# Design Thinking: from Bibliometric Analysis to Content Analysis, Current Research Trends, and Future Research Directions

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## Abstract

The purpose of this study is to conduct a comprehensive systematic literature review, bibliometric analysis, and content analysis of design thinking (DT). To identify the research papers, a systematic literature review was done. After reading, all titles of the articles, abstract, keywords, and full-length articles based on the requirement, unrelated articles to design thinking were removed. In the second step, articles were read more critically. Finally, bibliometric and content analyses of the selected articles were carried out. Content analysis was done based on bibliometric coupling between the selected article and the recent article. The paper identified sixteen existing research diversification in design thinking. An indistinct interpretation of the progress of research article publication, research diversification on theme and subtheme of 16 clusters, present research trends, and five prospective research directions on design thinking has been identified here.

**Keywords** Design thinking · Systematic literature review (SLR) · Bibliometric analysis · Content analysis · Research

## Introduction

Many a time the most successful brands of the world create breakthrough ideas based on customer understanding by using the principles of design for value creation. Design thinking is a discipline that is built on a designer's approach to understanding the customer's demands very sensitively with what is scientifically possible and assisting in the conversion of customer value into an opportunity to be successful in the marketplace (Brown, 2008).

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The history of this discipline is not merely a history of an object but is a history of changing views of subject matter held by designers (Buchanan, 1992).

As the economics of the developed world is shifting their concentration from industrial manufacturing to service, knowledge work, and human-centric activities. In this process, design thinking could be a decisive difference factor (Brown, 2008).

Design thinking is a common discipline that is altering our society from the ground up, not just in terms of exterior manifestation but also in terms of our attitudes toward products and services (Buchanan, 1992).

Nowadays, design thinking is gaining much more importance and emerges as a thrilling new paradigm to deal with the complications in different sectors as far as a field like business, education, medicine, and IT. The desire to embrace and use this knowledge in a variety of fields has resulted in immediate demand for a clear and precise understanding of design thinking.

In new product development, an organization generally follows the "stage-gate" process and executes this process through a cross-disciplinary team to be successful in the marketplace. But in this rapidly changing technological environment, organizations are facing tremendous challenges to fulfill the customer needs and this is causing many organizations to understand the innovation principle (Beckman & Michael, 2007). Today, marketing organizations should focus on the individual customer to do so they need to understand the context in which the customer lives (Beckman & Michael, 2007).

The product or service design is the decisive component for any business for a competitive advantage. The problem in different management functional areas can be solved by design thinking and nowadays design thinking gaining recognition both in academics and business press (David & Martin, 2006). Though the application of design thinking in management problems is new and unexplored, however, managers are trying to apply this concept to resolve the different problems and academicians and practitioners are trying to define it (David & Martin, 2006).

A study on "Design thinking-a creative approach to educational problems of practice" which is published in Thinking Skills and Creativity Journal stated that the problem faced by an educator today is complex which rarely solved through a simple or linear solution. Design thinking can be used to solve the problem creatively (Henriksen et al., 2017).

With the aid of design thinking, the entrepreneurship mentality of medical education is quickly developing to address the industry's ongoing issues, and it may contribute to the establishment of a formal educational framework or competence model for present or future programs (Niccum et al., 2017).

Business management students around the globe face various challenges as they deal with multidisciplinary groups. They can be well prepared by various design thinking methods like flipped classrooms and client-based projects to handle real-life challenges (Foster & Yaoyuneyong, 2016).

An article "Design thinking: organizational learning in VUCA environments" (Cousins, 2018), stated that VUCA (volatility, uncertainty, complexity, and ambiguity) is a characteristic of the digital economy. To tackle this situation, design thinking is gaining popularity as it facilities the organization for fast learning.

Leaders across the globe believe that innovation is the source of differentiation and source of competitive advantage, design thinking which has more management principles and best practices to explore has to offer much more to the business world in days to come (Brown, 2008).

Design thinking is getting more attention now a day all across different fields like education, management, medical, sports, IT, and so on. It can be seen that researchers have started paying more attention to this subject. However, the previous researcher has given attention to the various filed related to design thinking, but not to the core area of design thinking.

## The Justification for the Research

Considering the significance of design thinking above, this research article wants to see the research pattern of the past decade and the potential research direction for the future. The uniqueness of this article is that to date nine authors have done the literature review based on systematic literature review (SLR) and bibliometric analysis in the design thinking domain, but except two authors, they are Johansson-Skoldberg et al. (2013) and Micheli et al., none of them have done the literature review directly on design thinking. All the literature review researches associated with design thinking topics are like competitiveness, health profession education, innovation management, entrepreneurship and education, service design, design thinking, and place, the core of Dorst's design thinking has done based on systematic literature review and bibliometric analysis. Whereas this article has applied a combination of SLR, bibliometric analysis, and content analysis to understand and discover the intellectual structure and present a complete synopsis of design thinking. To understand the past literature review on design thinking, details of the all articles are given below in a tabular form (Table 1).

Out of above mentioned nine articles, only two articles closely related to the literature review of design thinking are described below.

Johansson-Skoldberg et al. (2013) in their article on "Design thinking: past, present and possible future" which is published in the "Creativity and Management Journal (Vol 22 No 2)", based on the previous work they tried to find out the relationship between designerly thinking and design thinking. To find the answer to the research, they started with a question like, "what is the literature in design thinking? In this article, they have shown the progress of design thinking articles has an increasing trend and 2011 was a critical juncture in design thinking because of Cambridge Design Management Conference. In this research article, 168 articles from conference papers, articles, and magazines were analyzed with a systematic literature review. Though this article is not very prominently related to design thinking literature review but to get a direction of the current research, this article has been discussed here.

Micheli et al. (2018) have done a review of literature on design thinking based on systematic literature review, card shorting exercise, and cluster analysis. In this study, they have identified 10 clusters in design thinking and given various

**Table 1** Previous systematic review details with author name and journal details

| Sl. No | Authors | Article title | Year of publication | Journal name | Journal volume | Journal issue | Related to direct literature review |
|---|---|---|---|---|---|---|---|
| 1 | Johansson-Sk"Idberg U., Wood-illa J., ćetinkaya M | Design thinking: past, present and possible futures | 2013 | Creativity and Innovation Management | 22 | 2 | Yes |
| 2 | Micheli P., Wilner S.J.S., Bhatti S.H., Mura M., Beverland M.B | Doing design thinking: conceptual review, synthesis, and research agenda | 2018 | Journal of Product Innovation Management | 36 | 2 | Yes |
| 3 | D'Ippolito B | The importance of design for firms competitiveness: a review of the literature | 2014 | Technovation | 34 | 11 | No |
| 4 | McLaughlin J.E., Wolcott M.D., Hubbard D., Umstead K., Rider T.R | A qualitative review of the design thinking framework in health professions education | 2019 | BMC Medical Education | 19 | 1 | No |
| 5 | Bagno R.B., Salerno M.S., da Silva D.O | Models with graphical representation for innovation management: a literature review | 2017 | R and D Management | 47 | 4 | No |
| 6 | O'Brien E., Hamburg I | A critical review of learning approaches for entrepreneurship education in a contemporary society | 2019 | European Journal of Education | 54 | 4 | No |
| 7 | J. Luca E., Ulyannikova Y | Towards a user-centred systematic review service: the transformative power of service design thinking | 2020 | Journal of the Australian Library and Information Association | 69 | 3 | No |
| 8 | Overmyer T., Carlson E.B | Literature review: design thinking and place | 2019 | Journal of Business and Technical Communication | 33 | 4 | No |
| 9 | Weedon S | The core of Kees Dorst's design thinking: a literature review | 2019 | Journal of Business and Technical Communication | 33 | 4 | No |

Source: Author

research directed related to professional skillset, core constitutions, skill and process, and application of design thinking in research (Table 2).

Based on the above discussion, it is clear that there is a big void in the literature review research in design thinking. Moreover, no authors have adopted SLR, bibliometric analysis, and content analysis techniques to explore design thinking till now. In this way, this research article is unique.

Based on the research gap identified above, the purpose of this research study is to find out the below-mentioned research questions:

RQ1. What are the year-wise publication trends along with author-wise (citation and number of an article), country wise, and journal-wise (descriptive analysis) publication details of the design thinking articles?
RQ2. Based on global citation and local citation, which are the most influential research articles in this area?
RQ3. How the research in design thinking is diversified or clustered? What is the theme of the different clusters?
RQ4. What are the different possible future research directions?

In this research, SLR is adopted to collect the articles. Firstly, articles are identified from the Scopus article database then the articles are shorted as per the relevancy of the topic. The third step is to critically analyze the article to find a synthesis. Bibliometric analysis is carried out to find out the most contributing journals based on citation, country contributions, and to identify the different clusters. To identify the trends of current research and to find out the future research directions, content analysis has been carried out.

This study critically analyses the different research articles in the design thinking area and presented an overall structure of intellectual analysis. The important outcome in this research work will benefit the academician and practicing manager to understand the research status, structure, and evolution of different themes in design thinking. The future research direction of this research will give a direction about the future research to the new researchers in design thinking.

To the best of my knowledge, this is the first research study in the design thinking area that applied SLR, bibliometric analysis, and content analysis at a time to get a result that will answer the pre-identified research questions.

The contribution of this research works to the design thinking can be mentioned in the three ways.

1. No previous research work has been conducted considering SLR and bibliometric analysis but this research work provided insight like most-cited authors, journal name with publication details, and country-wise contribution in design thinking.
2. The previous researcher has not given any focus on content analysis along with systematic literature review and bibliometric analysis.
3. These research works reveal the future research direction in design thinking with the help of content analysis (articles published in 2019, 2020, and 2021) of recently published articles.

**Table 2** Comparison details of the present study and previous study

| Author name | Time frame | The total number of articles | Methods | Key findings | Future research directions |
|---|---|---|---|---|---|
| Johansson-Sk"ldberg U., Woodilla J., Cetinkaya M | Not clearly mentioned in the article. (It is mentioned that data was collected from after 2000 published articles, and this article was published in the year 2013). Approximately 12 years | 168 | Systematic literature review (SLR) | Based on Design and design-erly thinking (previous study) categorized into five sub-discourses: the creation of artifacts, reflexive practice, problem-solving activity, a way of reasoning/making sense of things, creation of meaning | Ethnographic research |
| Micheli P., Wilner S.J.S., Bhatti S.H., Mura M., Beverland M.B | 32 years | 104 | Systematic literature review, card shorting exercise, and cluster analysis | Identified 10 clusters and research directions | Professional skillset, core constitutions, skill and process, application in research |
| Present study | 12 years | 1000 | Systematic literature review, bibliometric analysis with cluster identification, content analysis with TCCM Framework analysis | Identified 16 clusters, publication trends year-wise, top contributing journals, authors, and country. Most cited and co-cited article details. Intellectual structure of research and future research directions | Entrepreneurship Education Service Design Value co-creation New Product Development Design Knowledge |

Source: Author

The remaining research article portion is organized as follows: "Research Methodology," "Description Analysis," "Bibliometric Analysis," "Content Analysis," "Discussion, Findings, and Research Directions for the Future," and "Limitation and Conclusions."

## Research Methodology

There are many ways to do the literature review like SLR, meta-analysis, bibliometric analysis, and content analysis (Hulland & Houston, 2020). In this article, SLR is used to identify, sort, and report the article (Duque-Uribe et al., 2019). In the first step of SLR, articles are collected from the Scopus database with the help of keywords like "Design Thinking," "Design," and "Thinking." Next, relevant articles of design thinking were selected. In the third stage, all the articles are critically examined and presented in a synthesized manner based on Preferred Reporting Items for Systematic Reviews and Meta-Analysis(PRISMA) statement. The earlier researcher that used the PRISMA framework includes patient satisfaction (Batbaatar et al., 2017), application of punctuated equilibrium theory (PET) in policy change (Kuhlmann & van der Heijden, 2018), to measure the quality the life framework (Monsalve et al., 2020) and digital libraries research (Maryati et al., 2020).

To find out the global cited, locally cited, most contributing researchers, country-wise contribution, co-citation analysis, and the bibliometric coupling for cluster analysis were done with the help of VOSViewer and spreadsheet software (Paul & Criado, 2020). As both software are simple to use and give a superior visual impact, as well as the ability to handle various data display formats (Mulet-Forteza et al., 2018).

A content analysis was done on the selected articles of different clusters as it helps to identify the different themes and subthemes of the cluster, research diversification, and research trends (Fonseca et al., 2011).

In addition to this, separate content analysis is also being performed to know the current research trends and future research directions in this subject (Downe-Wamboldt, 1992).

Apart from the content analysis of the recent articles, to identify the research gap in the existing literature in theories, contexts, characteristics, and methodology (TCCM), the TCCM framework has been used. Earlier research work that used the TCCM framework included cause-related marketing, alliance termination research, culture, and international business research (Rajan et al., 2020).

### The Outcome of the Search Result

For the analysis, all the articles are collected from the Scopus database with the help of different keywords like design, thinking, and design thinking. A Scopus database has a Boolean syntax (AND, NOT, OR) which helps authors to identify the correct articles from the indexed database. There are many databases like Scopus, Web of

Science (WoS), and Google Scholar, from where the author can extract the required articles' details for the analysis.

In a comparative study of bibliometric data of the WoS, Scopus, and Google Scholar concluded that the Scopus database provides 20% more coverage than the WoS database whereas the result of the Google database is inconsistent (Falagas et al., 2008), and the Google Scholar database offer poor data for the analysis (De Battisti & Salini, 2013). Scopus database is managed by Elsevier publishing house.

Based on the above discussion, the present study is based on a Scopus database for a better insight into the subject.

To get the articles' details in a Scopus database, the search string was restricted to the title of the article, abstract, and keywords in the areas of management, accounting, engineering, and the documents types are based on the English language, peer-review articles were selected from 2010, as 10 years data analysis is very much important for the research (Rialp et al., 2005). A total of 2007 articles were featured initially and after the filtered with the below mentioned (Table 3) excluding criteria, a total number of 1000 articles have been selected based on article name, author(s) name, affiliations, journal name, volume, issue no, abstract, keywords, and references (Paul & Criado, 2020).

A PRISMA framework is adopted to perform this research, which is described in Fig. 1.

All the selected articles are divided into two subgroups: group one is for the content analysis of cited papers and another group of recently published papers to identify the present research trends. After that year-wise article trends, citation numbers, and country-wise contribution have been analyzed.

## Description Analysis

### Publication Trends

The year-wise publication trend in design thinking indicates that this area is getting major attention since 2015. It can be noticed that the number of articles per year after 2015 is quite in high numbers. In 2019, there are quite a high number of the article has been published in this area. In 2021, the number of articles is less, because the analyzed data has been collected in April 2021 and this academic year is yet to end (Fig. 2).

**Table 3** Inclusion and exclusion criteria

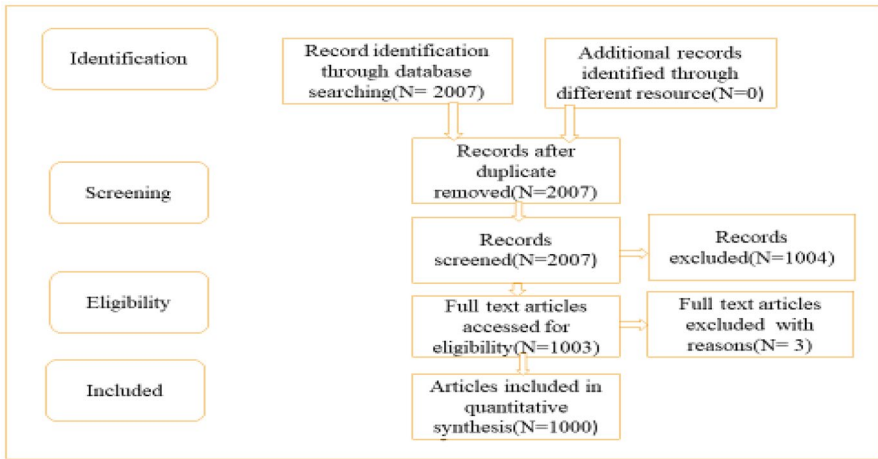| Inclusion criteria | Exclusion criteria |
| --- | --- |
| Articles related to only design thinking | Conference papers |
| Only peer-reviewed articles | Book Chapter, book review |
| Articles published in the English language | Articles in press |

Source: Author

**Fig. 1** PRISMA framework. Source: Author

## Top Contributing Authors in the Field

Brown (2008) is the highest contributing author with 5542 global citations. This topmost article has been published in Harvard Business Review in 2008 on the topic "Design Thinking." Buchanan (1992) is the second-highest contribution author in this field with 4286 global citations. This work has been published in the Design Issue Journal and Dym et al. (2005) with 2938 global citations became the third most contributing in this field (Table 4).

## Topmost Cited Contributing Authors During 2010–2021

Dorst (2011) is the most contributing author with a global citation of 533 with an article title of "The core of design thinking and its application," which has been
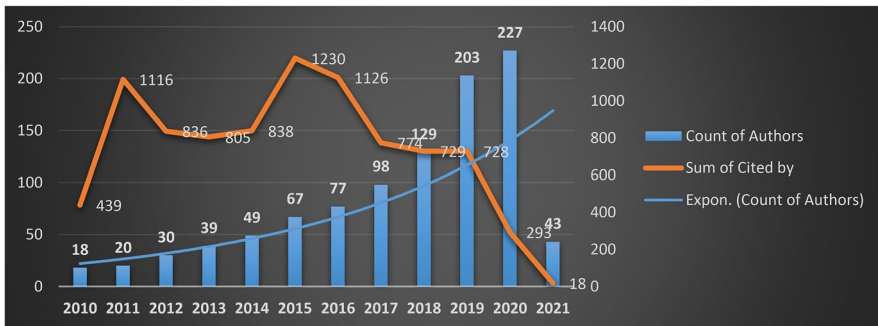


**Fig. 2** Year-wise publication and citation trends. Source: Author. Figure shows the year-wise increasing publication trends from 2010 to 2021. The design thinking area is drawing attention

**Table 4** Most cited author worldwide

| Sl. no | Authors | Title | Year | Journal name | Repository | No. of citations |
|---|---|---|---|---|---|---|
| 1 | T Brown | Design thinking | 2008 | Harvard business review | academia.edu | 5542 |
| 2 | R Buchanan | Wicked problems in design thinking | 1992 | Design issues | JSTOR | 4286 |
| 3 | CL Dym, AM Agogino, O Eris, D D Frey… | Engineering design thinking, teaching, and learning | 2005 | Journal of Engineering … | Wiley Online Library | 2938 |
| 4 | T Brown, J Wyatt | Design thinking for social innovation | 2008 | Development Outreach | elibrary.worldbank.org | 1826 |
| 5 | K Dorst | The core of 'design thinking and its application | 2011 | Design studies | Elsevier | 1472 |
| 6 | D Dunne, R Martin | Design thinking and how it will change management education: An interview and discussion | 2006 | Academy of Management Learning & … | journals.aom.org | 1024 |
| 7 | U Johansson-Sköldberg, J Woodilla… | Design thinking: past, present and possible futures | 2013 | Creativity and … | Wiley Online Library | 944 |
| 8 | SL Beckman, M Barry | Innovation as a learning process: Embedding design thinking | 2007 | California management review | journals.sagepub.com | 872 |
| 9 | L Kimbell | Rethinking design thinking: Part I | 2011 | Design and culture | caa.tandfonline.com | 852 |

Source: Author

published in a Design Studies Journal in 2011. Johansson-Skoldberg et al. (2013) is the second most cited author with a citation of 311 (Table 5).

### Top 10 Authors Based on the Article Published

During this time (2010 to 2021), Liedtka is the number one author with a publication of four articles; and Dorst, Leavy, Bierwolf, Benson and Dresdow, Choi and Kim, and Clouse are the second authors; and Howlett, Tonkinwise, and Buchanan are the 3rd authors in design thinking area (Table 6).

### Top 10 Contributing Journals Based on Articles Published

During this year (2010–2021), design studies are the topmost journal with the highest publications of 28 articles with 1174 global citations. Sustainability (Switzerland) is the second and International Journal of Design Education is the 3rd journal in this area with 23 and 21 article publications, respectively. These top 10 journals contributed almost 20% of a research article in this area during this year (Table 7).

### Top 10 Contributing Countries in Article Publications

Below mentioned are the top 10 countries from where more than 70% of the articles were published during 2010–2021. The USA is the number one country with 324 article publications and has 32.40% contribution in design thinking article publication. Australia is in second and the UK holds the 3rd position in design thinking article publications (Table 8).

### Bibliometric Analysis

Here, with the help of VOSviewer software, global citation, and local citation analysis of each identified research paper of design thinking are carried out. Here VOS stands for visualization of similarities.

The reason for selecting the VOSviewer is that VOSviewer can display the different clusters in various ways with different aspects. It has different functions like zoom, scroll down, scroll up, and searching, by which any researcher can visualize the map for an examination. The maps developed by VOSviewer are very useful with a large number of rows. Most software does not display these types of satisfactory features for a bibliometric analysis (Van Eck & Waltman, 2010).

**Table 5** Ten most cited authors worldwide during 2010–2021

| Sl. no | Author details | Title of the article | Year of publication | Journal name | Vol | No | Starting page | End page | No. of citations |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Dorst K | The core of design thinking and its application | 2011 | Design Studies | 32 | 6 | 521 | 532 | 533 |
| 2 | Johansson-Sk"ldberg U., Woodilla J., €etinkaya M | Design thinking: past, present and possible futures | 2013 | Creativity and Innovation Management | 22 | 2 | 121 | 146 | 311 |
| 3 | Razzouk R., Shute V | What is design thinking and why is it important? | 2012 | Review of Educational Research | 82 | 3 | 330 | 348 | 256 |
| 4 | Yeager D.S., Hulleman C.S., Hinojosa C., Lee H.Y., O'Brien J., Romero C., Paunesku D., Schneider B., Flint K., Roberts A., Trott J., Greene D., Walton G.M., Dweck C.S | Using design thinking to improve psychological interventions: The case of the growth mindset during the transition to high school | 2016 | Journal of Educational Psychology | 108 | 3 | 374 | 391 | 201 |
| 5 | Howlett M | From the 'old' to the 'new' policy design: Design thinking beyond markets and collaborative governance | 2014 | Policy Sciences | 47 | 3 | 187 | 207 | 127 |
| 6 | Geissdoerfer M., Bocken N.M.P., Hultink E.J | Design thinking to enhance the sustainable business modeling process? A workshop based on a value mapping process | 2016 | Journal of Cleaner Production | 135 | - | 1218 | 1232 | 121 |
| 7 | Seidel V.P., Fixson S.K | Adopting design thinking in novice multidisciplinary teams: The application and limits of design methods and reflexive practices | 2013 | Journal of Product Innovation Management | 30 | SUPPL 1 | 19 | 33 | 118 |

**Table 5** (continued)

| Sl. no | Author details | Title of the article | Year of publication | Journal name | Vol | No | Starting page | End page | No. of citations |
|---|---|---|---|---|---|---|---|---|---|
| 8 | Carroll M., Goldman S., Britos L., Koh J., Royalty A., Hornstein M | Destination, imagination and the fires within: Design thinking in a middle school classroom | 2010 | International Journal of Art and Design Education | 29 | 1 | 37 | 53 | 116 |
| 9 | Kimbell L | Rethinking design thinking: Part II | 2012 | Design and Culture | 4 | 2 | 129 | 148 | 92 |
| 10 | Tsai C.-C., Chai C.S | The "third"-order barrier for technology-integration instruction: Implications for teacher education | 2012 | Australasian Journal of Educational Technology | 28 | 6 | 1057 | 1060 | 91 |

Source: Author

**Table 6** Top 10 contributing authors based on number of articles published during 2010–2021

| Sl. no | Author | Articles published | No. of citation |
|--------|--------|--------------------|-----------------|
| 1 | Liedtka J | 4 | 257 |
| 2 | Dorst K | 3 | 542 |
| 3 | Leavy B | 3 | 109 |
| 4 | Bierwolf R | 3 | 21 |
| 5 | Benson J., Dresdow S | 3 | 19 |
| 6 | Choi H.H., Kim M.J | 3 | 19 |
| 7 | Clouse C | 3 | 8 |
| 8 | Howlett M | 2 | 131 |
| 9 | Tonkinwise C | 2 | 55 |
| 10 | Buchanan R | 2 | 48 |

Source: Author

## Citation Analysis

As per Ding and Cronin (2011), an article's reputation can be judged by the number of citations it receives from the other articles. In a meaningful sense, it is like how many times an article is being cited by the other articles. The relatedness of an article can be judged based on direct citation, while co-citation and bibliometric coupling are considered a secondary indicators of relatedness (Klavans & Boyack, 2016).

During the citation analysis, it has been found that 668 articles out of 1000 articles in the database cited each other and created a network node. Nodes are the intellectual links between the articles when they cite each other.

**Table 7** Top 10 journal names based on the articles published during 2010–2021

| Sl. no | Journal name | No. of the articles published | Total citations |
|--------|--------------|-------------------------------|-----------------|
| 1 | Design Studies | 28 | 1174 |
| 2 | Sustainability (Switzerland) | 23 | 38 |
| 3 | International Journal of Design Education | 21 | 8 |
| 4 | International Journal of Art and Design Education | 18 | 195 |
| 5 | International Journal of Technology and Design Education | 18 | 152 |
| 6 | She Ji | 18 | 127 |
| 7 | Journal of Cleaner Production | 17 | 346 |
| 8 | International Journal of Design Management and Professional Practice | 16 | 4 |
| 9 | Thinking Skills and Creativity | 16 | 112 |
| 10 | International Journal of Engineering Education | 15 | 70 |
| | | **190** | **19.93%** |

Source: Author

**Table 8** Top 10 countries based on published articles in design thinking

| Sl. no | Country name | No of the article published | Total citation numbers | % Contribution of the article published |
|---|---|---|---|---|
| 1 | USA | 324 | 2877 | 32.40% |
| 2 | Australia | 96 | 1690 | 9.6% |
| 3 | UK | 75 | 1003 | 7.50% |
| 4 | Canada | 53 | 550 | 5.30% |
| 5 | Germany | 42 | 143 | 4.20% |
| 6 | Netherlands | 31 | 988 | 3.10% |
| 7 | Taiwan | 30 | 378 | 3.00% |
| 8 | China | 27 | 106 | 2.70% |
| 9 | Singapore | 25 | 467 | 2.50% |
| 10 | Finland | 24 | 154 | 2.40% |
| **Total** | | 727 | | **72.70%** |

An article by Dorst (2011) got a maximum global citation of 533 as well as a maximum local citation of 620. Whereas Johansson-Skoldberg et al. (2013), Razzouk and Shute (2012), and Yeager et al., (2016) got 311, 256, and 201 respectively in global citations (Table 9).

## Co-citation Analysis

If both articles appear in the reference list of other articles, they are co-cited (Xu et al., 2018). Here, the articles are considered to be in the nearly same area of research because of the citation (Hjorland, 2013). To analyze co-citation, "cited reference" as a unit of analysis was used in VOSviwer. A local citation is those citations that indicate the number of citations done by others in 1000 articles. Whereas global citation is the whole number of citations in a different field. Local citations are calculated based on VOSviewer analysis and global citation numbers are collected from the Scopus database.

In this co-citation analysis, Dorst (2011) remains the topmost cited author based on local citation, Johansson-Skoldberg et al. (2013) hold the second position with 311 citations, and Tsai and Chai (2012) hold the third position with 291 local citations (Table 10).

## Bibliometric Coupling (Data Clustering)

The concept of bibliometric coupling was introduced by Kessler (1963).

To make the cluster of the collected Scopus database, "document" is selected as a unit of analysis in VOSviewer software to perform bibliometric coupling. There is a similar research theme in a cluster of articles and while different clusters have a limited relationship in the article database (Xu et al., 2018). In bibliometric coupling, an association between the two articles can be possible when

**Table 9** Top 10 cited articles based on global citations analysis

| Sl. no | Title of article | Authors | Year | Journal name | Journal volume | Journal issue | Global citation | Local citation |
|---|---|---|---|---|---|---|---|---|
| 1 | The core of design thinking and its application | Dorst K | 2011 | Design Studies | 32 | 6 | 533 | 620 |
| 2 | Design thinking: past, present and possible futures | Johansson-Sk"ldberg U., Woodilla J., €etinkaya M | 2013 | Creativity and Innovation Management | 22 | 2 | 311 | 311 |
| 3 | What is design thinking and why is it important? | Razzouk R., Shute V | 2012 | Review of Educational Research | 82 | 3 | 256 | 256 |
| 4 | Using design thinking to improve psychological interventions: the case of the growth mindset during the transition to high school | Yeager D.S., Hulleman C.S., Hinojosa C., Lee H.Y., O'Brien J., Romero C., Paunesku D., Schneider B., Flint K., Roberts A., Trott J., Greene D., Walton G.M., Dweck C.S | 2016 | Journal of Educational Psychology | 108 | 3 | 201 | 201 |
| 5 | From the 'old' to the 'new' policy design: Design thinking beyond markets and collaborative governance | Howlett M | 2014 | Policy Sciences | 47 | 3 | 127 | 165 |
| 6 | Design thinking to enhance the sustainable business modeling process? A workshop based on a value mapping process | Geissdoerfer M., Bocken N.M.P., Hultink E.J | 2016 | Journal of Cleaner Production | 135 | | 121 | 133 |
| 7 | Adopting design thinking in novice multidisciplinary teams: the application and limits of design methods and reflexive practices | Seidel V.P., Fixson S.K | 2013 | Journal of Product Innovation Management | 30 | SUPPL 1 | 118 | 122 |

**Table 9** (continued)

| Sl. no | Title of article | Authors | Year | Journal name | Journal volume | Journal issue | Global citation | Local citation |
|---|---|---|---|---|---|---|---|---|
| 8 | Destination, imagination and the fires within: design thinking in a middle school classroom | Carroll M., Goldman S., Britos L., Koh J., Royalty A., Hornstein M | 2010 | International Journal of Art and Design Education | 29 | 1 | 116 | 116 |
| 9 | Rethinking design thinking: part II | Kimbell L | 2012 | Design and Culture | 4 | 2 | 92 | 114 |
| 10 | The "third"-order barrier for technology-integration instruction: implications for teacher education | Tsai C.-C., Chai C.S | 2012 | Australasian Journal of Educational Technology | 28 | 6 | 91 | 291 |

Source: Author

**Table 10** Top 10 cited authors based on global citations analysis (2011–2021)

| Title | Authors | Year | Journal name | Journal volume | Journal issue | Global citation | Local citation |
|---|---|---|---|---|---|---|---|
| The core of design thinking and its application | Dorst K | 2011 | Design Studies | 32 | 6 | 533 | 620 |
| Design thinking: past, present and possible futures | Johansson-Sk"ldberg U., Woo-dilla J., €etinkaya M | 2013 | Creativity and Innovation Management | 22 | 2 | 311 | 311 |
| The "third"-order barrier for technology-integration instruction: implications for teacher education | Tsai C.-C., Chai C.S | 2012 | Australasian Journal of Educational Technology | 28 | 6 | 91 | 291 |
| What is design thinking and why is it important? | Razzouk R., Shute V | 2012 | Review of Educational Research | 82 | 3 | 256 | 256 |
| Using design thinking to improve psychological interventions: the case of the growth mindset during the transition to high school | Yeager D.S., Hulleman C.S., Hinojosa C., Lee H.Y., O'Brien J., Romero C., Paunesku D. Schneider B., Flint K., Roberts A., Trott J., Greene D., Walton G.M., Dweck C.S | 2016 | Journal of Educational Psychology | 108 | 3 | 201 | 201 |
| From the 'old' to the 'new' policy design: design thinking beyond markets and collaborative governance | Howlett M | 2014 | Policy Sciences | 47 | 3 | 127 | 165 |
| Design thinking to enhance the sustainable business modeling process? A workshop based on a value mapping process | Geissdoerfer M., Bocken N.M.P., Hultink E.J | 2016 | Journal of Cleaner Production | 135 | | 121 | 133 |
| Adopting design thinking in novice multidisciplinary teams: The application and limits of design methods and reflexive practices | Seidel V.P., Fixson S.K | 2013 | Journal of Product Innovation Management | 30 | SUPPL 1 | 118 | 122 |

**Table 10** (continued)

| Title | Authors | Year | Journal name | Journal volume | Journal issue | Global citation | Local citation |
|---|---|---|---|---|---|---|---|
| Framing design thinking: the concept in idea and enactment | Carlgren L., Rauth I., Elmquist M | 2016 | Creativity and Innovation Management | 25 | 1 | 86 | 121 |
| Doing design thinking: conceptual review, synthesis, and research agenda | Micheli P., Wilner S.J.S., Bhatti S.H., Mura M., Beverland M.B | 2018 | Journal of Product Innovation Management | 36 | 2 | 62 | 119 |

Source: Author
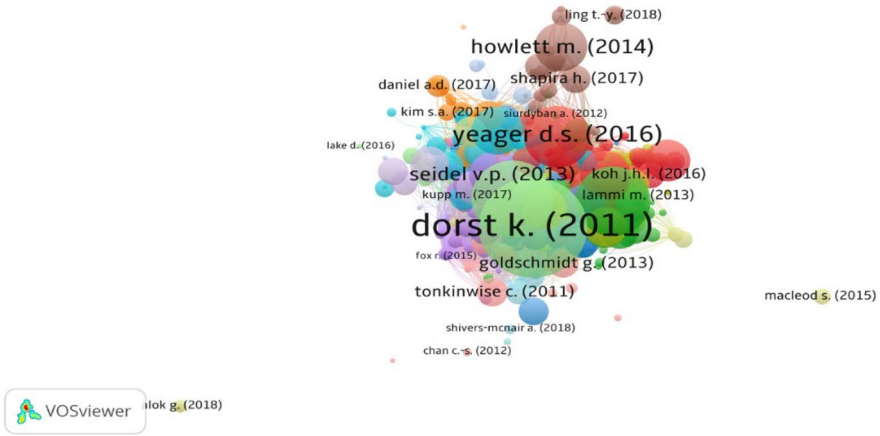
**Fig. 3** Bibliometric cluster analysis. Note: Image generated by VOSviewer, different colors shows different clusters

two articles have a high proportion of similar in keywords, description, and citation (Weinberg, 1974). Through bibliometric coupling analysis, a similar relationship between the articles has been established.

Figure 3 represents the clusters identified by the VOSviewer through bibliometric coupling based on the co-occurrence matrix.

In the above clusters, different colors represent different cluster and the size of the circle represent the number of citation an article received (Fig. 4).

## Analysis of Cluster Formed

To understand the different clusters in this subject, a bibliometric coupling analysis is performed in VOSviewer. To know the different themes of each cluster, the top 10 global cited articles are analyzed (in the case of cluster 15, it is 8, and in the case of
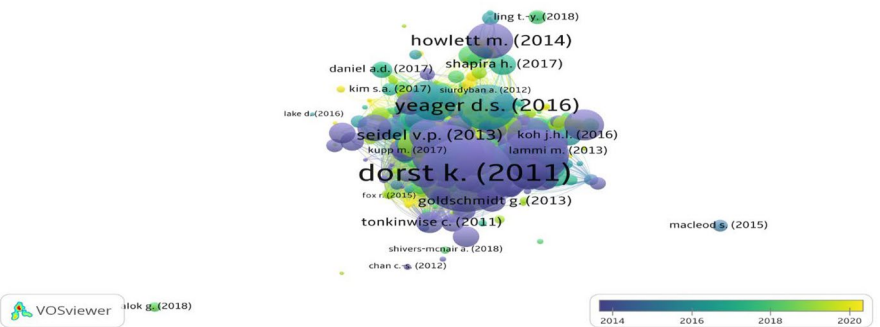


**Fig. 4** Bibliometric analysis based on year basis. Note: This analysis is done by the author with the help of VOSviewer software

**Table 11** Cluster with articles and author details

| Cluster 1 authors | Cluster 2 authors | Cluster 3 authors | Cluster 4 authors | Cluster 5 authors |
|---|---|---|---|---|
| Carroll et al. (2010) | Bekker et al. (2015) | Andreassen et al. (2016) | Adams (2011) | Mahmoud-Jouini et al. (2016) |
| Henriksen et al. (2017) | D'ippolito (2014) | Burdick and Willis (2011) | Biddulph (2011) | Beverland et al. (2015) |
| Kali et al. (2011) | Dong et al. (2015) | Dalsgaard (2014) | Byrne et al. (2017) | Chen and Venkatesh (2013) |
| Koh et al. (2015) | Dong et al. (2016) | Kevern (2011) | De vere et al. (2010) | Gaim and Wahlin (2016) |
| Koh et al. (2016) | English and King (2015) | Kuo et al. (2019) | Khan et al. (2013) | Na et al. (2017) |
| Leavy (2012) | Kelley (2015) | Marques and Borba (2017) | Kimbell (2012) | Parris and McInnis-Bowers (2017) |
| Mentzer et al. (2015) | Oxman (2017) | Mathews (2010) | Leinonen (2014) | Pusca and Northwood (2018) |
| Micheli et al. (2012) | Paton and Dorst. (2011) | Selin et al. (2015) | McLaughlin et al. (2019) | Retna (2016) |
| Tsai et al. (2012) | Razzouk and Shute (2012) | Smith et al. (2015) | Norros (2014) | Seidel and Fixson (2013) |
| Yeager et al. (2016) | Singh and Gu (2012) | Wrigley and Straker (2017) | Stevenson (2019) | Welsh and Dehler (2013) |
| **Cluster 6 authors** | **Cluster 7 authors** | **Cluster 8 authors** | **Cluster 9 authors** | **Cluster 10 authors** |
| Baumann et al. (2019) | Badwan et al. (2018) | Chindarkar et al. (2017) | Banerjee and Mukhopadhyay (2016) | Cairns et al. (2019) |
| Bicen and Johnson (2015) | Daniel (2016) | Clarke and Craft (2019) | Bas and Guillo (2015) | Clune and Lockrey (2014) |
| Geissdoerfer et al. (2016) | Daniel et al. (2017) | Howlett (2014) | Cousins (2018) | Goldschmidt and Rodgers (2013) |
| Glen et al. (2015) | Huq and Gilbert (2017) | Ling and Chiang (2018) | Foster and Yaoyuneyong. (2016) | Mintrom and Luetjens (2016) |
| Hobday et al. (2012) | Kim et al. (2017) | McGann et al. (2018) | Janzer and Weinstein (2014) | Portugali and Stolk (2014) |
| Kozlowski et al. (2018) | Linton and Klinton (2019) | Nair and Howlett (2016) | Jung and Chang (2017) | Ranger and Mantzavinou (2018) |
| Lam and Shulha (2015) | Lynch et al. (2021) | Pluchinotta et al. (2019) | Lancione et al. (2015) | Self and Baek (2017) |
| Roth et al. (2015) | Niccum et al. (2017) | Royston (2013) | Leonard et al. (2016) | Tonkinwise (2011) |
| Sinan Erzurumlu and Erzurumlu (2015) | Nielsen and Stovang (2015) | Shapira et al. (2017) | Patel and Mehta (2017) | Tonkinwise (2014) |
| Van de grift et al. (2016) | | Sorice and Donlan (2015) | Ramos et al. (2016) | Whiting (2017) |
| **Cluster 11 authors** | **Cluster 12 authors** | **Cluster 13 authors** | **Cluster 14 authors** | **Cluster 15 authors** |
| Chupin (2011) | Carlgren et al. (2016) | Alok et al. (2018) | Carlgren et al. (2016) | Boyer (2020) |
| Connell and Tenkasi (2015) | Coco et al. (2020) | Alok et al. (2020) | Dell'Era et al. (2020) | Greenwood et al. (2019) |

**Table 11** (continued)

| Cluster 1 authors | Cluster 2 authors | Cluster 3 authors | Cluster 4 authors | Cluster 5 authors |
|---|---|---|---|---|
| Dorst (2011) | Ellmers G. (2017) | Haupt (2015) | Joachim et al. (2020) | Leverenz (2014) |
| Elsbach and Stigliani (2018) | Lee et al. (2019) | Jeon (2019) | Leavy (2010) | Pope-Ruark (2019) |
| Goodspeed et al. (2016) | Liang et al. (2016) | Kavousi et al. (2020) | Liedtka (2011) | Purdy (2014) |
| Johansson-Skoldberg et al. (2013) | Lichtenthaler et al. (2020) | Lee (2011) | Liedtka (2014) | Roy and Brine (2013) |
| McLaughlan and Lodge (2019) | Muluneh et al. (2018) | Liang et al. (2017) | Micheli et al. (2018) | Sheehan et al. (2018) |
| Pasmore et al. (2019) | Pabel and Pearce (2018) | Lin and Cheng (2015) | Ratten and Jones (2020) | Shivers-McNair et al. (2018) |
| Shani and Coghlan (2018) | Rodney (2020) | Macleod et al. (2015) | Taylor (2014) | |
| Verganti et al. (2020) | Woocher (2012) | Mclaren et al. (2012) | Tkaczyk (2014) | |
| **Cluster 16 authors** | | | | |
| Lee (2019) | | | | |
| Sleiman et al. (2019) | | | | |

Source: Author

cluster 16, it is 2). As it is accepted the top 10 articles in a cluster can describe the theme where the author follows the theme of highly cited articles (Fahimnia et al., 2015). Table 11 shows the top 10 cited authors with the year of article publication details in each cluster.

In this study out of 1000 articles, 668 articles have a minimum of one citation and 285 articles do not have any citation. Out of 668 cited articles, 594 are connected with nodes and form 16 clusters with different themes and subthemes (Table 12). So, in this above analysis, approximately 89% of the connected articles are covered. The remaining 74 articles have also been studied thoroughly, and they are scattered in multiple viewpoints. As a result of the above study of article coverage, it can be stated that all of the key design thinking views have been covered.

To get an overview of each cluster mentioned above. The topmost global cited article of each cluster with author details, journal details, year of publication, and keywords are given in Table 13.

Out of these 16 clusters, design studies are only one journal that has a presence in 6 clusters.

### Dynamic Co-citation Analysis

Table 14 gives an idea regarding the year-wise publication trends in each cluster starting from 2010. From the table, it can be seen that clusters 1, 2, 3, 4, 6, and 14 received publication since 2010. Clusters 5, 9, and 12 started getting articles in 2012. Clusters 7, 10, 11, and 13 have developed since 2011. Cluster 8 and cluster 15 started getting publication in 2013. Cluster 16 started in the year 2019. The reason behind the cluster16 development may be as academicians are giving more importance to outcome-based learning with industry connect.

### Content Analysis

Content analysis is commonly used to better comprehend each cluster's insights. Here, articles with more than 25 citations have been selected for this analysis. A similar condition was applied by Hota et al. (2020) to ensure the high quality of an article. Articles that are published in the years 2019, 2020, and 2021 (total 461) were analyzed separately. The reason to bifurcate the article in this analysis based on the above criteria are:

1. The article generally takes time to get a citation and recently published articles may not have received that time.
2. Recent articles are helpful to understand the recent research trends in this area..

The name of each cluster has been identified based on the theme of the cluster. Cluster 1 articles all are related to the application of design thinking focuses in education, so the name given to cluster 1 is focused on education. Cluster 2 is

**Table 12** Theme and subthemes of each cluster

| Cluster | Theme | Subthemes | Numbers of articles |
|---|---|---|---|
| 1 | School education | Medical, engineering, high school, architectural, language, teacher's education | 82 |
| 2 | Design framework | STEM, theories, model, and framework | 79 |
| 3 | Digital learning | Value innovation through IT, sustainability learning | 78 |
| 4 | Interdisciplinary area | Urban design, ergonomics, wearable technology | 66 |
| 5 | Product and project innovation | Reflexive practice, brand ambidexterity, intrapreneurs | 61 |
| 6 | Sustainable business model | Sustainable mining, radical innovation, redesign canvas, performance landscapes | 58 |
| 7 | Innovation and entrepreneurship | Entrepreneurship education, entrepreneurial skills, open innovation | 38 |
| 8 | Policy development | Collaborative governance, policymaking, public decision making, capacity challenges, public sector design | 28 |
| 9 | Global challenges | VUCA environment, social and cultural perspective, cross-disciplinary | 26 |
| 10 | Design process | Process, opportunities, challenges, critical issues, design studies, games | 19 |
| 11 | The core of design thinking application | IT, business, education, and medicines | 14 |
| 12 | Creativity and framework | Tourism, entertainment industry, lean startup, graphic design, crowdfunded, change management | 13 |
| 13 | Focus on service industry | Health care service, model of service experience, modeling in service and service design | 12 |
| 14 | Strategy and leadership | Strategy development, value innovation, crafting strategy | 10 |
| 15 | Professional and technical communication | Writing studies, teaching writing, teaching case, professional communication, teaching, and learning | 8 |
| 16 | Outcome-based learning | Empowering students and industry connections | 2 |

Source: Author

**Table 13** Top most global cited journal details in each cluster based on global citations

| Cluster | Authors | Title | Year | Journal name | Journal volume | Journal issue | Citation number | Author keywords |
|---|---|---|---|---|---|---|---|---|
| 1 | Yeager D.S., Hulleman C.S., Hinojosa C., Lee H.Y., O'Brien J., Romero C., Paunesku D., Schneider B., Flint K., Roberts A., Trott J., Greene D., Walton G.M., Dweck C.S | Using design thinking to improve psycho-logical interventions: The case of the growth mindset during the transition to high school | 2016 | Journal of Educational Psychology | 108 | 3 | 201 | Adolescence; Growth mindset; Incremental theory of intelligence; Motivation; Psycho-logical intervention |
| 2 | Razzouk R., Shute V | What Is Design Thinking and Why Is It Important? | 2012 | Review of Educational Research | 82 | 3 | 256 | Design process; design thinking; expert and novice; expertise |
| 3 | Smith R.C., Iversen O.S., Hjorth M | Design thinking for digital fabrication in education | 2015 | International Journal of Child-Computer Interaction | 5 | - | 78 | Design thinking; Digital fabrication; Education; Participatory design |
| 4 | Kimbell L | Rethinking design thinking: Part II | 2012 | Design and Culture | 4 | 2 | 92 | Design thinking; Design-ers; Innovation; Organi-zation design; Practices |
| 5 | Seidel V.P., Fixson S.K | Adopting design think-ing in novice multi-disciplinary teams: The application and limits of design methods and reflexive practices | 2013 | Journal of Product Innovation Manage-ment | 30 | SUPPL 1 | 118 | (NA) in the article |
| 6 | Geissdoerfer M., Bocken N.M.P., Hultink E.J | Design thinking to enhance the sustaina-ble business modeling process? A workshop based on a value map-ping process | 2016 | Journal of Cleaner Production | 135 | - | 121 | Business model inno-vation; Corporate sustainability; Design thinking; Failed value exchanges; Value crea-tion; Value ideation |

**Table 13** (continued)

| Cluster | Authors | Title | Year | Journal name | Journal volume | Journal issue | Citation number | Author keywords |
|---|---|---|---|---|---|---|---|---|
| 7 | Roach D.C., Ryman J.A., Makani J | Effectuation, innovation, and performance in SMEs: an empirical study | 2016 | European Journal of Innovation Management | 19 | 2 | 47 | Affordable loss; Design thinking; Effectuation; Firm performance; Innovation; Networks |
| 8 | Howlett M | From the 'old' to the 'new' policy design: Design thinking beyond markets and collaborative governance | 2014 | Policy Sciences | 47 | 3 | 127 | Policy advice; Policy design; Policy formulation; Policy instruments; Policy tools; Public policy |
| 9 | Lancione M., Clegg S.R | The lightness of management learning | 2015 | Management Learning | 46 | 3 | 19 | Business Schools; change; critical management education; design thinking; knowledge integration; universities |
| 10 | Tonkinwise C | A taste for practices: Unrepressing style in design thinking | 2011 | Design Studies | 32 | 6 | 46 | aesthetics; design activity; styling; taste; user behavior |
| 11 | Dorst K | The core of 'design thinking and its application | 2011 | Design Studies | 32 | 6 | 533 | design practice; framing; problem-solving; reasoning |
| 12 | Carlgren L., Rauth I., Elmquist M | Framing Design Thinking: The Concept in Idea and Enactment | 2016 | Creativity and Innovation Management | 25 | 1 | 86 | (NA) in the article |
| 13 | Lee S | Evaluating serviceability of healthcare servicescapes: A service design perspective | 2011 | International Journal of Design | 5 | 2 | 49 | Healthcare design; Service design; Serviceability; Servicescape |

**Table 13** (continued)

| Cluster | Authors | Title | Year | Journal name | Journal volume | Journal issue | Citation number | Author keywords |
|---|---|---|---|---|---|---|---|---|
| 14 | Leavy B | Design thinking? a new mental model of value innovation | 2010 | Strategy & Leadership | 38 | 3 | 68 | Corporate strategy; Design and development; Innovation; Knowledge management |
| 15 | Purdy J.P | What can design thinking offer writing studies? | 2014 | College Composition and Communication | 65 | 4 | 31 | (NA) in the article |
| 16 | Sleiman T., Chung-Shin Y., Haddad R.A | Empowering Students in Leading their Education and Practice: The Design Workbook | 2019 | International Journal of Art and Design Education | 38 | 2 | 1 | Design; design thinking; education; interface; practice; workbook |

Source: Author

**Table 14** Year-wise publications of each cluster

Published articles in each cluster

| Year | Cluster 1 | Cluster 2 | Cluster 3 | Cluster 4 | Cluster 5 | Cluster 6 | Cluster 7 | Cluster 8 | Cluster 9 | Cluster 10 | Cluster 11 | Cluster 12 | Cluster 13 | Cluster 14 | Cluster 15 | Cluster 16 | Grand total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2010 | 2 | 1 | 4 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 10 |
| 2011 | 4 | 2 | 2 | 2 | 0 | 0 | 2 | 0 | 0 | 1 | 3 | 0 | 1 | 1 | 0 | 0 | 18 |
| 2012 | 4 | 4 | 2 | 2 | 2 | 1 | 0 | 0 | 2 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 20 |
| 2013 | 4 | 4 | 4 | 3 | 6 | 1 | 1 | 1 | 1 | 2 | 1 | 0 | 0 | 0 | 1 | 0 | 29 |
| 2014 | 3 | 4 | 8 | 4 | 4 | 1 | 0 | 1 | 1 | 3 | 0 | 0 | 0 | 3 | 2 | 0 | 34 |
| 2015 | 7 | 8 | 10 | 3 | 8 | 8 | 1 | 2 | 4 | 0 | 1 | 0 | 3 | 0 | 0 | 0 | 55 |
| 2016 | 4 | 12 | 6 | 5 | 5 | 5 | 2 | 2 | 6 | 1 | 2 | 2 | 0 | 1 | 0 | 0 | 53 |
| 2017 | 10 | 8 | 7 | 3 | 10 | 7 | 5 | 6 | 2 | 3 | 0 | 1 | 2 | 0 | 0 | 0 | 64 |
| 2018 | 12 | 11 | 8 | 12 | 10 | 8 | 10 | 3 | 5 | 2 | 2 | 3 | 2 | 0 | 2 | 0 | 90 |
| 2019 | 19 | 17 | 18 | 17 | 11 | 9 | 9 | 4 | 3 | 3 | 2 | 2 | 1 | 1 | 2 | 2 | 120 |
| 2020 | 13 | 7 | 9 | 14 | 5 | 15 | 7 | 8 | 2 | 3 | 3 | 4 | 2 | 3 | 1 | 0 | 96 |
| 2021 | 0 | 1 | 0 | 0 | 0 | 2 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 |
| Grand total | 82 | 79 | 78 | 66 | 61 | 58 | 38 | 28 | 26 | 19 | 14 | 13 | 12 | 10 | 8 | 2 | 594 |

Source: Author

related to the design framework theme; similarly, a different cluster has a different name based on a certain theme.

## Cluster 1—Focused on School Education

Cluster 1 is represented by 82 articles and is the largest cluster in this subject. This cluster has started getting an article from 2010, and there was a continuous article publication till 2020. This cluster has a maximum number of article publications in the year 2019. The subthemes of this cluster are related to a different school of education like medical, engineering, high school, architectural, language, media, and teacher education.

The first article on this cluster on "Using design thinking to improve psychological interventions: The case of the growth mindset during the transition to high school" (Yeager et al., 2016)**,** in the Journal of Educational Psychology, developed a model based on design thinking to improve and scale interventions for education problems. To teach a growth mindset effectively, a guideline has been discussed here.

Mentzer et al. (2015) published research in the Journal of Engineering Education in 2015 titled "Engineering design thinking: high school students' performance and knowledge." This article compares and contrasts high school engineering students' and engineers' design processes. This research also looked at how high school freshmen compared to their peers.

In this study, fifty-nine high school students from four different states were asked to think aloud in a practice session. The result concluded that students take less time in comparison to the expert to the process of information, whereas freshmen generally took less time for the idea generation (Mentzer et al., 2015).

In a similar study in a Journal of Adolescent and Adult Literacy on a research topic of Gamified vocabulary: online resources and enriched language learning, the author finds out that use of adapting online resources helped to support differentiated learning with the help of design thinking in the eleventh standard students' group (Abrams & Walsh, 2014).

A study on "Design thinking: A creative approach to educational problems of practice" which is published in Thinking Skills and Creativity Journal stated that the problem faced by an educator today is complex which rarely solved through a simple or linear solution. Design thinking can be used to solve the problem creatively (Henriksen et al., 2017).

Above are some examples of the subtheme that focuses on high school education, engineering education, media education, and teachers' education.

## Cluster 2: Focused on a Design Framework

Cluster 2 is represented by 79 articles and is the second largest cluster in this area. This cluster has started getting an article from 2010 and continues the article publication till 2021. This cluster has a maximum number of article publications in the

year 2019. The subthemes of this cluster are related to different subthemes related to process, characteristic, techniques used, and model.

Design creativity strategies foster diverse thinking, according to a study published in the Design Studies Journal, and there is a need for an integrated generative design framework to support human designers' design exploration (Singh & Gu, 2012).

The ability to identify problem goals and include constraints are the monitoring factors for generations of ideas, according to a study published in the European Journal of Engineering Education (English et al., Engineering design processes in seventh-grade classrooms: Bridging the engineering education gap, 2012).

Design-based learning (DBL) is an effective learning approach that helps students absorb and process theoretical knowledge, according to a study published in the International Journal of Engineering Education in 2013 (Gemez et al., 2013).

According to a study published in Technovation stated that design has altered individual perceptions of new products, firm understanding, and strategy formulation, and design thinking can assist in improving an organization's value creation process (Beatrice, 2014).

English and King (2015), in their research report on "Fourth-graders learning STEM through engineering design" in the International Journal of STEM Education, stated that students can be engaged in the design and redesign process by using STEM discipline knowledge, but there must be a proper balance between the two.

According to a study published in the International Journal of Child-Computer Interaction, the Reflective Design-based Learning (RDBL) framework helps students to achieve the teaching–learning aim (Bekker et al., 2015).

A research article titled "The effect of abductive reasoning on concept selection decisions" published in the design study journal in 2015 stated that innovative abduction should be used by decision-makers to come up with fresh ways to frame suggested concepts and to investigate new operating principles (Dong et al., The effect of abductive reasoning on concept selection decisions, 2015).

In a research on "Thinking difference: Theories and models of parametric design thinking," which was published in Design Studies in 2017. It is argued that parametric schema plays a pivotal role in parametric design thinking as a strategic medium (Rivka, 2017).

Above are some studies related to process, characteristics, techniques, and models related to design thinking.

## Cluster 3: Focused on Digital Learning

Cluster 3 is based on digital learning. This cluster has 78 articles from 2010 to 2020-time frame. Some of the subtheme of this area are value creation and sustainability learning, mobile-based media learning, ecologically sustainable design, case study, digital scholarship, sustainability through education, intellectual development, pragmatist concept, etc.

A study in the English Teaching Journal on the topic "Using a studio-based pedagogy to engage students in the design of mobile-based media" finds out how an augmented reality simulation explores embedded design practice aligned with a sociocultural view of literacy (Mathews, 2010).

An article on "Digital learning, digital scholarship and design thinking" in Design Studies Journal traces that how the rise of digital culture has led to a reconsideration of the learning model. This study also stated that design thinking is a suitable learning option in this digital era. An article on "Green building and sustainable infrastructure: Sustainability education for civil engineers" which is published in the Journal of Professional Issues in Engineering Education and Practice, talked about sustainable design where green building rating system concepts were used in sustainable building and infrastructure design. This article also talked about sustainability through education (Kevern, 2011).

Selin et al. (2015) talked about how scenario planning and design thinking can be combined for a better future as it creates a new window for opportunities. Similarly in an article on "Linking service design to value creation and service research" also talked about the SERVQUEL model and updated version of service profit chain with service design (Andreassen et al., 2016).

## Cluster 4: Interdisciplinary Area

This cluster has 66 articles which are from different disciplinary areas like application of design thinking for professional development (Adams, 2011), product development engineering (Vere et al., 2010), application of design thinking in urban design policy (Biddulph, 2011), anthropology and design thinking (Kimbell, 2012), sustainable practice (Khan et al., 2013), human factors/ergonomics (HFE) and design thinking (Norros, 2014), design thinking and collaborative learning (Leinonen, 2014), Internet of things (IoT) and Wearable Technology (Byrne et al., 2017), design thinking framework in health professions education (McLaughlin et al., 2019), and maker spaces pedagogical capabilities (Stevenson et al., 2019).

So, it is observed that articles of cluster 4 are from different perspectives and focus on interdisciplinary areas.

## Cluster 5: Product and Project Innovation

There are 61 articles in cluster 5 focus on product innovation and related areas. A brief discussion has been provided in this section of the articles that are reflected in this cluster. *Adopting design thinking in novice multidisciplinary teams: The application and limits of design methods and reflexive practice*s (Seidel & Fixson, 2013) and *Reconciling the tension between consistency and relevance: design thinking as a mechanism for brand ambidexterity* (Beverland et al., 2015) are few of them. The articles featured in this cluster are related to product and project innovation.

## Cluster 6: Business Model Development

Cluster 6 has 58 articles that have been published from 2010 to 2021. These articles are related to design thinking and business model development. In this cluster, the article explored the impact of different technologies, capabilities, and different business model innovation, sustainable business development, gamification, second-generation model of innovation, model development in the field of education, business model in a highly turbulent environment, sustainable fashion development, advanced technologies with fuzzy logic, entrepreneurial business models and community-based experiential learning, climate change, new shopping experience model, design thinking and new product development, quality function deployment (QFD) methodology, library and information science, and social sciences.

All the mentioned articles are related to business model innovation and have strong relations among them in this cluster.

## Cluster 7: Innovation and Entrepreneurship

Cluster 7 has 38 articles with the theme of entrepreneurship and innovation.

A study on "effectuation, innovation, and performance in SMEs: an empirical study" in "European Journal of Innovation Management," talked about the firm performance to innovate however many things yet to explore with the innovation model (Roach et al., 2016).

Some of the other article like "All the world's a stage: transforming entrepreneurship education through design thinking" is about entrepreneurship pedagogy development by utilizing design thinking to enhance student satisfaction and ensure learning outcomes (Huq & Gilbert, 2017). Another one is "DesUni: university entrepreneurship education through design thinking" where value creation through design thinking in business education concepts have been discussed (Nielsen & Stovang, 2015). Some of the similar articles in this cluster are Tourism Education: What about entrepreneurial skills? (Daniel et al., 2017) etc.

All the abovementioned articles are related to the entrepreneurship and innovation process to improve value creation and cluster together.

## Cluster 8: Policy Development

Cluster 8 contains 28 articles related to policy development. Some of the sub-theme in these areas are collaborative governance, strategic sustainable development, public decision-making process, policy trap, social policy design, public sector design, urban planning, and empower community development.

All of the articles are related to policy development so the name of the cluster is given policy development.

### Cluster 9: Global Challenges

Cluster 9 deals with the solutions to the global challenges of 26 articles. Some of the subthemes in this area are the VUCA environment, neocolonialism, real-world challenges, global supply chain, social innovation, the immigrant community, cultural aspect, etc. An article on design thinking and VUCA environments (Cousins, 2018), which is published in the Academy of Strategic Management Journal stated that VUCA is a characteristic of the digital economy. To tackle this situation design thinking is gaining popularity as it helps the organization for fast learning. An article on "Social design and neocolonialism," published in Design and Culture Journal discussed the importance of sociocultural and why should a designer be sensitive to it (Janzer & Weinstein, 2014). Business management students around the globe face various challenges as they deal with multidisciplinary groups. They can be well prepared by various designed thinking methods like flipped classrooms and client-based projects to handle real-life challenges (Foster & Yaoyuneyong, 2016).

All these articles are dealing with the global challenges in this cluster so the name of the cluster is given global challenges.

### Cluster 10: Design Process

Cluster 10 have 19 articles that explore the different design process and some of the subtheme in this cluster are process, opportunities, challenges, critical issues, what is design studies, games, etc. Some of the articles in this cluster are *A taste for practices: Un-repressing style in design thinking* (Tonkinwise, 2011), *The design thinking approaches of three different groups of designers based on self-reports* (Goldschmidt & Rodgers, 2013), and *Design thinking in policymaking processes: opportunities and challenges* (Mintrom & Luetjens, 2016). All the mentioned articles are related to the design process and have created a cluster.

### Cluster 11: Core of Design Thinking

Cluster 11 has only 14 articles related to the core of design thinking. Some of the subtheme are the review and research, ecosystem, organization change, and operation practices.

This cluster of the articles are based on the core of design thinking, and some of the articles in this cluster are *The core of "design thinking and its application"* (Dorst, 2011) and *"Design thinking and organizational culture: a review and framework for future research"* (Elsbach & Stigliani, 2018), etc.

### Cluster 12: Creativity and Framework

There are only 13 articles in this cluster and getting attention since 2012. This cluster is mainly focused on different framework development and newly applied creative work in association with design thinking. Some of the subtheme in this cluster are the application of IoT, AI (artificial intelligence) and different frameworks

related to tourism engagement, prosumers, ARPU (average revenue per unit) framework to understand the fan's value and importance of social media platform for the entertainment industry, framework related to the emerging business problem in the software industry, etc.

## Cluster 13: Focus on Service Industry

Cluster 13 mainly focuses on the service industry. Some of the subthemes of this area are related to education, medical science, neuroscience, museum design, cognitive model, service experience design, engineering education, and exhibition management. The healthcare industry is now more patient-centric, and competition in this is growing very fast. To offer the most suitable solution, organizations are focusing on design thinking and service design (Lee, 2011).

In a study on "Visual attention and association: An electroencephalography study in expert designers" which is published in "Design Studies" journal in 2017 on 12 healthy designer experts about the experiences on visual attention confirm that the front parietal portion region was partially activated during the engagement of visual effect (Liang et al., 2017). This is a new kind of study which connects design thinking to neuroscience.

With the help of design thinking, the Palo Alto Art Center was able to give the solution to the challenges faced by the royal family. In this study, they focus on prototyping, testing, gathering user feedback, processes to resolve the issue. Design thinking is an approach that is more human-centric to resolve the problem (Larson, 2017). This cluster has only 12 articles related to the service industry. Articles in this area are getting attention since 2011.

## Cluster 14: Strategy and Leadership

Cluster 14 is based on strategy and leadership. Some of the subthemes of this cluster are strategy development, value innovation, and crafting strategy. This cluster has started getting an article from 2010, but per year article output is very less as in the last 11 years, there are only 10 articles in this cluster. An article on "Design thinking: a new mental model of value innovation (Leavy, Design thinking: a new mental model of value innovation, 2010)" stated that design thinking can be a key capability to create value innovation in an organization. In a similar study, it has been observed that design thinking with the set of tools and empathy to the customer helps in value innovation for the organization (Liedtka, 2011).

All the articles in this cluster are related to strategy and leadership so the name given for this cluster is appropriate.

## Cluster 15: Professional and Technical Communication

Cluster 15 is based on professional and technical communication. Some of the subthemes of these areas are writing studies, teaching writing, teaching cases, professional communication, teaching, and learning, etc. In this cluster, there are only 8

articles with a similar theme of professional and technical communication. All the abovementioned articles are strongly correlated and formed cluster 15.

### Cluster 16: Outcome-Based Learning

Cluster 16 is based on outcome-based learning and has only two articles. This theme has developed from 2018. The first article in this cluster is "Empowering students in leading their education and practice: the design workbook (Sleiman et al., 2019)"; to meet the challenges for the future, a design thinking workbook can be very helpful as it empowers the students by removing the designer block. This article also suggested using a designer workbook as a separate course to meet the future demand of society.

The second article in this cluster is "Revitalizing traditional street markets in rural Korea: design thinking and sense-making methodology (Lee, 2019)"; this article talked about the double diamond model which helps the student to think creatively. This study also stated that there will be more effective learning when there is more emphasis on pedagogy-based learning and design-based integrated education.

## Discussion, Findings, and Research Directions for the Future

In this research SLR and bibliometric analysis helps to identify the (1) progression of research in a particular research area, (2) the diversification of the clusters, (3) the theme of the clusters, and (4) current research trends. All the answers to the research questions are fulfilled by SLR and bibliometric analysis. Out of 668 cited articles 594 are connected with nodes and form 16 clusters with different themes and subthemes. The remaining 74 articles are scattered in different clusters. The article has more than 25 citations that have been selected for the content analysis. Articles published recently in 2019, 2020, and 2021 were again selected for content analysis to know the recent research trends and research gaps.

### Key Findings

The findings may be summarized as follows: trends in the publication by year in this subject are quite encouraging, as the publication of the articles in this subject is increasing year after year. In 2010, there were 18; in 2011, it was 20, but in 2012, it was 30. The sudden jump in this year, possibly because of the Cambridge International conference on design thinking in 2011, this international conference can be linked behind the attention to this subject.

Brown (2008) is the highest contribution author in this field with a global citation of 5542 for the article on "Design Thinking" which has been published in Harvard Business Review in the year 2008. Buchanan (1992) is the second highest contribution author in this field with 4286 global citations. This work was published in the Design Issue Journal, and Dym et al. (2005) with 2938 global citations became the third most contributing author in this field.

During 2010–2021, Dorst (2011) is the most contributing author with a global citation of 533 with an article title of "The core of design thinking and its application," which has been published in Design Studies Journal in 2011. Johansson-Skoldberg et al. (2013) is the second most cited author with a citation of 311 with an article title on "Design thinking: past, present and possible future," published in Creativity and Innovation Management in 2013.

In co-citation analysis, Dorst (2011) remains the topmost cited author based on local citation of 620, Johansson-Skoldberg et al. (2013) holds the second position with 311 citations, and Tsai & Chai (2012) holds the third position with 291 local citations.

During this time (2010 to 2021), Liedtka is the topmost author with a publication of four articles, and Dorst, Leavy, Bierwolf, Benson & Dresdow, Choi & Kim, Clouse are the second authors, and Howlett, Tonkinwise, and Buchanan are the 3rd authors in a Design Thinking subject. Design studies are the topmost journal with the highest publications of 28 articles with 1174 global citations. Sustainability (Switzerland) is the second and International Journal of Design Education is the 3rd journal in this area with 23 and 21 article publications, respectively.

In this area, 16 clusters have been identified by VOSViewer applying bibliometric coupling.

Cluster 1 primarily focuses on the use of design thinking in a variety of school settings, including medical, engineering, high school, architectural, language, and teacher education. Cluster 2 focuses on the design framework. Some of the subthemes in this cluster are STEM, theories, models, and frameworks. Cluster 3 is based on digital learning; some of the subthemes in this area are value creation and sustainability learning. Cluster 4 is based on interdisciplinary learning; some of the research articles have given focuses on urban design, ergonomic, IoT, wearable technology, health profession, architectural education, professional learning, etc. Cluster 5 is based on product innovation and problem-solving. Some of the subthemes in this area are reflexive practice, brand ambidexterity, and intrapreneurs. Cluster 6 articles are mainly focused on the sustainable business model and some of the subthemes of this cluster are sustainable mining, radical innovation, redesign canvas, performance landscapes, etc.

The articles of cluster 7 mainly focus on innovation and entrepreneurship. Some of the subthemes in this cluster are entrepreneurship education, entrepreneurial skills, innovation, entrepreneurship programs in medical education, and open innovation. The theme of cluster 8 is policy development, some of the subtheme of these areas are collaborative governance, policymaking, public decision making, capacity challenges, public sector design, etc.

The cluster of 9 mainly focuses on the global arena. Some of the subthemes of this cluster are the VUCA environment, social and cultural perspective, and cross-disciplinary. Cluster 10 has articles that explore the different design processes and some of the subthemes in these areas are process, opportunities, challenges, critical issues, what is design studies, games, etc.

Cluster 11 emphasizes the basics of design thinking areas. Some of the subthemes of these areas are related to IT, business, education, and medicines. Cluster 12 focuses on creativity and framework in different filed; some of the subthemes

in these areas are tourism, media and entertainment industry, lean startup, graphic design, technology and the IoT, crowdfunded, and change management. All the articles in cluster 13 are focused on the service industry; some of the subthemes are like healthcare service, model of service experience, modeling in service, service design, etc. Cluster 14 mainly focus on strategy and leadership area. Some of the subtheme of this cluster are strategy development, value innovation, crafting strategy, etc. Cluster 15 is based on professional and technical communication with the subtheme of writing studies, teaching writing, teaching cases, professional communication, teaching, and learning, etc. Cluster 16 mainly focuses on outcome-based learning with the subtheme of empowering students and industry connections.

There are just 74 papers with more than 25 worldwide citations, indicating that this topic is understudied and does not receive enough attention from authors throughout the world.

## Research Directions for the Future

To understand the future research directions, content analysis of recent articles (published in 2019, 2020, and 2021) and content analysis of the selected articles which were featured in 16 clusters have been done. The analysis of future research directions is given below.

### Entrepreneurship Education-Related Research Gap

Since the first entrepreneurship course at Harvard University in 1947, many programs have been executed all over the world. Nonetheless, there is still much argument about the scope, goals, and techniques that are most effective in developing an entrepreneurial attitude (Daniel, 2016).

Medical institutions are increasingly focusing on teaching students how to solve complicated problems and build solutions. Due to ongoing developments in healthcare, the landscape of medical school entrepreneurship and innovation programs is fast developing to address novel abilities required by physicians. Design thinking could help in this connection (Niccum et al., 2017).

Design thinking may be used in a variety of initiatives in medical education, ranging from technological intervention projects to curriculum creation, lifelong learning skills, and teamwork (Badwan et al., 2018).

Tourism is another sector where the concept of design thinking can be applied. Nowadays, many tourism courses have grown significantly. In this industry, students have to acquire enhanced non-cognitive skills which are most valued by the tourism industry (Daniel et al., 2017). By searching the whole article database of 1000, it is been observed that there are only two more articles related to the tourism industry, one is related to city tour and the next one is "Selecting senses of humor in tourism settings—A guide for tourism operators (Pabel & Pearce, 2018)." Entrepreneurship education talked about the practical approaches and students can go outside of the classroom to learn the perspective. Here design thinking can be a valuable tool to teach entrepreneurship (Linton & Klinton, 2019).

From the above discussion, it is clear that there is a need for entrepreneurship education research as the number of articles in this is very less.

## Less-Explored Areas of Service Design

Addressing an overall experience problem with user-centered design thinking is a crucial topic in service experience design. An integrated model is required to explore and prioritize service design actions based on data obtained from service sites (Lin & Cheng, 2015).

Library service is an area that is unexplored by many authors (Luca & Ulyannikova, 2020). Lean Six Sigma has been extensively used globally in the service sector. There is only one article related to the Six Sigma application in mobile hospital underpinning design thinking. This is a unique area, where academia and industry collaboration is required to solve the organizational problem (Sunder et al., 2020).

For a long time, service researchers have been investigating the application of technology to services, yet little emphasis has been devoted to the use of technology at the front end of service innovation and design (Bantau & Rayburn, 2016).

In 2016, a paper in the Journal of Service Management titled "Linking service design to value creation and service research" attempted to look at service design in the context of well-known services marketing models like SERVQUAL and an updated version of the Service-profit-chain (Andreassen et al., 2016).

An article which is published in Design Studied journal in 2017, established a relationship between design thinking and neuroscience for better-applied research this area needs to explore more (Liang et al., 2017).

Oil and natural gas, agriculture, electronic manufacturing companies, fresh food supply chains, airlines, banks, and app-based businesses are some of the less-explored industries in which design thinking study is needed.

## Less-Explored Area of Value Co-creation

Co-creation is a situation when two or more parties works together to produce a mutually valuable outcome; it has different advantage to the organization like improved return on investment, enriched customer insight, intellectual resources, orientation with a mission statement, and improved quality of service, improve differentiation, etc.

Service industry and solution selling both increase value through co-creation. However, the concept of co-creation is a macro concept which still required much attention (Luotola et al., 2017).

In recent years, there has been an increasing emphasis on the business value of design thinking. The emphasis has switched to business education as well (Nielsen & Stovang, 2015).

In today's competitive business world, there is tremendous pressure to remain to be competitive. To get the advantage, there are many open business model innovations (OBMIs) focused on the customer, business model co-creation, virtual collaboration, and design thinking. Literature analysis shows that the field of OBMI is still an under-researched area (Brasseur et al., 2017).

Some of the articles are throwing light on whether with the help of design thinking can we tackle the international market challenges like economic development or other socio-cultural challenges (Fleischmann, 2017). Co-creation is a vast area with different perspectives but how to explore this area with the help of design thinking is required more attention for future research.

## More In-depth Research Is Required in New Product Development

Practicing managers and researcher have developed many approaches to help the product development team to come up with new products from their organization. The key concern for all the approaches is how it translates the need and want of the customers. Design thinking has emerged as a customer-centric approach to solving customer problems (Meinel et al., 2020).

Yet research has not addressed the implications for NPD (new product development) nor investigated how BMI (business model innovation) affects NPD capabilities (Beltagui, 2018).

New product development is a vast area starting from market survey to product launch and this area needs to explore more.

## More Underexplored Areas of Design Knowledge

This area of research talks about how we can implement design thinking into a digital learning platform. This underexplored area of research tries to find out with the changes of digital education culture there is a need for reconsideration of existing education models (Burdick & Willis, 2011).

To get a persistent influence on education, technological innovation desires to be accomplished (Kali et al., 2011). As the global industries are changing along with technological development, there is a need for a change of the existing education model if we want to place our students into the industry as an employee (Wrigley & Straker, 2017).

There are only 8 research articles in this area but the challenges are more in this area starting from students to teachers and how to test the knowledge of the students' in the digital platform. The researcher has to think of a proper model where the student and teacher will have a win–win situation for greater knowledge development.

**TCCM Framework** Apart from the content analysis of recent articles published in 2019 to 2021 to identify the future research areas, a TCCM (theories, contexts, characteristics, and methodology) framework has been used to decide the future research agenda in theories, context, characteristics, and methodology this subject.

The same approach has been used by many authors in their research papers related to cause-related marketing (Singh & Dhir, 2019), alliance termination research (Rajan et al., 2020), cultural and international business research (Srivastava et al., 2020) and organization Ambidexterity research (Chakma et al., 2021).

TCCM analysis helps the researcher to identify the gaps in the previous studies and give guidance for future studies (Rajan et al., 2020).

## Theory Development

Earlier researcher in this field has developed many theories and framework related to design thinking, like theory contemporary design theory, theory of the third ecology, critical thinking and system theories, sustainable design theory, decision theory, critical theory, DBL framework, evaluation theory, learning by doing, design cognition theory, reflective design-based learning framework (RDBL framework), and structurationist theory.

Although there is a significant development in the areas of theory development, there is insufficiency in terms of the development and application of various theories related to design thinking.

For instance, present literature has a limited application of design thinking in the Strategy and leadership area, more precisely how design thinking will help organizations to ensure the process perspective, customer perspective, and financial perspective. How design thinking will be an explosive engine for the growth of an organization (Simona et al., 2011). Therefore, future research needs new theoretical lenses to explore and explain the uncovered areas of design thinking as a whole (Table 15).

## Context

The evolution of design thinking research has advanced the knowledge with various theories applied, cluster formation, methodology, and so on. The context of design thinking research literature is diverse and scattered that only a few integrative conclusions could be drawn.

In the past, design thinking was looked at in the context of School learning (David & Martin, 2006; Carroll et al., 2010) design framework (Bekker et al., 2015), (Dong et al., The effect of abductive reasoning on concept selection decisions, 2015), digital learning (Burdick & Willis, 2011), product and project innovation (Beltagui, 2018), and sustainability business model (Leerberg et al., 2010). In recently design thinking is more focused on the service industry (Aseres & Sira, 2020), strategy and leadership (Robbins, 2018; Liedtka, Learning to use design thinking tools for successful innovation, 2011), (Liedtka, Innovative ways companies are using design thinking, 2014) preferential and technical communication (Boyer, 2020; Greenwood et al., 2019; Sheehan et al., 2018; Shivers-McNair et al., 2018), and outcome-based learning (Lee, 2019; Sleiman et al., 2019) at various level of analysis, which is highlighted in Table 16.

## Characteristics

Over the past many years, various authors tried to unlock the various antecedents or enablers for design thinking. Though the prior studies can identify the various antecedents for the design thinking like strategic leadership, critique, technology understanding, place, imagination, personal sensitivities, emotional need,

**Table 15** Theory and framework

| Theory and framework | Description | Author(s) |
|---|---|---|
| Contemporary design theory | This theory focuses on meeting the need of the present without compromising the ability of future generations to meet their own needs | Zuo et al. (2010) |
| Theory of the third ecology | Chermayeff and Tzonis's (1973) theories that human potential and creation of knowledge can be optimized via improved social concourse and intercourse. In this theory, they noted that sociological and ecological change moves faster than biological and psychological changes | Bay (2010) |
| Critical thinking and system theories | An ability to explore the problem after integrating the all information to derive a decision. System thinking theories focus on a whole is more than the sum of the parts and every part affects the whole system's behavior | Wang and Wang (2011) |
| Sustainable design theory | It is an extensive body of knowledge that emphasizes how societal and environmental issues can be addressed by rethinking the industrial products, processes broadly towards the sustainable economic system | Kevern (2011), Khan et al. (2013)., |
| Decision theory | Decision theory studies the logic and the mathematical properties of decision-making under uncertainty. Statistical decision theory focuses on the investigation of decision-making when uncertainty can be reduced by information acquired through experimentation | Birkeland (2012), Carlgren et al. (2016) |
| Critical theory | A critical theory perspective allows for elicitation of responses for which the participants have tacit awareness and serves as an exploratory vehicle in understanding initial patterns of design thinking and critique | Gray (2013) |
| DBL (framework) | The design-based learning (DBL) framework, which includes project characteristics, design elements, teacher's role, assessment, and social context, was based on an extensive literature review that suggests ideas for improving the professional development of DBL teachers to redesign their projects | Puente et al. (2013) |
| Evaluation theory | Evaluative thought is the mode of thought through which expectations, experientially determined values, and feelings mark progress toward a goal. In a theory of design thinking, evaluative thought is the mode of thought through which expectations, experientially determined values, and feelings mark progress toward a goal | Frisk et al. (2014) |

**Table 15** (continued)

| Theory and framework | Description | Author(s) |
|---|---|---|
| Learning by doing | It is a hands-on approach to learning, learner must interact with their environment to adapt and learn. Design Thinking is a mindset and approach to learning, collaboration, and problem-solving. In practice, the design process is a structured framework for identifying challenges, gathering information, generating potential solutions, refining ideas, and testing solutions | Nazidizaji et al. (2015) |
| Design cognition theory | Cognition is the study of all forms of human intelligence, including vision, perception, memory, action, language, and reasoning. Expanding the knowledge about human cognitive processes is necessary for understanding the nature of the mind, and consequently the nature of design thinking | Haupt (2015) |
| Reflective design-based learning framework (RDBL framework) | Reflective Design-based Learning (RDBL) framework, which extends the existing Design-based Learning (DBL) model presented by Gomez et al. by adding a specific Reflective learning component (The 'R' in RDBL) and more attention to the digital properties of the learning environment | Bekker et al. (2015) |
| Structurationist theory | Structuration theory, developed by Giddens seeks to reconceptualize the dualism of individuals and society as the duality of agency and structure. Central to structuration theory is the notion of human agency, the capability of people to engage in purposive actions with both intended and unintended consequences | Stephens et al. (2015) |

Source: Compiled by author

**Table 16** Context details

| Contexts | Authors |
|---|---|
| Organization level | Zuo et al. (2010), Chen and Venkatesh (2013), Frisk et al. (2014), Carlgren et al. (2016) |
| City level | Bay (2010) |
| Business unit level | Simons et al. (2011) |
| Association level | Wang and Wang (2011) |
| Course level | Kevern (2011), Khalaf et al. (2013) |
| Urban planning | Chupin (2011), Caliskan (2012), Birkeland (2012) |
| Country level | Hobday et al. (2012), McLaren (2012), Wells (2013); Thorpe and Gamman (2013), Blizzard et al. (2015) |
| School level | Tan and Wong (2012), Bekker et al. (2015) |
| University level | Gray (2013), Bower et al. (2013), Ulibarri et al. (2014) |
| Project level | Puente et al. (2013) |
| Class level | Leverenz (2014) |
| College level | Benson and Dresdow (2014) |
| Institution level | Behm et al. (2014), Nazidizaji et al. ( 2015) |
| Industry level | Kembaren et al. (2014) |
| Individual level | Pink (2014) |
| Venture capitalist | Muratovski (2015) |
| Societal level | Sorice and Donlan (2015) |
| Design Environment | Haupt (2015) |
| Gamification level | Roth et al. (2015) |
| Multi-level | Lancione and Clegg (2015b) |
| Product level | Go et al. (2015) |

Source: Author

intelligence quotient (IQ), and aesthetic knowledge. However, existing literature is inconsistent in terms of empirical evidence, as some of the researchers believe that creativity in design thinking is not purely person-specific, it arises when someone interacts with some experienced individual, it is a cultural process. It

**Table 17** Characteristics details

| Author details | Article DOI | Characteristics | Document type |
|---|---|---|---|
| Simons et al. (2011) | 10.1057/jcb.2011.25 | Strategic leadership | Review |
| Gray (2013) | 10.1386/adch.12.2.195_1 | Critique | Article |
| Wells (2013) | 10.1007/s10798-012–9207-7 | Technology understanding, imagination and personal sensitivities | Article |
| Ulibarri et al. (2014) | 10.28945/2062 | Emotional need | Article |
| Nazidizaji et al. (2015) | 10.1016/j.foar.2015.08.002 | Intelligence quotient | Article |
| Stephens and Boland (2015) | 10.1177/1056492614564677 | Aesthetic knowledge | Article |

Source: Author

required an atmosphere where risk-taking and experimentation are encouraged (Wells, 2013). Therefore, it is being expected more studies to unveil other enablers that may have a significant impact on design thinking (Table 17).

## Methods

To date, in the research of design thinking, many analytical methods have been used, like case study methods (Bay, 2010) (Simons et al., 2011), exploratory factor analysis (Blizzard et al., 2015), co-relation (Nazidizaji et al., 2015), literature review (Johansson-Skoldberg et al., 2013), case study with two-tailed t-test (Goodspeed et al., 2016), hypothesis testing (Wang & Wang, 2011), in-depth interview (Venkatesh et al., 2012), interview (Chen & Venkatesh, 2013), interview and observation (Gray, 2013), meta-analysis (Khan et al., 2013), observation in a workshop (Ulibarri et al., 2014), and ANOVA (Puente et al., 2013).

It could be seen that there is a gap in addressing mixed methodologies for analyzing determinants and outcomes of design thinking. Also, multiple case study methods would be impactful to develop the conceptual frameworks. Further, future researchers may give more attention to implementing more analytical approaches, hybrid review methods, and econometric tools for enhancing the methodological rigor in design thinking (Table 18).

**Table 18** Method details

| Methods | Authors |
| --- | --- |
| Case study | Simons et al. (2011), Liedtka (2011), Kevern (2011), McLaren (2012), Bay (2010), Thorpe and Gamman (2013), Janzer and Weinstein (2014), Muratovski (2015), Lancione and Clegg (2015b), Van De Grift and Kroeze (2016), Lynch et al. (2021) |
| Hypothesis testing | Wang and Wang (2011) |
| In-depth interview | Venkatesh et al. (2012), Gray (2013), Carlgren et al. (2016) |
| Conceptual | Hobday et al. (2012), Birkeland (2012) |
| Interview | Chen and Venkatesh (2013), Frisk et al. (2014) |
| Meta-analysis method | Khan et al. (2013) |
| ANOVA | Puente et al. (2013) |
| Observation and workshop | Ulibarri et al. (2014) |
| Co-relation analysis | Behm et al. (2014), Nazidizaji et al. (2015) |
| Digital visual sensory | Pink (2014) |
| Exploratory factor analysis and regression analysis | Blizzard et al. (2015) |
| Case study (with two-tailed t-test) | Goodspeed et al. (2016) |
| Systematic literature review | Johansson-Skoldberg et al. (2013), Micheli et al. (2018) |

Source: Author

### Theoretical Application

Knowledge understanding about the clusters in this article will help the researcher to understand the ongoing researches in this field and content analysis of the recent article provides five research directions for future research.

### Managerial Application

The manager of an organization can gain knowledge about the present research and future research direction in this field. Managers can early adopt the future research and would get a competitive advantage in the marketplace.

## Limitation and Conclusions

This research aimed to understand the knowledge structure and research trends of design thinking through the integration of systematic, bibliometric, and content analysis with the TCCM framework for advancing the research domain. The current knowledge on design thinking has been systematized by identifying and reviewing the various parameters based on identified research objectives.

With the help of the abovementioned research methods, a comprehensive review of trends in design thinking like most productive countries, authors, journals, different clusters with theme and subtheme, year-wise cluster development trends, and promising opportunities for future research has been discussed here. The USA is ranked as the topmost productive country based on the number of article publications, followed by Australia and the UK. Though countries like China, Singapore, and Finland contributed to the literature, it is expected to have more research output in design thinking from emerging countries like India, because of the application of outcome-based learning in new education policy implications.

Like other research articles, this research article also has some limitations. In this research process, VOSviewer and Excel spreadsheet have been extensively used to generate different descriptive and bibliometric analysis. The keywords which have been used in the research article is not comprehensive, different words may bring some different result which leads to different cluster formation. Working with some other software with different algorithms and frameworks may provide some different results.

During the extract of the research articles details from the Scopus database, some of the articles of 2021 are not available because of the time limitation of the data extraction process. There are only 43 articles in the year 2021, as during extraction of data (on 22.03.2021), the academic year yet to complete its cycle. Some of the researchers can extract the full-year data from the Scopus database and add more value to recent research trends.

Within the umbrella of design thinking management, VOSViewer has identified 16 clusters in the "Bibliometric Analysis" section. The fifth section discusses design

thinking's future research direction. As a result, this research study has offered all conceivable solutions to the established questions, as stated in the research rationale section.

Moreover, the researcher can take any further research direction with suitable research objectives to explore the design thinking. Managers can take note of unexplored areas of design thinking in their upcoming projects application as well as the new ideas got from this research work can help them to provide a solution to a complicated design question of the organization.

This article also encourages the academician and scholars to add their contribution to the design thinking framework for theory-building activities by identifying the research gaps in terms of theories or context, characteristics, and methodologies to explore and uncover the area of design thinking research.

## Declarations

**Conflict of Interest** The authors declare no competing interests.

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