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The emergence of Design Thinking from Design Science to a Business Paradigm through the lens of Bibliometric Review

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Abstract

This study evaluates the current knowledge base of research on Design Thinking (DT) by conducting a bibliometric and network analysis of 986 scientific documents gathered from the Scopus database from 1992- 2021. The results reveal, inter alia, publication trends, identify influential documents, productive authors, journals, institutions, countries working and collaborating in the field of DT and the potential future research opportunities. Co-occurrence of Keywords and PageRank analysis was performed and relevant clusters emerging out of this analysis were described. The study maps the existing literature available and examines key research trends and theoretical underpinnings of this emerging discipline. Finally, the study provides detailed recommendations about the topics that need to be probed in detail in future research to advance a better understanding of this field.

Keywords: Design Thinking (DT), Bibliometric Review, Innovation, Creativity, Problem Solving, Design, Co-Citations, Co-occurrence, Gephi.

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1 Introduction

As firms continuously strive to drive business growth, they always look for ways to innovate. 'Design Thinking' has emerged as an effective, novel and human-centred approach to innovating and solving problems by taking a lot of inspiration from design-based methods, in the last twenty years (Nakata, 2020). Over time, the idea of how designers think and act has progressively moved out from the design field and expanded into the domain of business and practice explaining how design tools can foster innovation thus creating value for organizations (Ravasi & Stigliani, 2012). Design thinking essentially focuses on the practical implications of applying traditional design tools to solve ill-defined business problems (Matthews & Wrigley, 2017; Rylander, 2009). The concept has gained considerable attention among business press, academic literature and practitioners as a creative approach to solving the complex challenges facing organizations. Considering the growing relevance of this emerging discipline within the business field, many influential academic journals like the Academy of Management Journal and Journal of Product Innovation Management have described design thinking as an important concept in the field of innovation (Brown & Katz, 2011), while many prominent and influential publications like Harvard Business Review and The Economist have either come out with special issues or devoted complete sections to this field. The

growing interest and popularity of this concept have generated considerable interest among the academic community to examine it through a scholarly lens, which has resulted in the proliferation of research articles including the publication of a few review articles that have examined the growing discourse on design thinking (eg. Garbuio et. al., 2015; Johansson-Sköldberg, et. al, 2013; Elsbach and Stigliani 2018; Micheli et al. 2019).

Johansson-Sköldberg, et. al., (2013) held that literature in the DT field is broadly categorized into two streams, one is the design-based scholarly discourse from 1960 onwards, where the focus is on designerly ways of thinking, while the other pertains to have emerged within management and business field as a tool of innovation emerging from 1990 onwards. There is a rich scholarly discourse on designerly ways of thinking, and within the field of DT, the scholarly discourse is still emerging. While the writings in the field of DT are growing at a rapid pace, they remain largely anecdotal and lack rigorous academic grounding (Cousins, 2018). When we turn our attention to academic literature for a better understanding of this concept, we find to our surprise that there doesn't exist a sustained evolution of the field and literature doesn't provide us a clear understanding about how design thinking has evolved as a concept.

While in recent years the academic community has shown greater interest to look deeper into the design thinking concept resulting in the publication of a few systematic review articles but to the best of our knowledge, no review on DT to date has used a bibliometric analysis to examine this fast-growing field. While this method remains a useful quantitative method to map out the existing literature and reveal key research themes within a particular field (Donthu et al, 2021; Kumar et al, 2021a). With this objective in mind, we decided to conduct a bibliometric study to map out the existing academic literature in the field of design thinking, identify leading authors who have contributed to this field, the influential articles that played a key role in its evolution, academic outlets, institutions and countries from where research in this field is emerging and also ascertain future of Design Thinking research. This analysis will give us a comprehensive understanding of the existing knowledge structure of DT by providing us with a detailed overview and synthesis of existing academic research available within this field. In a way, the current study is a pioneering initiative to trace the evolution of DT with a bibliometric lens, examining the current status of work in this field and identifying the gaps thus indicating potential areas for future research. Thus, the following research questions (RQs) have been addressed in this review:

RQ1: What is the annual growth trend of literature in the field of DT?
RQ2: Which are the prominent publications (articles and outlets) of DT?
RQ3: Which are the leading countries, institutions and authors in the field of DT research?
RQ4: What are the existing research themes in the DT field and what do they convey about the DT field?
RQ5: What is the knowledge structure of DT currently and what can be the potential forthcoming study directions in the field of DT?

The current study makes a strong contribution to the academic literature on the Design Thinking field by mapping out the evolution of this discipline since its inception by capturing how research has progressed in this field within the academic community by quantitatively distilling a broad and inconsistent body of knowledge and provides a detailed and holistic view of Design Thinking. The authors believe that it will help both scholars as well as budding researchers in the field of DT to develop a better understanding of this concept and pick up interesting questions lying in the gaps. The study contributes to the ongoing debate by examining the current and emerging research themes and identifies potential future research avenues to advance the growth of knowledge in the DT domain. The current study, thus is an effort to trace the evolution of

Design thinking with a bibliometric lens, where the current status of the work and consequent future research directions are the focal points. The results of this study will be useful and help scholars, practitioners, and policymakers interested in this field by identifying the main authors, countries, institutions, publication outlets, articles, and research areas in the DT field, thus helping them to create an enhanced knowledge structure of DT field. The rest of this study is structured in the following sections; in the next section, we provide a brief overview of DT literature followed by explaining the bibliometric methodology adopted in this review. In subsequent sections, we report the results of our bibliometric analysis followed by reflections and finally outlining the agenda for future research to enrich the DT domain and the conclusion.

2 Literature Review

Though the term "Design Thinking" was coined by Peter Rowe (1987), as the title of his book where he argued that design professionals have an episodic approach to work relying more on hunches. But the intellectual roots of this field can be traced to the design science crusade of the late 1960s when the design process was deployed as a method for problem-solving. Simon (1969) talked about design as a set of rational procedures to solve a problem and its role in transforming existing conditions into preferred ones. With his cognitive approach to design, this became a reference point for academic writings about this emerging field. Schön (1987) stated that while the science of design focused on solving well-defined problems, in reality, professional designers face messy situations and talked about the intuitive nature of design processes to understand and solve ambiguous problems, calling it a "reflective practice". Buchanan (1992) talked about the need to shift the focus of design theory beyond its craft and industrial production by building on Rittel and Webber's (1973) wicked problem approach. He talked about a designerly approach focused on solving ill-structured, or "wicked" problems. The first Design Thinking Research Symposium (May 1991) was held to evaluate the ongoing research in the field of design from a design thinking perspective (Cross, Dorst, & Roozenburg, 1992). Johansson & Woodilla (2009) talked about designers making sense of their work by displaying a way of thinking that can be used by non-designers as a source of inspiration in other fields, rather than being restricted to a group of professional designers. Kolko (2010) stated that designers provide solutions by handling intricacy and recognizing simplicity in chaos through a process of veined blend. It is widely believed that the field of design has continued to expand its footprint by moving into many unexpected dimensions in practice and the growing acceptance to use design processes in other fields has generated strong interest in understanding how the way designers think and act. This growing interest has progressively moved the design approach to a much wider arena including the field of business, where researchers have focused their attention on how this approach can be used to solve many problems facing organizations. This led to adopting designerly problem-solving methods as a relevant approach for organizations trying to innovate (Brown, 2009) and achieve sustainable competitive advantage (Martin, 2009). While the term design thinking originated within the design discipline but increasingly it talks about the challenges faced by organizations (Kimbell, 2011). Martin (2005 a) distinguished design thinking from design by arguing that it is the way designers think and the mental processes they employ while designing products, services or systems, which is distinct from design where the outcome is elegant products. While design is a process of creation, design thinkers through a process of iteration and reflection try to create new valuable alternatives (Lafley & Martin, 2013). Broadly the term design thinking focuses on studying the practices of how designers think and act (Dorst, 2006; Lawson and Dorst, 2013). Brown (2009) talked about DT as a field, which uses a designer's sensibility and methods to find

people's needs and convert them into market opportunities by providing better customer value through a viable business strategy. He places 'innovation' at the heart of design thinking and believes that thinking and acting like a designer can transform the way one develops products, services, processes, and even strategy. Lockwood (2010b) talked about DT as a human-centred process that focuses on observation, collaboration and visualization of ideas. Increasingly over the past decade, many leading organizations have adopted DT as a wider phenomenon and a potential source of sustainable competitive advantage rather than its application from a limited product design and aesthetics perspective.

For the business world, design thinking has emerged as an attractive new concept emerging within the field of design by building on their practices. Johansson-Sköldberg et al (2013) talked about DT emerging as a simplified way of explaining designers' methods, which has been integrated into management discourse. Liedtka, J. (2015) talked about design thinking as a valuable tool for decision-makers within organizations to improve innovation outcomes by reducing their level of cognitive biases. Carlgren et al (2016) proposed a framework which included Design Thinking both as an idea and the enactment of the idea. Elsbach and Stigliani (2018) in their review talked about design thinking as an approach to problem-solving that uses the tools typically employed by designers to design products and services and this approach would deliver better results if it is infused within the culture of an organization. To further highlight the growing importance of design thinking for organizations and the business community, researchers have tried to provide strong evidence about the positive influence of DT on firm performance (Chiva & Alegre, 2009), its creative and innovative capability (Menguc, Auh, & Yannopoulos, 2014). Given the centrality of DT in rejuvenating organizations through developing its innovative capability and hence improving their performance, it is considered a key skill for managers to develop and imbibe (e.g., Liedtka & Ogilvie, 2011; Martin & Martin, 2009). Increasingly over the past decade, many leading organizations and start-ups have adopted design thinking as a wider phenomenon rather than its limited application in product design (Dunne, 2018). Micheli et al (2019) conducted a systematic literature review on design thinking and concluded that organizational design is an important pre-requisite for the successful outcome of design thinking. As firms struggle with high failure rates, they are looking at new ways to innovate, Design Thinking has emerged as a handy method of problem-solving and innovation (Nakata & Hwang, 2020). It is a design-based, human-centred approach to solving problems creatively and is increasingly adopted by firms as an innovative tool (Nakata & Hwang, 2020). The extant research casts light on the growing relevance of design thinking for the practice of management and instilling creativity and innovation.

3 Methodology

3.1 Bibliometric search

The search strategy adopted by the authors was on the lines proposed by Feng et al (2017) entailed-defining a search approach, selecting a database for the same, filtering initial test results, sharpening the search results, analyzing search results to extract descriptive statistics and finally performing the Science Mapping for co-citation analysis**.** The initial search for articles was done in the middle of 2021 and with a follow-up round at the beginning of 2022 to have a complete list of documents till the year 2021. The data collection process involved four stages: database search, scholarly filtration, language filtration, and subject filtration (refer to Fig. 1).

Step 1: Defining a search approach and selecting a database

The authors chose Scopus because it is a credible database for academic documents with wider coverage of publications meeting the stringent indexing requirements. This database is frequently recommended for bibliometric reviews (Donthu et. al., 2021; Kumar et al, 2020a; Kumar et al, 2020b) as it provides comprehensive and high-quality data for review. It is claimed by Scopus that the purpose of the database is "to enable external research groups or individual researchers in the field of bibliometric and quantitative research assessment to carry out strategic research using Elsevier data and to present the outcomes in peer-reviewed journal papers (Bass et al, 2020). It has several operational tools that enable bibliometric analysis and has been used by many bibliometric scholars (eg. Kumar et al., 2020). "Design Thinking", was used as a search keyword as it is the central concept of this review and Title, Abstract & Keywords were used as search fields. The search was extended till the end of 2021 to collect complete data published in this field and the database search generated 4,711 articles.

Step 2: Filtering the test results

To ensure the quality of the articles being analysed, we chose only journal articles, editorials and reviews as these are subjected to a rigorous peer review process to report insights of high quality. We removed conference papers, book chapters, books, conference review papers, short surveys, letters, and erratum in line with the recommendations by Paul et al. (2021). On this basis, we removed 2,673 i.e. 56.7% of the total search outcome, further as authors are English speaking, so we subsequently removed 172 i.e. 6% non-English articles (Guo et al, 2019) as translation works are impractical for reviews with large datasets (Donthu et al., 2021) leading to 1,866 documents.

Step 3: Sharpening the search results

The search was further limited to subject areas namely social science, business management, finance and accounting, decision science, economics and multidisciplinary areas. These are broadly the fields considered to be more relevant to “Business & Management” within which this study of Design Thinking was focused. The subject filtration excluded 857 articles, thus leading to 1009 documents. Authors read abstracts of all these papers to discern if those were within the scope of our analysis and removed 30 articles which appeared irrelevant, they subsequently read through the references of included articles and identified a few more relevant papers, 7 articles were added which were found to be of high impact in the domain. This criterion enabled us to narrow down our analysis to 986 papers, which served as the data for this study.

Step 4: Analysing the search results to extract descriptive statistics

After finalising of the dataset from Scopus, it was transferred into the .csv and. bib files. The .csv format was downloaded for use in Excel and Science Mapping software VOS viewer for co-citation analysis. The. bib file was used for extracting descriptive statistics and to study Performance Analysis for the journal, author and citation using the Bibliometrix package (bibliophily (app in R)

Step 5: Finally perform the Science Mapping for co-citation analysis.

Co-citation analysis was conducted using the bibliophily app of the bibliometric package in R. This app provides the feature of performing analysis on the unit of journals, authors and references (Kumar et al 2019). (Raghuram et al., 2009). The analysis was done based on papers (Mustafee et al, 2014) which aided in mapping the structure of science and obtaining an overview of research areas. This allowed the authors to get a deep insight into the underlying fine structures (Small, 1999; Jeong et al 2014; Zhao, 2006) through PageRank analysis.

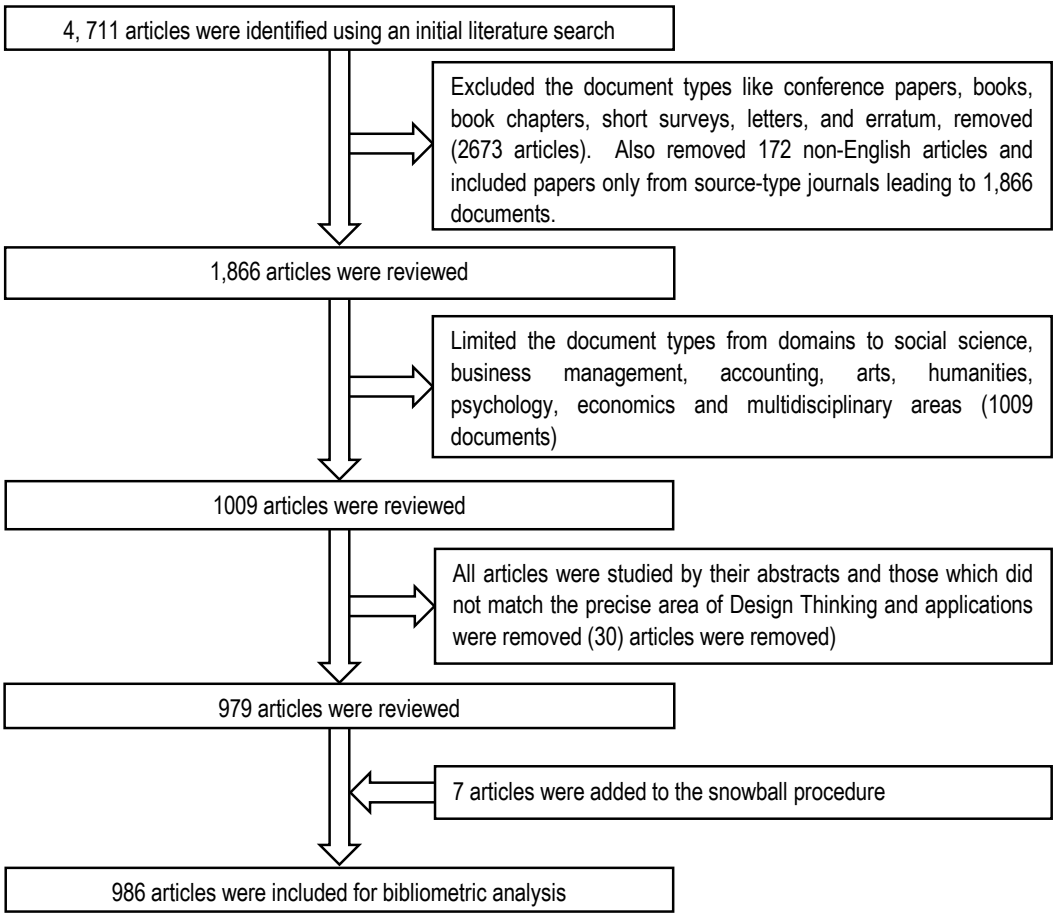

Figure 1. Steps for identification and collation of article corpus for bibliometric study

3.2 Bibliometric analysis

In this review, we undertook a bibliometric analysis of the 'Design Thinking' field (refer to Fig. 2). Using 986 scientific documents, which were taken from a bibliometric search in Scopus, we studied a series of bibliometric-based magnitudes. These were global and local citation and social network analyses to describe the publication trends (RQ1), the leading contributors (authors, countries, and institutions) and publications (outlets, articles) in the field of Design Thinking (RQ2 and RQ3). VOS viewer and Bibliometrix (R package) were used to explore the leading contributors and publications through co-authorship and PageRank analyses. Further VOS viewer was also used to map the intellectual structure of the DT field through keyword co-occurrence analysis (RQ4), this analysis helped us to identify the gap areas, which helped us to identify avenues for future exploration (RQ5). Gephi was used to visualize the networks in this review.

4 Results

The review highlights that the earliest article on Design Thinking was published in 1992 and the total number of articles indexed with Scopus till 2021, after scholarly, language and subject filtration stand at 986. So, this study in all examined 986 documents from 388 sources from 1992 through 2021 for its analysis. This section provides the detailed result of this bibliometric analysis using various techniques starting with the publication trends.

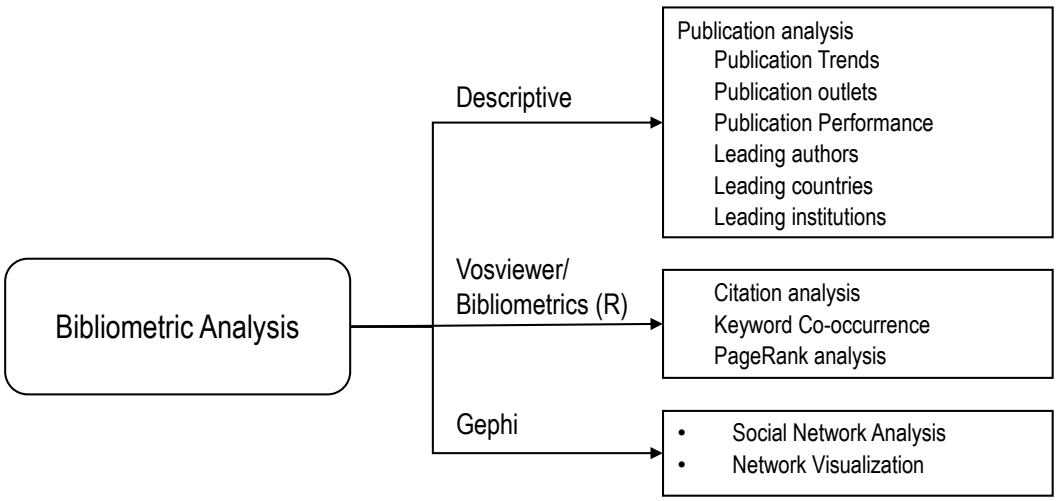

Figure 2. Analysis strategy for bibliometric review

4.1 Publication Trends (Year-Wise) (RQ1)

Figure 3 highlights the publication trends of papers every year. While the term DT came into usage in 1987, the research in this area took time to take off as till 2009 the number of articles published every year was in single digit. The pattern of publications can be shown in three stages (Fig. 3) – the early stage was from 1992 to 2009 when on average there were one or two or a maximum of five publications in a year. The second phase involved from 2010 onward till 2015 when the research output gained momentum and articles picked up from 15 in 2010 to 46 in 2015. While from 2016 onwards, the research output picked-up momentum with an average of more than 50 publications each year from 2016 onwards and crossed 100 publications in 2019 (n=124), 2020 (n=160) and 2021 (n=312). This is a clear pointer that research in this field gained momentum, and the research community started examining this field in 2016 onwards.

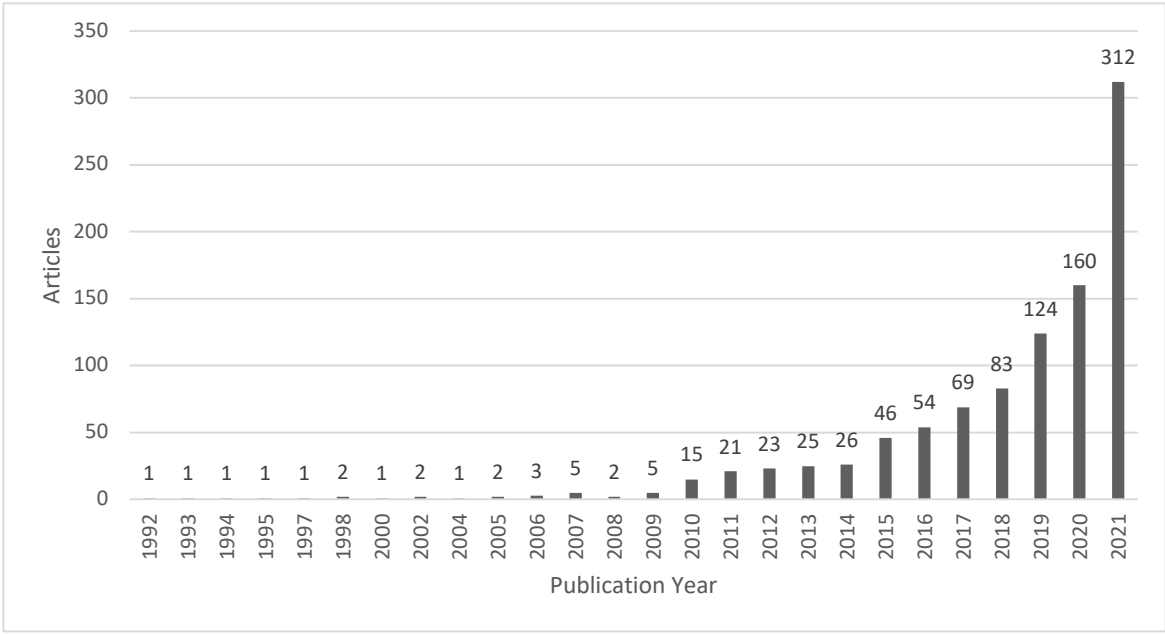

Figure 3. Year-Wise Production of Articles on Design Thinking

4.2 Publication outlet (RQ2)

Table 1 depicts the ranking of the top twelve journals based on the number of articles published in the field of design thinking along with the total citations received for the papers published in a particular journal along with average citations per document, the impact factor and the H-Index of the journal. The results indicate that the International Journal of Art and Design Education is the most prolific outlet for publishing DT papers (n=24) with a total of 223 citations, followed by Design Principles and Practices (n=23) and International Journal of Design Education (n=21) respectively. The top journals in terms of the number of citations are Creativity and Innovation Management and California Management Review with 534 and 339 citations respectively. Out of these 12 journals, 5 of them focus on Design related issues, some are focused on creativity and innovation, some on education and a couple of them are directed at practitioners. Another interesting observation coming out of this analysis was about articles on DT appearing in the Journal of Business and Strategy indicating the growing focus of DT research through a strategy lens.

Table 1. Most Productive Journals in the Design Thinking Field

Rank	Journal	N	C	C/N	IF	5 Yr. IF	H-Index
1.	International Journal of Art and Design Education	24	223	9.29	.650	.730	22
2.	Design Principles and Practices	23	19	.82	.09	.08	5
3.	International Journal of Design Education	21	8	.38	.04	.05	3
4.	She Ji: The Journal of Design, Economics, and Innovation	19	132	6.94	1.84	1.07	8
5.	Thinking Skills and Creativity	16	120	7.5	2.07	3.31	36
6.	California Management Review	11	339	30.81	3.90	6.55	124
7.	Creativity and Innovation Management	11	534	48.54	2.89	2.12	55
8.	Journal of Business Strategy	11	143	13	1.01	1.23	36
9.	Educational Technology Research and Development	8	34	4.25	2.30	2.75	84
10.	Journal of Interior Design	8	31	3.87	.60	.72	12
11.	Academy of Management Learning and Education	7	188	26.85	3.27	4.90	71
12.	Design and Culture	7	117	16.71	.317	.481	9

N: Number of publications; C: Number of citations: IF Impact Factor

4.3 Influential Publications (RQ2)

Global citations

Global citations refer to the number of citations received without any filter (Baker, et al, 2020). In this study, the article with the highest global citations is "Design Thinking" (n = 1455 citations),

followed by "Design Thinking and How It Will Change Management Education: An Interview and Discussion" ($n = 330$ citations) (see Table 2). The common theme across these most influential contributions is the emergence and growing importance of DT as a creative problem-solving tool, which can help organizations to emerge as innovative, and aid in achieving competitive advantage. Some of these papers also highlight the importance of DT as a pedagogical tool to develop creative and experiential skills in the education field.

Table 2. Most Influential Publications in Design Thinking Field based on Global Citations

Rank	Paper	Authors	Journal	Year	Global Citations
1	Design Thinking	Brown T	Harvard Business Review	2008	1455
2	Design Thinking and How It Will Change Management Education: An Interview and Discussion	David Dunne and Roger Martin	Academy of Management Learning & Education	2006	330
3	Design Thinking: Past, Present and Possible Futures	Ulla Johansson-Sköldberg, Jill Woodilla, Mehves Çetinkaya	Creativity and Innovation Management	2013	316
4	Innovation as a Learning Process: Embedding Design Thinking	Beckman S.L, Michael Barry	California Management Review	2007	293
5	What is Design Thinking and Why is It Important	Rim Razzouk & Valerie Shute	Review of Educational Research	2012	260
6	Using Design Thinking to Improve Psychological Interventions: The Case of the Growth Mindset During the Transition to High School	David S. Yeager et. al.	Journal of Educational Psychology	2016	209
7	Perspective: Linking Design Thinking with Innovation Outcomes through Cognitive Bias Reduction	Liedtka Jeanne	Journal of Product Innovation Management	2015	179
8	Destination, Imagination and the Fires Within: Design Thinking in a Middle School Classroom	Carroll M, Goldman. S, et., al.	International journal of art & design education	2010	120
9	Adopting Design Thinking in Novice Multidisciplinary Teams: The Application and Limits of Design Methods and Reflexive Practices	Victor P. Seidel, Sebastian K. Fixson	Journal of Product Innovation and Management	2013	119
10	Rethinking Design Thinking: Part 1	Kimbell. L	Design & Culture	2011	101

Local citations

Local citations refer to citations received from the articles in the review space for the bibliometric study (Baker et al., 2020). This implies local citations are calculated basis of the citations received from 986 articles on "design thinking" which were retrieved from Scopus and retained after applying filters as shown in Fig 1. In this review, the article with the highest number of local citations is "*Design Thinking*" ($n = 167$ citations) (see Table 3), followed by "Design Thinking: Past, Present and Possible Futures" ($n = 60$ citations). There are many articles which are common both in Table 2 & 3, which suggests that there are few articles in the DT domain, which are influential both within the larger research community as well as within the smaller subset of scholars researching in the field of Design Thinking.

Table 3. Most Cited Articles on DT Based on Local Citations

Rank	Article Title	Authors	Year	Local Citations	Journal
1	Design Thinking	Brown. T	2008	167	Harvard Business Review
2	Design Thinking: Past, Present and Possible Futures	U Johansson-Sköldberg, Jill Woodilla, Mehves Çetinkaya	2013	60	Creativity & Innovation Management
3	Innovation as a Learning Process: Embedding Design Thinking	Beckman S.L, Michael Barry	2007	56	California Management Review
4	What is Design Thinking and Why is It Important	Rim Razzouk & Valerie Shute	2012	45	Review of Educational Research
5	Adopting Design Thinking in Novice Multidisciplinary Teams: The Application and Limits of Design Methods and Reflexive Practices	Victor P. Seidel, Sebastian K. Fixson	2013	35	Journal of Product Innovation and Management
6	The Need for Design Thinking in Business Schools	Glen, R., Christy, S., Christopher, B	2014	32	Academy of Management Learning & Education
7	Perspective: Linking Design Thinking with Innovation Outcomes through Cognitive Bias Reduction	Liedtka Jeanne	2015	31	Journal of Product Innovation Management
8	Framing Design Thinking: The Concept in Idea and Enactment	Carlgren, L., Rauth, I., & Elmquist, M.	2010	23	Creativity & Innovation Management
9	Destination, Imagination and the Fires Within: Design Thinking in a Middle School Classroom	Carroll M, Goldman. S, et., al.	2010	23	International journal of art & design education
10	Design Thinking and Organizational Culture: A Review and Framework of Future Research	Elsbach, D., Stigliani, I	2018	20	Journal of Management

4.4 Most Productive Authors (RQ3)

Table 4 captures the work of the ten most prolific authors in the Design Thinking field through their quantum of work. Since design thinking as a field has gained prominence recently, these have become leading authors in this area. Knowing these authors and their work can help future researchers in this field understand the development and know whom to contact for potential research collaborations. This table reveals that Chai C.S and Wrigley C have been the most productive authors with seven contributions each, followed by Liedtka J with six and Bower M with five contributions, whereas the other top six contributors in this field have four publications each. Out of the top ten authors, five belonged to the USA, four to Australia and one from Hong Kong, clearly indicating the quantum of research coming from two countries. The work of leading author Chai C.S has mostly focused on the relevance of DT in the field of education and most of his work has been done in collaboration with other authors. Similarly, the work of another productive author, Wrigley C has been about the role of DT in the field of education especially in business education. Further, the work of Wrigley C has positioned the University of Sydney as the most productive institution researching the field of DT, with 7 out of 11 DT articles authored by Wrigley. C. While the work of Liedtka J from Darden School of Business from Virginia University, which contributed 6 articles focused majorly on how DT plays an important role in instilling innovation within the organization, also 6 out of 9 articles coming out from the University of Virginia are authored by Liedtka J.

The work of these contributors can be broadly categorised into two major domains one focusing on the role of DT as a creative problem-solving tool which aids organizations to remain innovative and its growing relevance as a pedagogical tool to help students develop their creative skills.

Table 4. Most Productive Authors in the Design Thinking Field

Rank	Author	Affiliation	Themes Examined	Journals	N	C	C/N	H-Index
1	Chai C S	Chinese University of Hong Kong	Design Thinking & Education	Australasian Journal of Educational Technology	7	212	30.14	5
			Design Thinking & Technological Pedagogical Content	Asia Pacific Education Researcher				
2	Wrigley C	University of Sydney, Australia	Design Thinking & Education	California Management Review	7	87	12.42	5
			Design Thinking & Formal Education	She Ji, Innovations in Education & Teaching International				
3	Liedtka J	Darden School of Business, USA	Design Thinking & Business Organizations	California Management Review	6	262	43.66	3
			Design Thinking & Product Innovation	Strategy & Leadership, Journal of Product Innovation & Management				
4	Bower M	Macquarie University, Australia	Design Thinking & School Education	Education Media International	5	31	6.2	3

Rank	Author	Affiliation	Themes Examined	Journals	N	C	C/N	H-Index
				British Journal of Educational Technology				
5	Beacham C	West Virginia University, USA	Design Thinking & Need Identification	Design Principles & Practices	4	4	1	1
6	Chen S	California State University, USA	Design Thinking & Organizations	Journal of Marketing Management	4	54	13.5	3
			Design Thinking & Innovative Organizations	Marketing Theory				
7	Fleischmann K	Griffith University, Australia	Design Thinking & Creative Industries	Creative Industries Journal	4	19	4.75	2
			Design Thinking & Circular Economy	Local Economy				
8	Mosely G	University of Sydney, Australia	Design Thinking & Formal Education	Thinking Skills and Creativity	4	31	7.75	2
			Design Thinking & MOOC Education	She Ji				
9	Pope-Ruark R	Elon University, USA	Design Thinking & Communication	Journal of Business & Technical Communication	4	13	3.25	3
				Teaching & Learning Enquiry				
10	Shively K	Ball State University, USA	Design Thinking & Curriculum	Gifted Child Today	4	11	2.75	1
			Development	Journal of Education of the Gifted				

4.5 Most Productive Countries (RQ3)

Leading Countries

The spread of articles in the order of countries exhibits that authors from 58 countries (refer to Fig. 4) have added to and published research on DT. This study shows that the United States is the biggest contributor to DT research with 410 articles (41.5%). This is followed by Australia 128 (12.9%), the United Kingdom 83 (8.4%), Canada 75 (7.6%) and China 42 (4.25%)

Leading Country Collaborations

Gephi was used as a tool to show the intellectual network of collaborating countries in DT research (refer to Fig. 5). The analysis of the country-wise intellectual network divulges four key clusters in DT research. The first major cluster involves the United States, which is at the centre of international collaborations with Canada, Japan, South Korea, Ireland, Finland, India and Israel. The second major cluster shows the United Kingdom, which is a fulcrum for international collaborations with the Netherlands, Portugal, Denmark, Brazil, South Africa and Switzerland. The third major cluster is with Australia connected to Italy, New Zealand and the Philippines. The fourth major cluster is Asia centric with China at its centre and includes Singapore, Hong Kong, Armenia and Mexico. A careful examination of country collaborations reveals that these are widespread and not linked to countries within a particular continent or neighbouring countries

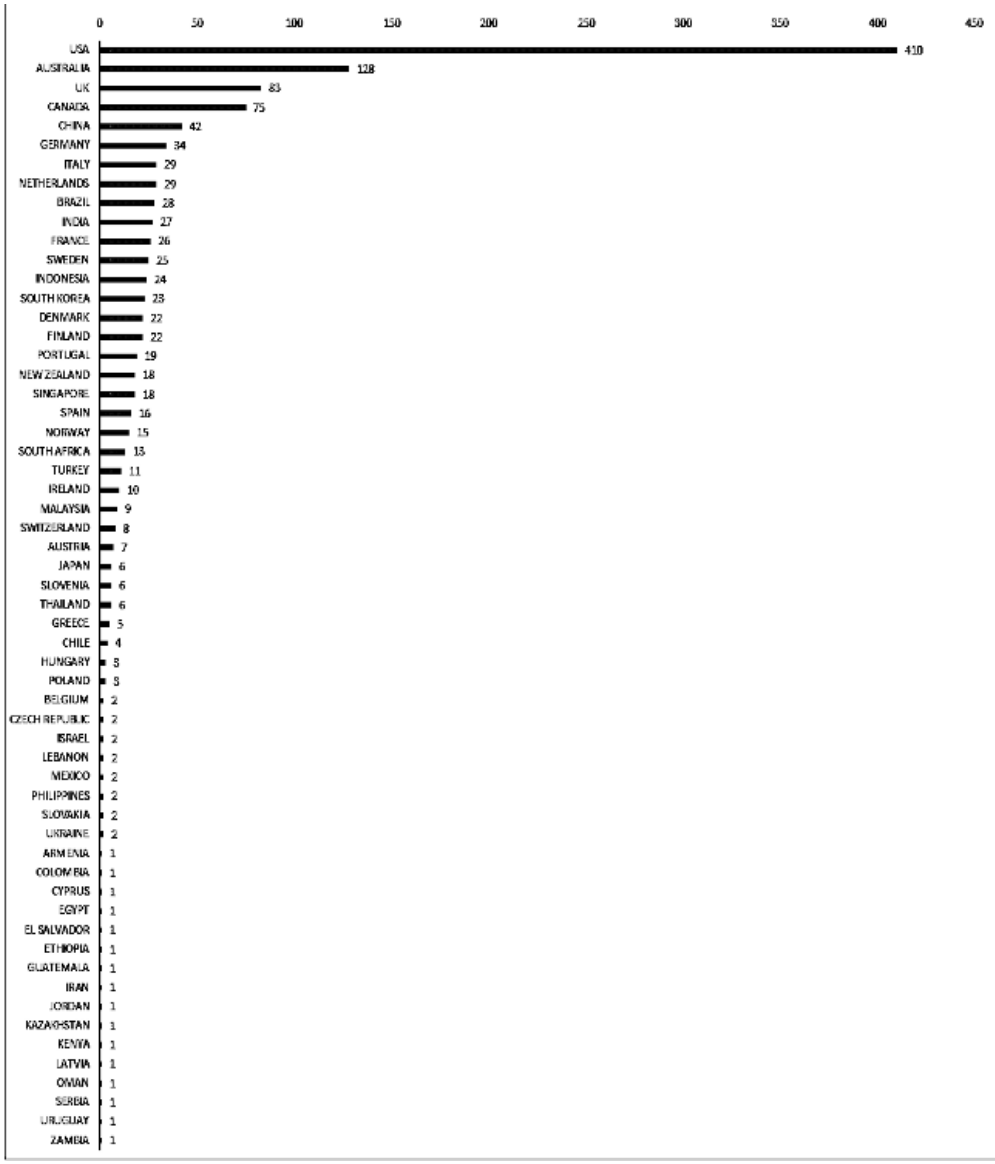

Figure 4. Country-wise distribution of Articles on Design Thinking

etc. The clusters were formed basis the country of the communicating author as shown in the Scopus data.

4.6 Most Productive Institutions (RQ3)

Table 5 lists the top 10 institutions which made the maximum number of contributions to the design thinking field. The top three institutions in terms of the number of contributions are the University of Sydney & University of Melbourne (Australia) with 11 articles each, followed by the University of Queensland (Australia) and Stanford University (USA) with 10 articles each and the University of Sao Paulo (Brazil) with 9 articles. Of the top ten institutions, 4 are from Australia, 2 from the USA. The institutions from the USA received the maximum number of citations with Stanford University receiving 673 citations and the University of Virginia receiving 499 citations. The table indicates that the most influential research in this field is coming from North America (USA & Canada). Another observation is that while the most influential and maximum quantum of research is coming out from the USA but this is spread across the institutions within the

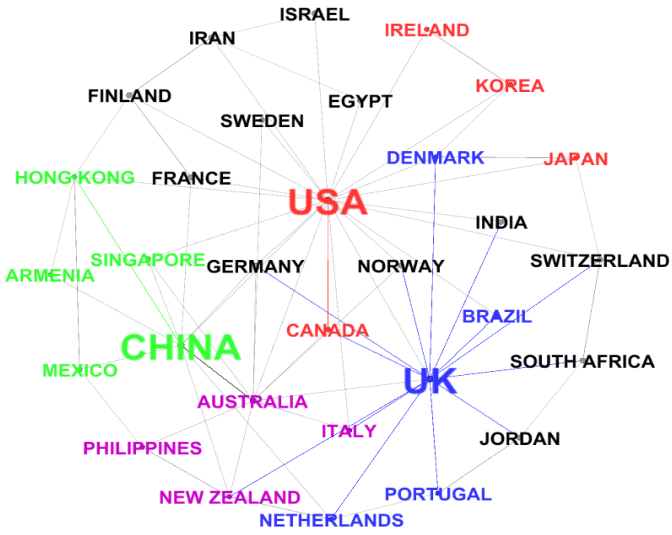

Figure 5. Country collaborations in Design Thinking research

The different colours show different regions in which work has been carried out and the collaborating countries. For example USA collaborated with Canada; China with Singapore, Mexico, Armenia and Hongkong etc.

country, while Australia is the 2nd biggest contributor to DT research with 128 articles behind the USA with 410 articles, research within Australia is concentrated within few institutions with four institutions contributing 40 out of the total 128 contributions.

Table 5. Important Institutions for Research on Design Thinking

S. No.	Institution	Country	N	C	C/N
1	University of Sydney	Australia	11	93	8.45
2	University of Melbourne	Australia	11	62	5.63
3	University of Queensland	Australia	10	166	16.6
4	Stanford University	USA	10	673	67.3
5	University of Sao Paulo	Brazil	9	41	4.55
6	University of Virginia	USA	9	499	55.44
7	Nanyang Technological University	Singapore	8	113	14.12
8	University of Toronto	Canada	8	105	13.12
9	Macquarie University	Australia	8	41	5.12
10	Aalto University	Finland	8	62	7.75

4.7 Research Themes (RQ4)

A PageRank analysis was done to identify key themes outlining the intellectual structure of Design Thinking. PageRank analysis was done as it measures the prestige of the article reflected by the citations received by it from other highly cited articles (Ding & Cronin,2011). Thus there is a possibility that an article, which is very highly ranked on global or local citations or both may not emerge as a prestigious article in PageRank analysis or vice-versa (Ding, Yan, Frazho & Caverlee,

2009). It is because of this, PageRank remains an essential tool in bibliometric analysis to identify the must-cite article within the pool of highly cites articles (Donthu, Kumar, Mukherjee, et., al, 2021). Further, this analysis creates clusters to divulge the themes in the review domain thus providing an additional benefit in the bibliometric review.

In this review, Table 6 shows five major clusters which emerged and reports 10 of the most prestigious articles within each cluster.

Cluster 1, which focuses on the theme of *Design Thinking* & Problem Solving emerged as the largest cluster (n = 161) with Buchanan's (1992) article titled "Wicked Problems in Design Thinking" published in Design Issues receiving the highest score on PageRank which is 0.030644532 while the article doesn't even figure in the list of top global and local citation list. The article is considered as one of the early and influential pieces laying the emergence of the DT field. This is followed by articles by Liedtka. J (2011) and Cross. N (2006) with PageRank scores of 0.008161016 and 0.007636883 respectively.

Cluster 2 which represents the theme of *Design Thinking & Education* (n = 154) emerged as the second largest cluster. In this cluster, Brown (2008) appears as the most prestigious author for the article titled "Design Thinking" with a PageRank of 0.052563387. Incidentally, this article has emerged as the most influential one both in the global citation (1455) as well as a local citation (167) as shown in Tables 2 & 3, indicating the relevance of this paper in the Design Thinking field. The next most prestigious article in the cluster by Dunne (2006) titled Design Thinking and How It Will Change Management Education received a PageRank score of 0.023287971 followed by Glen. R (2014) with a PageRank score of 0.008767068, this article also focuses on the role of DT in business education.

Cluster 3 which brings forth the theme of *Design Thinking as a Tool for Innovation* emerged as the third largest cluster (n = 95) with Beckman's (2007) article titled "Innovation as a Learning Process: Embedding Design Thinking" as the most prestigious article receiving the PageRank score of 0.014212536. This is followed by the articles by Johansson-Skldberg U (2013) and Dorst (2011) with PageRank scores of 0.01376982 and 0.013236143 respectively.

Cluster 4 which presents the theme of Emergence of DT within Design Discipline (n = 85) mostly focused on how the field of Design kept expanding its boundaries resulting in the emergence of Design Thinking from within it. The major works representing this cluster are the articles by Dorst & Cross (2001) and Dorst (2006) with PageRank scores of 0.003926954 and 0.00284619 respectively focusing on the role of Design in creativity and problem-solving.

Cluster 5 represents the theme of the Growing Relevance of Design Thinking Across Disciplines (n = 77). The most prestigious paper in this cluster titled 'What Is Design Thinking and Why is it Important' is authored by Razzouk. R (2012) with a PageRank of 0.011174377 followed by Brown's (2010) article on the role of Design Thinking in social innovation with a PageRank score of 0.006212687 followed by Dym C (2005) article focusing on the relevance of DT in the Engineering field with a PageRank score of 0.004622416. This cluster further illustrates the expanding role of DT across disciplines.

4.8 Keyword co-occurrence (RQ4)

A keyword co-occurrence analysis was done using all author keywords of 986 articles in VOS viewer to understand the key focus of DT research during the period of study i.e. 1992-2021. The rationale behind this analysis is that the keywords are indicative of the content as well as the key focus of the article (Comerio & Strozzi, 2019)). While the co-occurrence of keywords is indicative of the key themes of research as well as the evolution of the domain's intellectual structure (Ding, Chowdhury, & Foo, 2001; Donthu et al.,2021). Further, we created various

sub-clusters categorized in specific periods to understand the evolution of the intellectual structure of DT viewed through a periodical lens.

A careful examination of the keyword co-occurrence network reveals some interesting trends indicating the evolution of research in this field. The research in the field of DT in the years till around 2014 was focused on the design process, design, architecture and urban design revealing the roots and emergence of DT from within the field of design and showing early signs of expanding its boundaries as indicated by key-words like organizational change and action research. While from 2014-2016, the focus of DT research revolved around creativity, innovation, social innovation and product development highlighting how DT emerged as a tool of innovation and creative thinking. While in the 2016-18 period, the research focus shifted to using innovation and creativity to solve various problems facing organizations as indicated by keywords like problem-solving, problem-based learning, service design and experiential learning. During the period 2018-2021, the keywords reflect the focus of DT research on empathy, management education, digital transformation, human experiment and strategy, clearly indicating that DT increasing adoption in the field of education and its growing relevance as a strategic process, further the focus of research indicated the use of empathy as a key approach to gather insights.

Creativity and innovation emerged as the two most prominent topics in the keyword co-occurrence network, which find mentioned in most of the articles written on DT (two major keywords after "Design Thinking"). The seminal paper on the role of innovation in design thinking by Beckman S.L, Michael Barry, (2007) mentions how firms by embedding a design thinking approach are relying on continuous innovation as a tool of competitive advantage. Further research by authors like Liedtka (2015), "Linking Design Thinking with Innovation Outcomes through Cognitive Bias Reduction" stress on the importance of innovation within the DT field. The influential work of Brown.T, (2008) highlighted the growing relevance of DT to the business world and how it can be a creative tool for them to differentiate and build competitive advantage. A minute examination of keyword co-occurrence over a periodic lens reveals that the work of the above-mentioned and some other influential authors has firmly brought DT out of the domain of Design and put it at centre stage as a tool of organizational transformation by instilling creativity and innovative approach within them.

Table 6. Most prestigious articles on DT based on PageRank

Authors	Article Title	Year	Journal	PageRank
Cluster 1: Design Thinking and Problem Solving (n = 161)				
Buchanan R.	Wicked problems in design thinking	1992	Design issues	0.030644532
Liedtka J.	Learning to use design thinking tools for successful innovation.	2011	Strategy & Leadership	0.008161016
Cross N.	Designerly Ways of Knowing	2006	Design Studies	0.007636883
Boland, R. J., & Lyytinen, K.	Information systems research as design: Identity, process, and narrative	2004	Information Systems Research	0.004407913
Kelley, T.	Prototyping is the shorthand for innovation	2001	Design Management Journal	0.002431472
Owen, C.	Design thinking: Notes on its nature and use	2007	Design Research Quarterly	0.001977907
Liedtka, J.	In defence of strategy as design	2000	California Management Review,	0.001853973

Authors	Article Title	Year	Journal	PageRank
Lockwood, T.	Transition: How to become a more design-minded organization	2009	Design Management Review	0.001770783
Kelley, T., & Kelley, D	Reclaim your creative confidence	2012	Harvard business review	0.001591022
Oxman, R.	Think-maps: teaching design thinking in design education.	2004	Design Studies	0.00097102
Cluster 2: Design Thinking & Education (n = 154)				
Brown T.	Design Thinking	2008	Harvard Business Review	0.052563387
Dunne D.	Design Thinking and How It Will Change Management Education: An Interview and Discussion	2006	Academy of Management Learning and Education,	0.023287971
Glen R.	The Need for Design Thinking in business schools – A Review	2014	Academy of Management Learning and Education,	0.008767068
Sarasvathy S.D.	Causation and Effectuation: Toward a Theoretical Shift from Economic Inevitability to Entrepreneurial Contingency	2001	Academy of Management	0.002875437
Neck H.M.	Entrepreneurship Education: Known Worlds and New Frontiers	2011	Journal of Small Business Management	0.002555647
Honig, B.	Entrepreneurship education: Toward a model of contingency-based business planning	2004	Academy of Management Learning & Education	0.002133779
Welsh, M. A., & Dehler, G. E.	Combining critical reflection and design thinking to develop integrative learners.	2013	Journal of Management Education	0.001857893
Starkey, K., & Tempest, S.	The winter of our discontent: The design challenge for business schools	2009	Academy of Management Learning & Education	0.00168193
Shane, S. (2000)	Prior knowledge and the discovery of entrepreneurial opportunities	2000	Organization science	0.001069455
Vargo, S. L., & Lusch, R. F.	Evolving to a new dominant logic for marketing	2004	Journal of Marketing,	0.000887267
Cluster 3: Design Thinking as a Tool for Innovation (n = 95)				
Beckman S.L	Innovation as a Learning Process: Embedding Design Thinking	2007	California Management Review	0.014212536
Johansson-Skoldberg U.	Design Thinking: Past, Present and Possible Futures	2013	Creativity and Innovation Management	0.01376982
Dorst K.	The core of 'design thinking' and its application.	2011	Design studies	0.013236143
Liedtka J.	Perspective: Linking design thinking with innovation outcomes through cognitive bias reduction.	2015	Journal of product innovation management	0.013211214

Authors	Article Title	Year	Journal	PageRank
Seidel V.P.	Adopting design thinking in novice multidisciplinary teams: The application and limits of design methods and reflexive practices.	2013	Journal of Product Innovation Management	0.008962267
Kolko J.	Design Thinking Comes of Age	2015	Harvard Business Review	0.008307729
Brown T.	Change by design.	2011	Journal of product innovation management	0.006654983
Michlewski K.	Uncovering Design Attitude: Inside the Culture of Designers	2008	Organization Studies	0.005493548
Liedtka J.	Innovative ways companies are using design thinking	2014	Strategy & Leadership.	0.004526313
Kolko, J.	Adductive thinking and sense-making: The drivers of design synthesis	2013	Design issues	0.003853713
Cluster 4: Emergence of Design Thinking within Design Discipline (n = 85)				
Dorst, K., & Cross, N.	Creativity in the design process: co-evolution of problem–solution	2001	Design Studies	0.003926954
Norton P.	Four Paradigms: Traffic Safety in the Twentieth-Century United States	2015	Technology and Culture	0.002861757
Dorst K.	Design Problems and Design Paradoxes	2006	Design Issues	0.00284619
Mishra P.	Technological Pedagogical Content Knowledge: A Framework for Teacher Knowledge	2006	Teachers College Record	0.002468354
Lawson B.	Knowledge Sharing in Inter-Organizational Product Development Teams: The Effect of Formal and Informal socialization mechanism	2009	Journal of Product Innovation Management	0.001869423
Cross, N.	Expertise in design: an overview	2004	Design studies,	0.00148655
Charlton, P., Magoulas, G., & Laurillard, D.	Enabling creative learning design through semantic technologies	2012	Technology, Pedagogy and Education,	0.001333542
Kali, Y., McKenney, S., & Sagy	Teachers as designers of technology enhanced learning	2015	Instructional science	0.000865893
Valkenburg, R., & Dorst, K.	The reflective practice of design teams.	1998	Design studies	0.000757873
Cross, N.	Forty years of design research	2007	Design studies	0.000606726
Cluster 5: Growing Relevance of Design Thinking Across Disciplines (n = 77)				
Razzouk R.	What Is Design Thinking and Why Is It Important?	2012	Review of Educational Research	0.011174377
Brown T.	Design Thinking for Social Innovation	2010	Stanford Social Innovation Review	0.006212687
Dym C.L.	Engineering Design Thinking, Teaching, and Learning	2005	Journal of Engineering Education	0.004622416

Authors	Article Title	Year	Journal	PageRank
Carroll M.	Destination, Imagination and the Fires Within: Design Thinking in a Middle School Classroom	2010	The International Journal of Art and Design Education	0.004149514
Wrigley C.	Design thinking pedagogy: The educational design ladder.	2017	Innovations in Education and Teaching International	0.002233904
Amabile T.M.	Assessing the work environment for creativity.	1996	Academy of management journal	0.001300323
Charmaz, K.	The power of names.	2006	Journal of Contemporary Ethnography	0.001278206
Luka, I.	Design thinking in pedagogy	2014	The Journal of Education, Culture, and Society	0.001202702
Mintrom, M., & Luetjens, J.	Design thinking in policymaking processes: Opportunities and challenges	2016	Australian Journal of Public Administration,	0.001063819
Leifer, L. J., & Steinert, M.	Dancing with ambiguity: Causality behaviour, design thinking, and triple-loop-learning	2011	Information Knowledge Systems Management	0.000512711

5 Reflections

The extant literature on DT was examined to map the bibliometric aspects and intellectual structure of this field. The bibliometric analysis identified the most prolific and influential authors, countries, institutions, journals, articles, themes and topics of the DT research from 1992-2021. Specifically, the four research questions framed at the beginning of the article were answered by performing the citation, key-word occurrence, PageRank, publication and social network analysis, which resulted in the following major takeaways;

i. DT research has grown steadily in the initial years before picking up by 2010 and then growing exponentially since 2016 with more than 50 articles published annually, touching triple digits annually since 2019 onwards (RQ1).
ii. International Journal of Art and Design Education has been the most productive journal. A paper titled "Design Thinking" has been the most cited paper both globally (1455 citations) and locally (167) (RQ2)
iii. The most productive author has been Chai C.S with a total of 7 publications and (RQ3)
iv. The USA has been the highest contributor to DT research with 41.5% of articles. (RQ3)
v. The international hub of collaboration for DT research has been the United States followed by UK, Australia and China. (RQ3)
vi. The PageRank analysis puts forth the key research theme across the 5 clusters which are (RQ4):
    a. Cluster 1: Design Thinking & Problem-Solving
    b. Cluster 2: Design Thinking & Education
    c. Cluster 3: Design Thinking as a Tool for Innovation
    d. Cluster 4: Emergence of Design Thinking within the Design Discipline
    e. Cluster 5: Growing Relevance of Design Thinking Across Disciplines

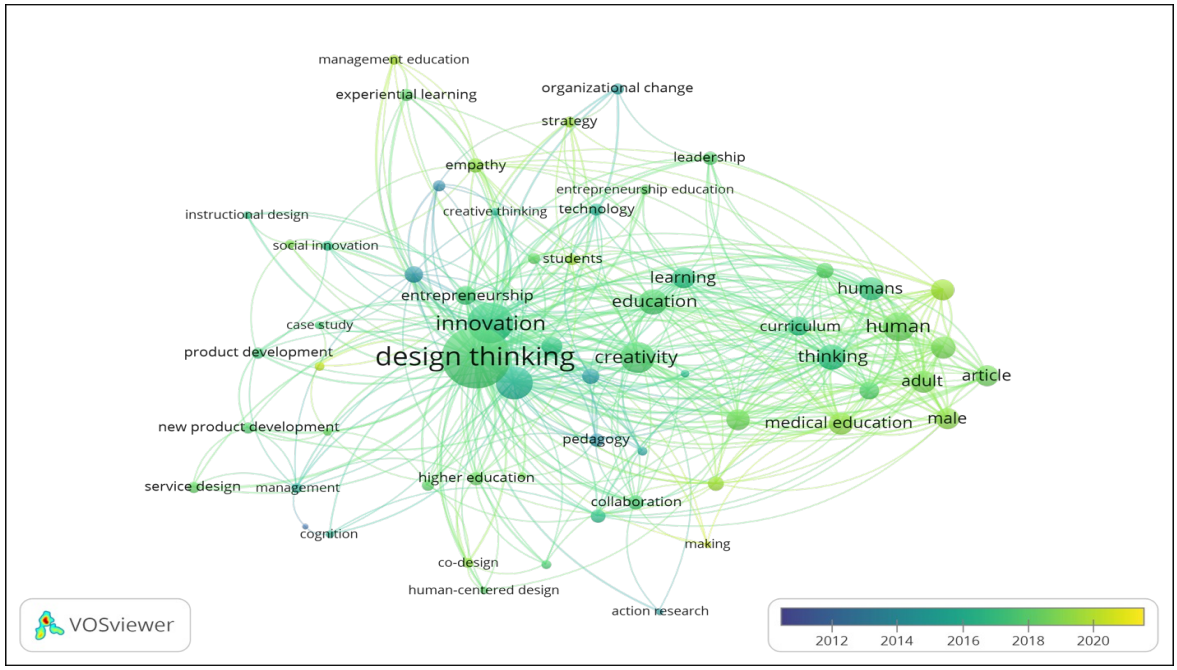

Figure 6. Research themes on Design Thinking research

vii. The topics which have been the focus of study within DT over time (RQ 4):

   a. 2010-2014: Design process, design, architecture and urban design
   b. 2014-2016: Creative thinking, creativity, innovation, social innovation and product development
   c. 2016-2018: Problem-solving, problem-based learning, service design and experiential learning
   d. 2018-2020: Empathy, management education, digital transformation, human experiment and strategy

Our understanding of existing research in DT was shaped by citation, PageRank and keyword co-occurrence network analysis and also helped us to identify potential future research directions and specific themes to be explored.

The existing research on DT was mainly focused on using DT as a tool to instil creativity and innovation, specifically by business organizations across the world as captured by business press also. The role of DT as a creative and innovative tool to solve challenges facing organizations was the central issue explored by almost every article examined in this current research while early research in this field highlighted how design thinking emerged within the design discipline and expanded its footprints and gained wider acceptance. This resulted in DT acquiring a broader role from its earlier limited relevance in product/service design to DT emerging as a strategic tool used by organizations as a creative problem-solving approach, which helps organizations to stay relevant and gain a competitive advantage over their rivals. The need to integrate DT into the educational curriculum was also discussed in many articles to expose the next generation to make them better prepared for the future. Over-time various frameworks and tools have been developed around the DT concept over the years with inputs from various scholars, consultants and business practitioners.

International Journal of Art and Design Education emerged as the major outlet for DT articles along with Design Principles and Practices, though our review of extant literature also mentions publications focused on the field of innovation, strategy and educational development as other publication outlets, which contribute to DT research. The possible reason behind the emergence of Design focused journals as major publication outlets is the emergence of the DT field from within the Design discipline and then growing its role and emerging as a distinct field with a much broader focus. But the fact remains that the DT field owes its origin within the Design field and initially built its roots from there and hence the major source of outlets. Upon detailed analysis, we also found leading practitioner journals like California Management Review and Harvard Business Review directed towards the business community also emerging as key publication outlets, where DT research has been published. In a sense, this highlights the interest of the business community towards this field and the use of scholars to publish their work in these outlets to reach the intended audience.

Our research found the article titled "Design Thinking" authored by Brown T published in Harvard Business Review in the year 2008 (Brown, 2008), which emerged as the highest cited article both in global and local citations. The article is viewed as a very influential work in the field of DT, which possibly explains its emergence as the highest cited in both global and local citation lists and confirms its standing and influence within the DT field and among scholars from both within and outside the DT research community. The article proposes the adoption of a human-centred design thinking approach for business organizations to become creative and innovative to develop it as a tool for differentiation and building competitive advantage. The fact that there were some articles, which figured both within the global and local citation list establishes the wider influence of a few articles both within the DT research community and outside looking for influential articles on the Design Thinking field. At the same time, the fact that few articles were different indicates the need to scrutinize both global and local citations to reveal a deeper state of affairs within a review domain (Donthu et., al., 2021).

It is also evident from the review that the US is the major pivot dominating research in the field of DT as highlighted both by the volume of output, individual author contributions as well as institutions they represent. This is followed by Australia, UK and some other European countries, clearly indicating that research in this field is primarily coming out from Western countries in terms of volume of output as well as major institutions and researchers involved in research in this growing field. Also, a close look at country collaboration again revealed the same trend with US, UK and Australia emerging as key lynchpins in DT research collaborations and this key trend may continue for some time given the prominence of these countries as per this review.

6 Avenues for Future Research (RQ5)

Our reflections and examination of existing research on DT indicate that largely the existing research has employed qualitative tools for research, so scholars going ahead should use quantitative measures to do empirical research to validate how DT helps organizations improve their performance and gain a competitive advantage over their competitors. This would help the field gain acceptability and help overcome the criticism associated with the field that the importance attributed to the DT field is based more on anecdotal evidence rather than strong empirical evidence. This research, in turn, will provide better insights into the role of DT in organizational performance and result in the wider diffusion of this approach within organizations.

The field of DT has become far more relevant in these times of the Covid-19 pandemic, which has caused massive disruption and organizations across the world are struggling and trying to

adapt to this fast-changing scenario. Organizations in these times are continuously searching for new ways to operate and are relying heavily on creative tools to develop new ways to operate and serve the changing customer needs to stay relevant. In these challenging times, DT provides them with the tool where they can connect better with all stakeholders by developing empathy, which will help them understand the consumers better and subsequently respond to their changing requirements in a far more nimble way. In fact, in these times, DT can be a very handy tool in the armour of organizations to cope with this disruption and find ways to serve their customers well, thus building a strong competitive advantage in this crisis. Going forward, we intend to propose a direction for future research in more detail below;

6.1 Developing Strong Scholarly Base

While the field of DT developed within the discipline of design, it gained its current form and wider acceptability, once the concept was picked up by the business world. This is also reflected in the quantum jump in publication output from 2010 onwards, once the very influential article by Brown (2008) appeared in Harvard Business Review, an outlet focused on practitioners, where he highlighted the role of DT for business organizations. Since then the concept has gained both wider acceptability as well as adoption within the business world. But like many examples of various novel concepts and tools promoted by business consultants and practitioners, DT discourse also faces the risk of being fizzling out, if the field doesn't acquire a strong scholarly base and academic grounding. Strong academic grounding will preserve essential parts of managerial applications as well as the core of the designerly thinking approach and build a strong foundation on it. DT field relies heavily on empathy, teamwork, organizational culture and structure, creative problem-solving approach and ideation to solve problems. So, future researchers can look into the academic literature available in these fields and explore the interlinkages with the established theories in these fields with the DT concept to develop strong scholarly moorings of this growing field. The field of DT emerged within the field of Design, yet the examination of the literature reveals that there doesn't exist any linkage between them. This is largely because the managerial discourse on DT doesn't refer much to the existing academic research within the field of Design. Business practitioners use the term "Design Thinking" and explain it in a way based on the needs of the management. Future researchers by exploring the linkages between the "Design" and "Design Thinking" approach as practised within the design and management world can draw on the available literature within the design field resulting in the development of an academic base for DT.

6.2 Strong Empirical Research

Increasingly DT is considered a powerful tool of creativity and innovation that helps firms in gaining a competitive advantage and remain relevant. The business world and press have highlighted its role in transforming organizations and improving their performance outcomes and helping them to differentiate. This is largely based on anecdotal evidence as there are hardly any empirical studies conducted in the field of DT. Our examination of academic literature in the field of DT while doing this bibliometric study reveals a paucity of empirical research. So, future researchers can build on the existing conceptual base by conducting empirical research using established tools to validate the importance of DT empirically, thus providing the field with the required legitimacy.

6.3 Role of Top Leadership

The implementation of DT within the organization requires the development of the necessary organizational culture to instil creativity and innovation leading to solving present and future

challenges facing organizations. This means that organizations need to develop the required organizational structures which will develop an open, experimentative culture, where a free flow of ideas can take place and acceptance of a certain degree of risk, failure and tolerance for ambiguity. It also requires that organizations should also accept qualitative forms of research along with relying on quantitative models, all this requires strong support from the top leadership within the organization. It is their responsibility to develop the necessary culture and support tools, which can see the deeper diffusion of the DT approach within the firms for it to deliver the intended outcomes. The existing DT research has not explored this field, so future researchers must look into this issue

6.4 Nature of Organizations

While all organizations are increasingly looking for ways to be more creative and innovative to stay relevant. This means that DT is a relevant tool for broadly all kinds of organizations but different types of organizations are structured differently facing different kinds of challenges and their internal situations are also very different. In this, context these organizations may have to adapt DT tools and practices as per their requirements as one size doesn't fit all. The situation and challenges facing start-ups are very different from large well-structured organizations. In this context, future researchers can look into the specific requirements and conditions of different kinds of organizations and then may need to customize the various aspects of DT to deliver better outcomes, which is an interesting area of research within the DT field.

6.5 Developing Creative Thinking & Problem Solving Skills

It is important to groom young minds to create new ideas instead of adopting existing ideas and sprucing them up. Catching them young would go a long way in creating an innovative society as the future world would be very different from today and the competencies and skills required to operate and manage the changing world would be different. Extant literature has suggested that design thinking should play a prominent role in the field of education as it has an innovative, business-oriented, multidisciplinary and problem-solving potential. The nature of DT application is empathetic and human-centred and scholars, as well as practitioners, need to identify future pedagogies and tools to be used in education as it is important to train them young to make them ready for the future.

7 Conclusion

DT has emerged as an important tool for organizations to be more creative and innovative, which goes a long way in improving their performance, sustainability and developing sustainable competitive advantage. This bibliometric review has helped to unpack and chronologically outline the intellectual development of the DT field based on existing research and also identify possible future research directions to further enhance our understanding of the DT field. The current review makes it very evident that DT is increasingly used as a strategic tool to instil a culture of creativity within organizations rather than a mere instrument of product/service design. Organizations focusing only on this aspect of DT may only take limited advantage of this approach while it has much wider applicability. The review clearly outlines the need for researchers to undertake empirical studies rather than only relying on anecdotal approaches about the importance of DT. There is hardly any research done in the field using survey-based and quantitative tools-based studies to empirically validate the outcomes attributed to DT, so future researchers can focus clearly in this direction.

While there have been few studies on DT in the social sector including the education field in extant literature. The instruments of DT are equally useful beyond business for Government and social organizations, which can use this approach to solve issues faced by people and society at large. Further, this tool can be very useful for start-ups as they are always looking for existing and future problems, which can be a source of opportunity for them to start something new. The very fact that DT is a qualitative tool, which uses specific tools to spot a problem, it is a suitable way for the start-ups to do field research rather than conducting detailed market research, which is an expensive and time-taking process. This can help these ventures to adopt a lean and quick approach, which fits well with the nature of entrepreneurial start-ups. Further, in the present times of the digital economy, most companies rely a lot on data-driven approaches to study consumer patterns, DT with its qualitative focus provide the right balance to employ both quantitative and qualitative approaches to know about their consumers well. This research found that the existing literature on DT as a creative and innovative tool is quite rich, with the majority of the studies focusing on this aspect. There is a need to study and build strong academic roots by building theoretical underpinnings, which this field lacks at the moment. The review revealed that the majority of the research happening in this field is centred in Western countries, and institutions and done by authors there. There is a strong need to expand this research to other parts of the world and for businesses and other organizations there to take benefit of this.

There are limited studies, which has focused on the role of organizational structure and culture, which can help in the diffusion and adoption of DT philosophy within the entire organization. There is a need to have a bibliometric study in this aspect as this will help in consolidating the existing studies in this direction, which will help scholars, practitioners and policymakers to understand the need to design and structure the organizations in such a way that they can be more creative and innovative. Because organizations are continuously searching for various tools to become more creative to stay relevant, we believe that DT will remain an intriguing and exciting field for scholars and policy-makers. The researchers have an onerous challenge to explore the various dimensions of DT and also develop a strong literature base for the concept, which has gained widespread currency rather than it turning out to be a fad, so there is a strong need for researchers to explore DT beyond existing silos so that the field gains academic respectability. Thus we hope that our suggestion and advice for a deeper study of the DT field will be heeded by scholars for the benefit of all stakeholders in the field.

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