

Unlocking the Power of Creative Thinking: A bibliometric analysis of the 21st Century

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Abstract

This study presents a bibliometric analysis of the creative thinking publication from the Scopus database from 2011-2021. This study reports the results using standard bibliometric indicators: (1) the current state of publication of creative thinking, (2) topic areas in creative thinking, (3) keyword analysis, (4) most productive authors, and (5) geographical contribution of publication. The researchers used VOSviewer, a programme for building and displaying bibliometric networks, which they obtained via the Scopus database and Harzing's Publish-or-Perish analysis to carry out this study. The results provide insightful information on the current level of creative thinking, including existing trends and changes.

Keywords: Creative Thinking; Creativity; Higher education; 21st Century

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1.0 Introduction

Over the past few decades, creativity has emerged as one of the most heated debates since it is now comprehended as one of the 21st century's most essential skills. There is a continuing discussion regarding how creativity and creative thinking should be defined. As the importance of creativity grows, education will play a crucial role in fostering awareness of creative thinking (Huang et al., 2019). As creativity becomes a crucial skill to master, exploring creative thinking can result in positive change.

Creativity has become an increasingly important topic of discussion as the key to efficient learning in higher education and beyond (Jahnke, Haertel, & Wildt, 2015; Nissim, Weissblueth, Scott Webber, & Amar, 2016; Rampersad & Patel, 2014). As the interest in creativity has grown exponentially, creative thinking was defined as a new way of life and work for the future (Huang et al., 2019 & Smith & Smith, 2010). Creativity is becoming more crucial in a world that is becoming more complex, which can foster creativity (Davies et al., 2013 & Well & Claxton, 2002). Furthermore, we will face Super Smart Society 5.0 and creative thinking skills to prepare students to ensure long-term employability (Fairuz et al., 2022). In the 21st century, one of the 4C skills that learners must possess is thinking creatively. This crucial requirement for creative thinking has been the subject of extensive research. A total of 276 documents have been retrieved and examined as of (October 28, 2022).

This bibliometric analysis provides an overview of trends in creativity research based on the publication trend in the Scopus database from 2011 to 2021. It intends to fill the gap in the literature. This study reveals how creative thinking is currently evolving as a crucial skill for the 21st century, the subject area used in creative thinking, significant contributions to creative thinking research, and the most influential document in the literature on creative thinking. Creativity has been examined in numerous fields of study. The review uses search strategies for the bibliometric database and data analysis techniques and then discusses the result.

The structure of this paper is as described below. The second section describes the methodology employed, while the third section discusses the results of the bibliometric analysis. The findings are discussed in Section 4, while the conclusions are presented in Section 5.

2.0 Literature Review

2.1 Defining creativity

Creativity itself is something subjective. The verb "to create" originally meant "to make,". "According to Torrance 1988, it is exceedingly difficult to precisely define creativity due to the fact that the characteristics of creativity are not limited in any way. Creativity is defined as the generation of novel and valuable ideas and products (Kaufman & Sternberg, 2019). Creativity can also be defined as the

generation of ideas into two distinct components, namely ideas originally received and ideas arising from the appropriateness of the situation (Amabile, 1983). In turn, according to (Amabile, 1983), the involvement of individuals in the creative process equals or improves in influencing actual creative thinking.

Creative thinking is a quality that must be possessed because a person can make decisions and solve problems by thinking creatively. Therefore, creativity can be concluded as a thought process that encourages the realisation of new ideas that are more meaningful. However, (Edward de Bono, 2002) defines creative thinking as "being different" that is by showing differences to be creative. To synthesise different views from the definition of creative thinking and creativity, this study will use the definition of the ability to generate new ideas and concepts and the ability to think differently in academia.

2.2 Creativity and 21st century

In recent years, there has been a growing perception that creativity and creative thinking should be encouraged as valuable outcomes of higher education and identified as so-called 21st-century skills (Partnership for 21st Century Learning, 2015). According to (Muhajir et al., 2019) based on the results of literature studies, 21st century skills are a very important skill humans possess. Technological advancements in the teaching and learning processes also require students to acquire various skills and knowledge. Whether prepared or not, students must have a backup plan for mastering the skills necessary to stay on the job when changes occur. In order to learn effectively in the 21st century, students need to be able to think creatively. This is consistent with (Roekel, 2017), who lists some of the 4K skills that the 21st century requires, namely communication, collaboration, critical thinking, and creative skills that will be able to facilitate an increasingly complex life for those who are willing and competitive to be on the career path when the aforementioned changes occur. Besides, the education system is open to all kinds of societal changes (Yılmaz, 2021). However, more research is required to understand how creative thinking develops in higher education institutes.

2.3 The Aims and Scope of Study

Through bibliometric analysis, this study examines prior literature on creative thinking. A deeper understanding of the literature on creative thinking is the concern of this study. The main research questions that are addressed in this study are:

RQ1: What is the current state of publication of creative thinking?

RQ2: What are the topic areas covered in creative thinking research?

RQ3: What is the keyword analysis in creative thinking?

RQ4: Who are the most productive authors of creative thinking?

RQ5: Which countries provide the most significant creative thinking publication?

This study aims to fill this gap by providing an overall picture of the current state and development of creative thinking, the topic area, the most productive contributors, the current collaboration pattern, and the most influential document in creative thinking literature.

3.0 Methodology

This section describes the method for retrieving articles on creative thinking by employing a bibliometric strategy to map the academic literature on the subject using data from Scopus. The reviewer operated the PRISMA technique from the Scopus database. Figure 1 depicts the verification process's identification, screening, eligibility, and data extraction and analysis phases. Using bibliometric analysis, this article aims to examine the trend of research on the productivity of creative thinking as an essential key for the 21st century and covers bibliometric indicators and network visualisation.

3.1 Bibliometric analysis

(Ahmi & Mohammad, 2019) state that the bibliometric analysis method is becoming increasingly popular as a research method today in order to reveal the patterns that have been observed in previous studies. This technique can assess the quantity and quality of the material that has been published in order to identify patterns or trends in a particular field of research (Sweileh et al., 2017). In addition, the bibliometric analysis provides a synopsis of the bibliographic and intellectual structures by investigating the social and structural relationships between the various research components, such as authors, nations, institutions, and topics (Donthu et al., 2021). In addition to that, it was reported by (Van Eck & Waltman, 2021) that this indicator could analyse co-authorship, co-citation, and bibliographic coupling. Bibliometric studies can accurately describe the characteristics, level of knowledge, and current trends in a particular field of study. This method has been widely applied in performance evaluation across various fields (Wang et al., 2018; Ekundayo & Okoh, 2018).

Bibliometric analysis study becomes a valuable way to understand the state of research on creative thinking topics and identify trends and gaps in the literature. Therefore, the purpose of this study was to comprehend creativity. Based on the research content analysed, we aimed to derive trends relevant to future research by identifying keywords related to creativity that has been vigorously explored in research. To achieve this, the bibliometric study employed the five procedures outlined. (1) define the objective and scope of the study; (2) choose the techniques for the bibliometric approach; (3) collect the data for the bibliometric analysis; (4) conduct the bibliometric analysis, which includes

performance analysis and scholarly mapping; and (5) demonstrate the findings and discuss their implications for future research.

3.2 Data Source

This study is based on a bibliometric analysis technique that employs quantitative and statistical methods to determine patterns of article distribution in specific issues and periods (Mart Parreo et al., 2016). This article has been identified as one of the largest and oldest indexing databases within the Scopus database (<http://scopus.com>) (Ramrez-Montoya et al., 2022). Furthermore, according to Sweileh et al. (2017), Scopus provides bibliometric indicators directly and straightforwardly. Elsevier owns Scopus, and all of the journals in this database are of high quality. Scopus is a prominent academic database. This massive database aims to provide a complete picture of global creative thinking research using the specified keywords; 477 documents were examined.

3.3 Screening year

(TITLE (*creative AND thinking* OR *creativity*)) AND ((higher AND education)) AND (21st AND century) AND (LIMIT-TO (PUBYEAR , 2022) OR LIMIT-TO (PUBYEAR , 2021) OR LIMIT-TO (PUBYEAR , 2020) OR LIMIT-TO (PUBYEAR , 2019) OR LIMIT-TO (PUBYEAR , 2018) OR LIMIT-TO (PUBYEAR , 2017) OR LIMIT-TO (PUBYEAR , 2016) OR LIMIT-TO (PUBYEAR , 2015) OR LIMIT-TO (PUBYEAR , 2014) OR LIMIT-TO (PUBYEAR , 2013) OR LIMIT-TO (PUBYEAR , 2011)) .

3.4 Creation of the dataset

The first step in the research process is to identify the keyword "creative thinking" OR "creativity" in the Scopus database using the article's title. The search query for creative thinking was applied to the title in the Scopus database (on October 28 2022) with the search query TITLE (*creative AND thinking* OR *creativity*), which resulted in the production of 3269 documents of the creative thinking literature to be analysed. This bibliometric study determined that a total of 276 documents published between 2011 and 2021 were ready for review in its analysis after conducting a screening search within the article title (TITLE (*creative AND thinking* OR *creativity*)) and ((higher AND education)) and (21st AND century). Since the search query was only used to search within the document's title, none of the documents was removed because all of the documents obtained were about creative thinking. In light of this, each of the 276 documents was considered for inclusion in the bibliometric study. The flow of the search strategy utilised in this investigation is shown in Figure 1.

3.5 Data Analysis

This research uses the analysis function of the Scopus database and tools such as Microsoft Excel to perform calculations such as the frequency of published documents and to generate relevant charts and graphs. Publish or Perish for publication performance and impact based on selected metrics, and VOSViewer for mapping and visualising bibliometric

networks. VOSViewer is open-source software (www.vosviewer.com) for creating and visualising network-based bibliometric maps based on network data (Waltman, Van Eck, & Noyns, 2010).

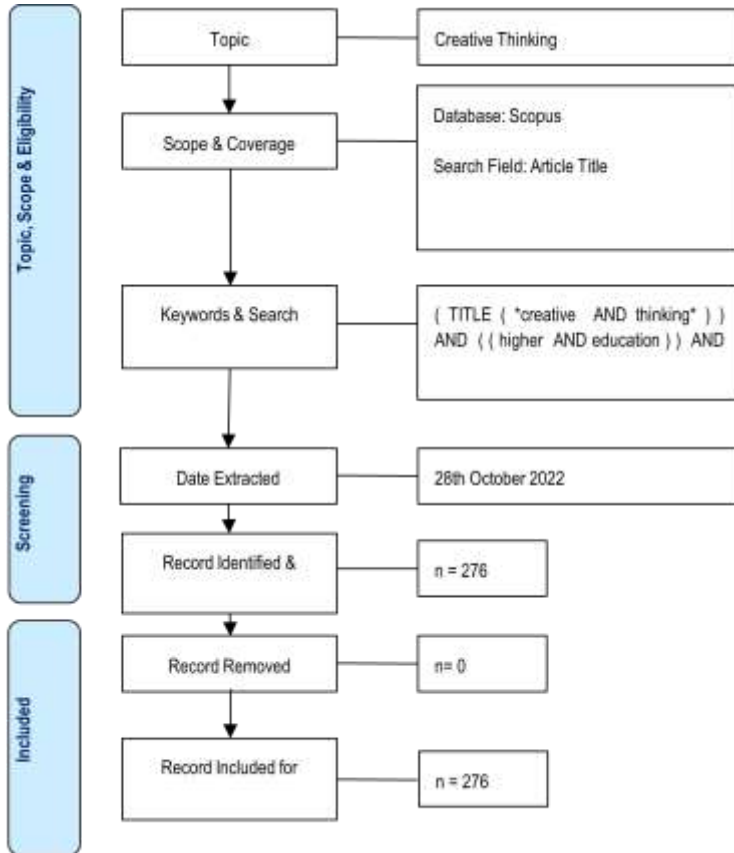


Figure 1: Process Flow for the Search Strategy

(Source: Zakaria, R., Ahmi, A., Ahmad, A. H., & Othman, Z. (2020) *Worldwide Melatonin Research: A Bibliometric Analysis of the Published Literature between 2015 and 2019*, *Chronobiology International*.)

4.0 Results

In accordance with the research questions from the study, the results were discussed in this section.

4.1: Development of creative thinking and Its Distribution (RQ1)

This research examines the following data in order to provide an answer to the RQ1 about the current state of creative thinking: (a) publications by year; (b) the source and type of document; and (c) the source title.

(a) Publication by Year

The statistic depicted in Figure 2 demonstrates the annual growth of creative research publications from 2011 through 2022. Between 2016 and 2022, there was a steadily growing increase in the number of documents relating to creative thinking. This reflects the increasing interest, relevance, and importance of creative thinking as an essential key for the future.

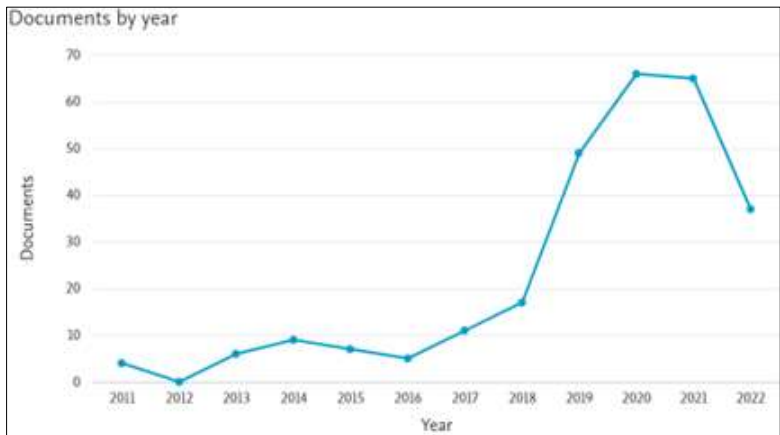


Figure 2: Shows studies on the development of creative thinking from 2011 to 2022.

Table 1: Publication Year

Year	Total Publication (TP)	Percentage %
2022	37	13.41%
2021	65	23.55%
2020	66	23.91%
2019	49	17.75%
2018	17	6.16%
2017	11	3.99%
2016	5	1.81%
2015	7	2.54%
2014	9	3.26%
2013	6	2.17%

2011	4	1.45%
Total	276	100

Note: TP=total publications; %=percentage

(b) The Source and Types of Documents

This research aims to determine the pinpoint where research papers on creative thinking are published. Table 1 demonstrates that journals, with 158 papers (57.25%), followed by 93 conference proceedings (33.70%), books (15; 5.43%) and book series (10; 3.62 %).

Table 2: Source Type of Creative Thinking

Source Type	Total Publication (TP)	Percentage %
Journal	158	57.25%
Conference Proceeding	93	33.70%
Book	15	5.43%
Book Series	10	3.62%
Total	276	100

Note: TP=total publications; %=percentage

In addition, this research's findings are organised according to the document type. Table 3 shows that 151 articles and 103 conference papers make up the majority of the 276 creative thinking items in research publications. 15 (5.43%) of the total number of documents are book chapters, followed by 5 (1.81%) of reviews and 1 (0.36%) of editorials or retracted articles.

Table 3: Document Published Literature in Creative Thinking

Document Type	Total Publication (TP)	Percentage %
Article	151	54.71%
Conference Paper	103	37.32%
Book Chapter	15	5.43%
Review	5	1.81%
Editorial	1	0.36%
Retracted	1	0.36%
Total	276	100

Note: TP=total publications; %=percentage

(c) Most Productive Source Titles

The most popular source titles for creative thinking are listed in Table 4. Thinking Skills and Creativity, Aip Conference Proceedings, and International Journal Of Instruction are listed in order two. Most publications were contributed by the Journal of Physics Conference Series, which provided 54 (19.57%) documents.

Table 4: Top 10 Most Active Source Titles for Creative Thinking

Source Title	Total Publication (TP)	Percentage %
Journal Of Physics Conference Series	54	19.57%
Thinking Skills And Creativity	20	7.25%
Aip Conference Proceedings	12	4.35%
International Journal Of Instruction	10	3.62%
European Journal Of Educational Research	7	2.54%
Lecture Notes In Computer Science Including Subseries Lecture Notes In Artificial Intelligence And Lecture Notes In Bioinformatics	7	2.54%
International Journal Of Interactive Mobile Technologies	4	1.45%
International Journal Of Scientific And Technology Research	3	1.09%
Journal Of Baltic Science Education	3	1.09%
TEM Journal	3	1.09%

Note: TP=total publications; %=percentage

4.2: Topic Areas (RQ2)

This result analyses the various creative thinking subject fields with study referring to a) subject categories. In addition, this conclusion answers the RQ2 questions on the literature on creative thinking.

a. Subject Areas

This study categorises papers into their respective fields of study according to the subject matter area in which they were published. The results are presented in Table 5. According to the findings, research on creative thinking can now be found in various academic fields of study. Most research on creative thinking is published in the journal's categories in the fields of social science, with 158 papers reporting for 57.25% of the total; physics and astronomy, with 65 (23.55%); and computer science, with 48 (17.39%). The findings also show that a study on creative thinking has been published in a journal under various subjects, including Engineering, Psychology, Arts and Humanities, Business, Management and Accounting, Mathematics, and many more.

Table 5: Top 10 Subject Areas on Creative Thinking

Subject Area	Total Publication (TP)	Percentage %
Social Sciences	158	57.25%
Physics and Astronomy	65	23.55%
Computer Science	48	17.39%
Engineering	24	8.70%
Psychology	22	7.97%
Arts and Humanities	19	6.88%
Business, Management, and Accounting	16	5.80%
Mathematics	14	5.07%
Environmental Science	8	2.90%
Decision Sciences	4	1.45%

Note: TP=total publications; %=percentage

4.3: Keyword Analysis (RQ3)

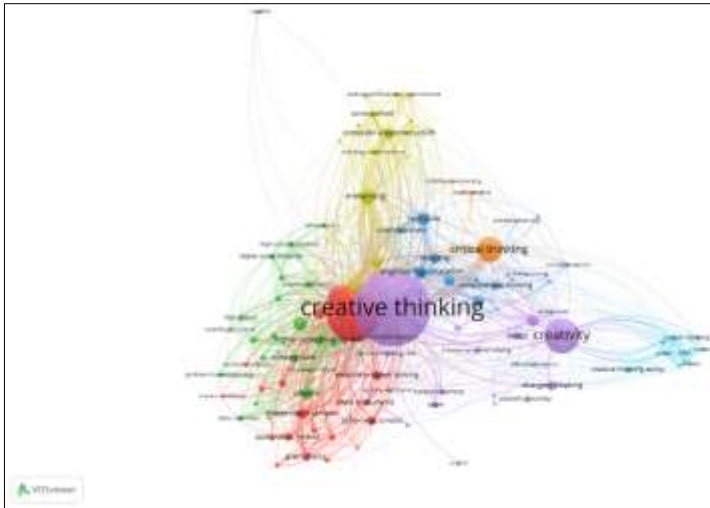


Figure 3: Network visualisation map of at least three-occurrence author keywords.

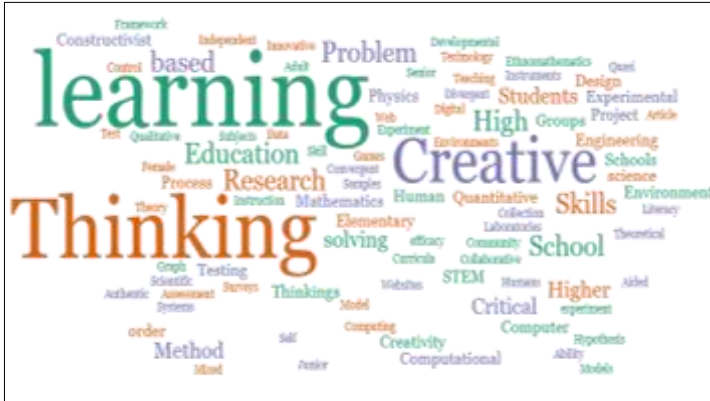


Figure 4: Word cloud of the keywords

Figure 3 depicts the author's keyword network, with each keyword occurring at least three times occurrence. This study constructs and visualises a bibliometric network using VOS viewer software to address the a) author's keywords to answer the RQ3. The connecting line's thickness, colour, circle size, and text size indicate relationships with other phrases. For example, similar-coloured words are frequently used together. Figure 3 shows that "creative thinking" is the term most frequently associated with both creativity and critical

thinking. The author's keyword network visualisation map generated 114 items with 8 clusters, 1222 links, and 2399 link strengths.

In this research, 92 varied author keywords were identified. Table 6 lists the top ten keywords utilised in the creative thinking literature. With 127 publications and a 46.01% share, "creative thinking" is the top keyword.

Table 6: Top 10 Keywords

Keywords	Total Publication (TP)	Percentage %
Creative Thinking	127	46.01%
Students	77	27.90%
Creativity	45	16.30%
Critical Thinking	31	11.23%
Education Computing	26	9.42%
Learning Systems	20	7.25%
E-learning	17	6.16%
Creative Thinking Skills	14	5.07%
Curricula	14	5.07%
Engineering Education	13	4.71%

Note: TP=total publications; %=percentage

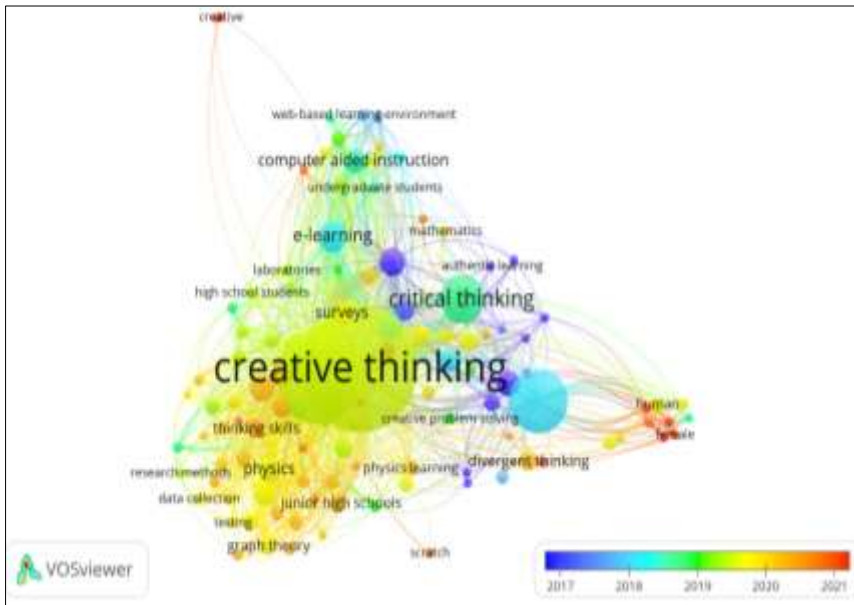


Figure 5: Overlay Visualisation Map of Author Keywords with at Least Three Occurrences.

Between 2017 and 2021, the development of creative thinking research go through five stages, as shown in Figure 5. Five colours, dark blue, light blue, green, orange, and red,

represent each stage of evolution. Each hue represents an evolved keyword for creative thinking. In 2017, the research term was symbolised by the colour dark blue.

In 2018, the colour for creative thought changed from dark blue to light blue. Keywords like "e-learning," "creative problem-solving," and "divergent thinking" are often used by researchers. The third keyword for the evolution of creative thinking is now green. The keywords such as "critical thinking," "problem-based learning," and "laboratories" were found in 2019.

Keywords such as "creative process," "creative thinking ability," "physics," "independent samples," "quantitative approach," and "human" suggest that they are often used when the colour of the keyword changes from green to yellow in 2020.

In 2021, convergent thinking, human experimentation, collaborative learning, learning environment models, and qualitative approaches were discussed as keywords. The use of creative and convergent thinking is common and related to the creative thinking research topic that will be conducted in the coming years.

4.4 Most Productive Contributors in Creative Thinking Studies (RQ4)

To address RQ4 on the top contributors in creative thinking studies, we analyse the productive (a) authors and (b) institutions that produce the most articles on creative thinking up until 2022.

a. Most Productive Author

According to Table 7, Indonesian researchers have dominated the production of creative thinking literature, with 118 publications.

Table 7: Top 10 Most Productive Authors

Author Name	Total Publication (TP)	Percentage %
Samat, C.	7	2.54%
Zubaidah, S.	7	2.54%
Hobri	6	2.17%
Malik, A.	6	2.17%
Sajidan	6	2.17%
Dafik	5	1.81%
Chaijaroen, S.	4	1.45%
Corebima, A.D.	4	1.45%
Perdana, R.	4	1.45%
Rudyanto, H.E.	4	1.45%

Note: TP=total publications; %=percentage

b. Most Influential Institutions

Table 8 shows that most institutions contributed the most creative thinking research documents. With 126 publications from 276 documents, Indonesian universities dominate the top 10.

Table 8: Top 10 Most Influential Institutions

Institution	Total Publication (TP)	Percentage %
Universitas Negeri Malang	18	6.52%
Universitas Sebelas Maret	15	5.43%
Universitas Jember	14	5.07%
Universitas Negeri Yogyakarta	14	5.07%
Universitas Pendidikan Indonesia	13	4.71%
Khon Kaen University	9	3.26%
Universitas Negeri Surabaya	6	2.17%
Universidade de Aveiro	4	1.45%
National Taiwan University of Science and Technology	4	1.45%
Universitas Lampung	4	1.45%

Note: TP=total publications; %=percentage

4.5 Geographical Distribution of Publications (RQ5)

Table 9 lists the top publication countries to answer RQ5. Indonesia contributes the most documents (126, 45.65%). The second-largest was the United States, with 26 (9.42%) and Thailand, with 16 (5.80%). China 13 (4.71%), Turkey 11 (3.99%), Taiwan and UK 10 (3.62%). The rest publish under ten publications.

Table 9: Top Countries contributed to the publications

Country	Total Publication (TP)	Percentage %
Indonesia	126	45.65%
United States	26	9.42%
Thailand	16	5.80%
China	13	4.71%
Turkey	11	3.99%
Taiwan	10	3.62%
United Kingdom	10	3.62%
Malaysia	9	3.26%
Australia	7	2.54%
Canada	6	2.17%

Note: TP=total publications; %=percentage

5.0 Discussion

In accordance with the findings of this study, this paper employs bibliometric analysis to examine the trend of research on creative thinking. This study focuses on the publications on creative thinking extracted from the Scopus database. As creativity is touted as an essential skill for the twenty-first century, bibliometric analysis reveals that the publication trend is a good indicator of the development of the field.

6.0 Conclusion

This study focused exclusively on the Scopus databases as the primary source of documents, as Scopus has become the most comprehensive database indexing scholarly

works (Sweileh et al., 2017; Ahmi & Mohamad, 2019). Overall, no search query is 100% effective at capturing all scholarly work in this field, and inconsistent results are to be anticipated.

The review suggests that, for future research, additional databases such as Web of Science, Google Scholar, and Dimensions be incorporated. In addition, future research must determine whether creativity will enhance students' employability, and students must comprehend the impact of creativity competencies skills for the 21st century.

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Article Contribution to Related Field of Study

This article has contributed to advancing knowledge by presenting the current trend in creative thinking research.

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