26 focus groups	Peer review	Methodological triangulation	Same instruments applied to 4 different cohorts. Combination of quantitative (survey) and qualitative (focus group and qualitative analysis) methods	104 graduate students (48 men and 56 women) over 4 academic years (2018–2022)
	Focus groups	30-minute semi-structured sessions.					
Phanphairoj & Waleeittipat, (2022)	Semi-structured interview	Open-ended questions	-	-	-	-	9 experts with 5 years of experience as qualified professionals.
	Structured questionnaire	45 items, Likert scale	-	Item-Construct Congruence Index (IOC)	AFC (χ^2 = 20.23, df = 15, p = 0.14). CFI = 0.99. SRMR = 0.01	-	623 undergraduate students
Santa-Maria et al., (2022)	Interview and workshop	6 workshops with 14 teams (3 hours and 4 hours)	-	-	-	-	-
	Expert feedback		-	-	-	-	16 experts
	Feedback surveys	Anonymous questionnaires, Likert scale	-	-	-	44 feedback surveys (Overall usefulness IM = 4.36, Overall ease of use IM = 4.35, Complementarity of activities IM = 4.68)	107 participants

Source: Own Elaboration.

In relation to the reliability of the instruments, 10 out of the total 22 studies used Cronbach's alpha, with the obtaining the highest value of 0.976 in its questionnaire, which was applied by dimensions (Gessala et al., 2025). In the study, this index was used in the pre-test and post-test exams and in the opinion questionnaire (Kiattibutra, 2025). The study used the same instruments applied across 4 cohorts to measure the reliability of its instruments (Fotaris & Mastoras, 2022). In the study, 44 feedback surveys were used to measure the reliability of their survey (Santa-Maria et al., 2022).

In relation to the samples, experts, researchers, professionals, undergraduate and graduate students, community representatives, local representatives, both males and females, library staff, parents, families, system designers, agricultural advisors, alumni, and managers and employees of SMEs took part. The biggest samples were obtained in the studies, where the number of undergraduates was 623, and the number of participants was 603 (Lukitasari et al., 2025; Phanphairoj & Waleeittipat, 2022). In the study, the sample size of 104 graduate students was kept for a 4-year period (2018–2022) (Fotaris & Mastoras, 2022).

Risk of Bias in Individual Studies

Assessment of the risk of bias was made with the help of ROBINS-I and MMAT. From the evaluation of ROBINS-I domains, D3, D4, and D7 domains were found to have a low risk of bias in all studies. Domain D1 and D5 domains had low risks in most studies, but one study each in both domains had a moderate risk of bias. Domain D6 exhibited comparatively more concerns with two studies being low risk

and three moderate risks. All studies evaluated with respect to domain D2 had a moderate risk of bias because of problems related to sampling and context.

On individual ROBINS-I assessment, differences were found between the various studies. Few studies showed moderate risk of bias due to problems regarding sample size, extraneous variables, measuring methods, and generalizability (Lukitasari et al., 2025; Gessala et al., 2025; Holanda et al., 2024; Menon et al., 2023). But these studies had strong points including the construct definition, standardized procedure, transparent reporting, and correct analysis approach. The studies which had a low risk of bias controlled their variables properly, had clear methodology, valid tools, outcome reporting, and no problems regarding participants (Bawaneh & Alnamshan, 2023).

According to MMAT-based evaluation, nine out of fifteen studies had a moderate risk of bias while six studies had a low risk of bias. The main reasons for a moderate risk of bias included issues concerning unclear procedures of qualitative data collection and analysis, limited information on data integration, insufficient consideration of the possible contradictions in qualitative and quantitative results, and restricted sample representability (Delgado-Parada, 2025; Kiattibutra, 2025; Indrianto et al., 2024; Viviani et al., 2024; Baxter et al., 2024; Date & Chandrasekharan, 2025; Msokera et al., 2023; Fotaris & Mastoras, 2022). There were some qualitative elements that had no descriptions of data collection process, data analysis and interpretation of results.

A few researches had the low risk of bias because all the necessary criteria according to MMAT were met (study design, methodology for data collection, analysis and interpretation of results) (Sathe et al., 2024; McGrath et al., 2025; Bender-Salazar, 2023; Gao & Yu, 2023). However, other papers identified as having low risk of bias had consistent reporting, proper approach to both qualitative and quantitative elements; but some of the criteria could not be analyzed because of the lack of contradictory information (Phanphairoj & Waleeittipat, 2022; Santa-Maria et al., 2022).

However, the majority of the reviewed research was characterized by moderate and low bias levels. Main factors associated with uncertainty concerned sample problems, methodology of qualitative analysis, self-reports, and mixing of findings in mixed methods research. However, all but one study demonstrated sufficient methodological quality, transparency of results presentation, and proper data analysis procedures.

IV. Discussion

This academic study performed a systematic review of literature with the intention to review the theories and the data collection methods used in research applying the DT approach in the last years. The process resulted in the identification of 19 papers that were published from 2015 until 2025 after the identification and screening process (Bajaj et al., 2026). However, there were some limitations in the inclusion/exclusion criteria, duplication, absence of theoretical foundations, and absence of papers in journals. Nonetheless, these criteria made the sample more consistent for analysis (Pérez-Rodríguez & Siso-Pavón, 2025).

Findings on theories and instruments employed in the research indicated the cooperative, problem-solving, and pragmatic aspect of the DT; of course, qualitative (7) and mixed methods (8) research excelled quantitative research (5). It showed the diversity of the methodological approach, and at the same time its complexity, which means that future research could use diversity of theories such as experiential learning and creativity, and instruments such as questionnaire and semi-structured interviews (Houston et al., 2025). Diversity of theories, which was found as the most commonly used one, indicated the pragmatism, creativity and user-centeredness of the DT methodological approach (Foster & Miller, 2025).

Concerning the tools used, the frequently used were questionnaires and semi-structured interviews. It was established that 15 of the papers made use of multiple tools while collecting data, while 5 of them made use of a single tool. The qualitative researches used in-depth interviews, observations, focus groups, semi-structured interviews, and workshops; the quantitative researches used questionnaires, guides, and tests; there were also mixed-methods researches that utilized in-depth interviews, questionnaires, tests, observations, focus groups, workshops, surveys, and expert opinions at the same time (Rydzewski & Wagner, 2025).

Despite the fact that the questionnaire was the most common tool for obtaining large samples, it can also fail to provide information about attitudinal and psychographic aspects related to DT (Jaeger & Giacalone, 2021). Quantitative studies were added to qualitative research in order to create a wide range and depth of DT methodology.

In case of content validity, it was demonstrated that 9 instruments were assessed via expert judgment, while in terms of construct validity 10 tools were assessed using method triangulation. As for the reliability of the tools, 10 of them had a Cronbach's alpha, and the highest value was 0.976; one of the biggest samples included 623 students (García, 2022).

In relation to the analysis of the risk of bias in the studies, the Robins-i method was employed in quantitative studies, whereas the MMAT method was utilized in analyzing qualitative and mixed-method studies. It must be noted, however, that the fact that 7 of the studies had a low risk of bias and 13 a moderate risk of bias suggested that DT methodology was carried out appropriately. Under this situation, domains 3, 4, and 7 had a low risk of bias in the studies, which ensured their consistency (Kaboudi et al., 2024).

The fact that the number of studies had varied origins, such as 8 in Asia, 7 in Europe, 1 in Africa, 1 in Australia, 1 in North America, and 2 in South America, was represented by

the use of various theoretical models in the DT methodology. The predominance of English language in the articles suggested scientific communication in intellectual production, characterized by variety in the application of tools to diverse target populations.

It is true that although the chosen publications belong to the period between 2015 and 2025, it was noticed that during the period from 2025 to 2024 there was an increase in the number of publications concerning DT approach that focused on the connection with users and solving environment-related problems through empathy (Blay & Espartinez, 2024).

There were some limitations for the chosen research such as searching through only three databases for the chosen articles. This could be considered as a limitation because searching theory-based articles could possibly limit the search of methods, approaches, and techniques and therefore reduce the spectrum of DT approaches' applications. Another limitation could be connected with the variety of DT applications contexts – such as engineering, library science, health, nutrition, SMEs, education, tourism, and community management – and different instruments (Velásquez et al., 2022).

Other limitations arose in the evaluation of risk of bias, especially in D2 with regard to participant selection and in D6 with respect to outcome assessment, though less in D1 with regard to variable control or in D5 with respect to loss to follow up. To address these limitations, future research must refine sampling strategies to prevent selection bias and enhance generalizability across diverse populations. Lastly, despite the systematic evaluation of the risk of bias, it did involve some degree of subjectivity.

The results of this review showed that the theoretical basis of the DT model was indeed strong, and provided several validated measures that can be used in different circumstances. It is suggested that the measures used be able to assess the different stages of DT (empathize, define, ideate, prototype, and test).

Accordingly, the following recommendations were made to guide future research studies in the light of these results: **(1)** Sampling strategy in order to prevent any type of bias in D2 and make it generalizable by using different sampling techniques; **(2)** methodology diversification, encouraging the use of instruments based on qualitative and mixed methods research which may be rich methodologically with respect to DT; **(3)** transparency and reporting, giving thorough details regarding missing data management, sample size, and methodology of managing confounding variables to mitigate moderate risks of bias; and **(4)** continuous validation, highlighting the need for continued validation and modification of the instruments used to measure the dynamism of DT.

Concluding, the theoretical background of applying instruments was strong and diverse including concepts such as experiential learning and creativity. Though it is true that the instruments designed through quantitative research had the necessary psychometric qualities, but in terms of validating the evidence, it was marred by some moderate level of risk of bias in terms of sampling and representativeness. However, it was recommended that any further research about DT in future should try to solve this problem by developing more versatile methodologies.

It was noted that DT science continues to progress both from a theoretical perspective and from the standpoint of methodology; scientists are expected to make up for the difference between innovation and research.

V. Conclusion

The aim of this systematic review is to discuss the theoretical background and data collection instruments used in Design Thinking (DT) studies from 2015 to 2025. According to the PRISMA 2020 protocol, 5,433 sources have been found in Scopus, Web of Science, and SciELO, and 19 publications were chosen for the review. In terms of the theoretical background, there was a great variety of frameworks (19 in total) in this research. It should be noted that the most popular framework was Experiential Learning Theory (8 articles, 24%), followed by Creativity Theory (5 articles, 15%) and Constructivism Theory (4 articles, 12%). Speaking about the data collection methods, the questionnaires were the most widespread instrument (22%, 11 articles), followed by semi-structured interviews (20%, 10 articles), observation, and workshops (12% each) and focus groups (10%). The review showed that there was also great attention towards instrument validation, wherein a number of the reviewed papers employed the use of expert judgment, triangulation, and reliability tests to enhance measurement quality. The differences in theory, context, and the mode of the test, however, suggest the urgent need for the development of standardized frameworks to measure DT performance. Further studies are needed to develop validated and holistic instruments that can assess all the aspects of the DT process, incorporate both qualitative and quantitative approaches to measurement, and maintain methodologically sound sampling and transparent reporting practices. Such approaches can contribute to the theoretical development, comparability, and practical significance of Design Thinking research in various multidisciplinary fields.

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Conflict of Interest

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