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Examining the Trend of Creative Thinking as an Essential Key for 21st Century: A bibliometric mapping

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Abstract
Learning in the 21st century requires creative thinking from students. However, bibliometric research still needs to be conducted on developing creative thinking at higher education institutes. This bibliometric study overview of the development of creative thinking is based on three bibliometric indicators: (1) the current development of creative thinking, (2) the subject area of creative thinking, and (3) significant contributions to the study of creative thinking. The methodology uses VOSviewer from the Scopus database and Harzing's Publish-or-Perish analysis. The results from this study provide essential information based on the current developments and trends in creative thinking among students.

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

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1.0 Introduction

In recent years, creativity has become one of the most debated topics and is recognized as one of the crucial skills in the 21st century and, indeed, the key to effective learning in higher education and beyond (Jahnke, Haertel, & Wildt, 2015; Nissim, Weissblueth, Scott Webber, & Amar, 2016; Rampersad & Patel, 2014). Creative thinking was defined as a new way of life and working within the future as interest in creativity has grown exponentially (Huang et al.,2019& Smith & Smith,2010). Creativity is becoming a vital skill in an increasingly complex world that can develop creativity (Davies et al.,2013 & Well & Claxton, 2002). Thinking creatively is one of the 4C abilities that students in the learning process must possess in the 21st century. Much research has been conducted based on this essential need for creative thinking. As of (28th October 2022), a total of 276 documents have been retrieved and analyzed.

This bibliometric study aims to fill the gap in the literature by providing an overview of trends in creativity research based on the Scopus database publication trend from 2011 to 2022. This study shows the current development of creative thinking as an essential key for the 21st century, the subject area used in creative thinking, significant contributions to the creative thinking research area, and the most influential document in the creative thinking literature. Creativity has been studied in several disciplines area. The review adopts the search procedures on the bibliometric database and data analysis methods described and discusses the result. This study also provides limitations and implications for research practice.

1.1 Creativity and 21st-Century

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As creativity becomes a new way of life in the future, education will play an essential role in developing interest in creativity (Huang et al., 2019). The inability to master creativity will cause students to fall behind and affect the development of the country's labour force. This statement, backed by (Lee, 2002), students who lack creativity may find it challenging to solve progressively complex problems in their professional endeavours. Furthermore, they face the risk of struggling in competition with foreign workers, posing potential obstacles to their success in the employment landscape. In addition, creativity is conceived as an engine of economic development, a driver of technological advancement, leadership in the workplace and life success that can increase human productivity and standard of living. (Joo, McLean, & Yang, 2013; Makel & Plucker, 2008). Examining creative thinking can lead to positive change, as creativity becomes a critical skill to master. This research evaluates past creative thinking literature through bibliometric analysis. This study aims to gain a deeper understanding of creative thinking literature. This research focuses on answering the following research questions (RQs):

RQ1: What is the current development of creative thinking?
RQ2: What are the topic areas in creative thinking research?
RQ3: Who are the most productive contributors to creative thinking research?

2.0 Methodology

This section discusses the method used to retrieve articles related to creative thinking by employing a bibliometric approach to map the research literature on creative thinking using metadata extracted from Scopus. The reviewer used the technique called PRISMA, from the Scopus database. Figure 1 shows the verification process of identification, screening, eligibility, and data extraction and analysis. This paper examines the trend of research on the productivity of creative thinking as an essential key for the 21st century using bibliometric analysis. The bibliometric indicators and the network visualization are presented in this paper.

The bibliometric study was conducted in the following five steps to achieve this. (1) define the objective and scope of the study, (2) select the techniques for the bibliometric approach, (3) collect the data for the bibliometric analysis, (4) perform the bibliometric analysis, which includes performance analysis and scholarly mapping, and (5) provide the results and discuss their implications for future research.

2.1 Bibliometric Analysis

According to (Ahmi & Mohammad, 2019), the bibliometric analysis method is popular as a research method today in revealing the trends of studies. This method can evaluate the quantity and quality of published material to observe trends or patterns in a specific research area (Sweileh et al., 2017). Furthermore, the bibliometric analysis summarizes the bibliographic and intellectual structures by analyzing social and structural relationships between different research components: author, countries, institutions, and subjects (Donthu et al., 2021). Besides, (Van Eck & Waltman, 2021) reported that this indicator can analyze co-authorship, co-citation, and bibliographic coupling. Bibliometric analyzes can effectively describe the level of knowledge, characteristics, and trends in a specific discipline. This technique has been widely used to measure the performance of various disciplines (Wang et al.,2018; Ekundayo & Okoh, 2018).

2.2 Data Source

This study is based on a bibliometric analysis method that uses quantitative and statistical approaches to determine patterns of article distribution in certain issues and time periods (Martí Parreño et al., 2016). This article has been discovered as the most significant and oldest indexing database from the Scopus database (http://scopus.com) (Ramírez-Montoya et al., 2022). Furthermore, according to (Sweileh et al., 2017) Scopus offers bibliometric indicators directly and simply. Elsevier owns Scopus, and all journals in this database are highly viewed and one of the prominent academic databases. This massive database aims to provide a comprehensive picture of global creative thinking studies. 477 documents were examined using the given keywords.

2.3 Data Collection

The research process begins by identifying the keyword "creative thinking" OR "creativity" in the Scopus database based on the title of the article. The creative thinking search query was applied to the title in the Scopus database (28th October 2022) with the search query TITLE (*creative AND thinking* OR *creativity*) and produced 3269 documents of the creative thinking literature to be analyzed. After a screening search within the article title (TITLE (*creative AND thinking* OR *creativity*)) AND ((higher AND education)) AND (21st AND century), 276 documents were eligible in this bibliometric study after screening between 2011 and 2021. No documents were removed as the search query was performed only by searching within the title, and all documents obtained are about creative thinking. Thus, all 276 documents were eligible for this bibliometric study. Figure 1 demonstrates the flow of the search strategy in this study.

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)).

A. TITLE (*creative AND thinking* OR *creativity*)

B. (TITLE (*creative AND thinking* OR *creativity*)) AND ((higher AND education)) AND (21st AND century)
C. (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))

2.4 Data Analysis

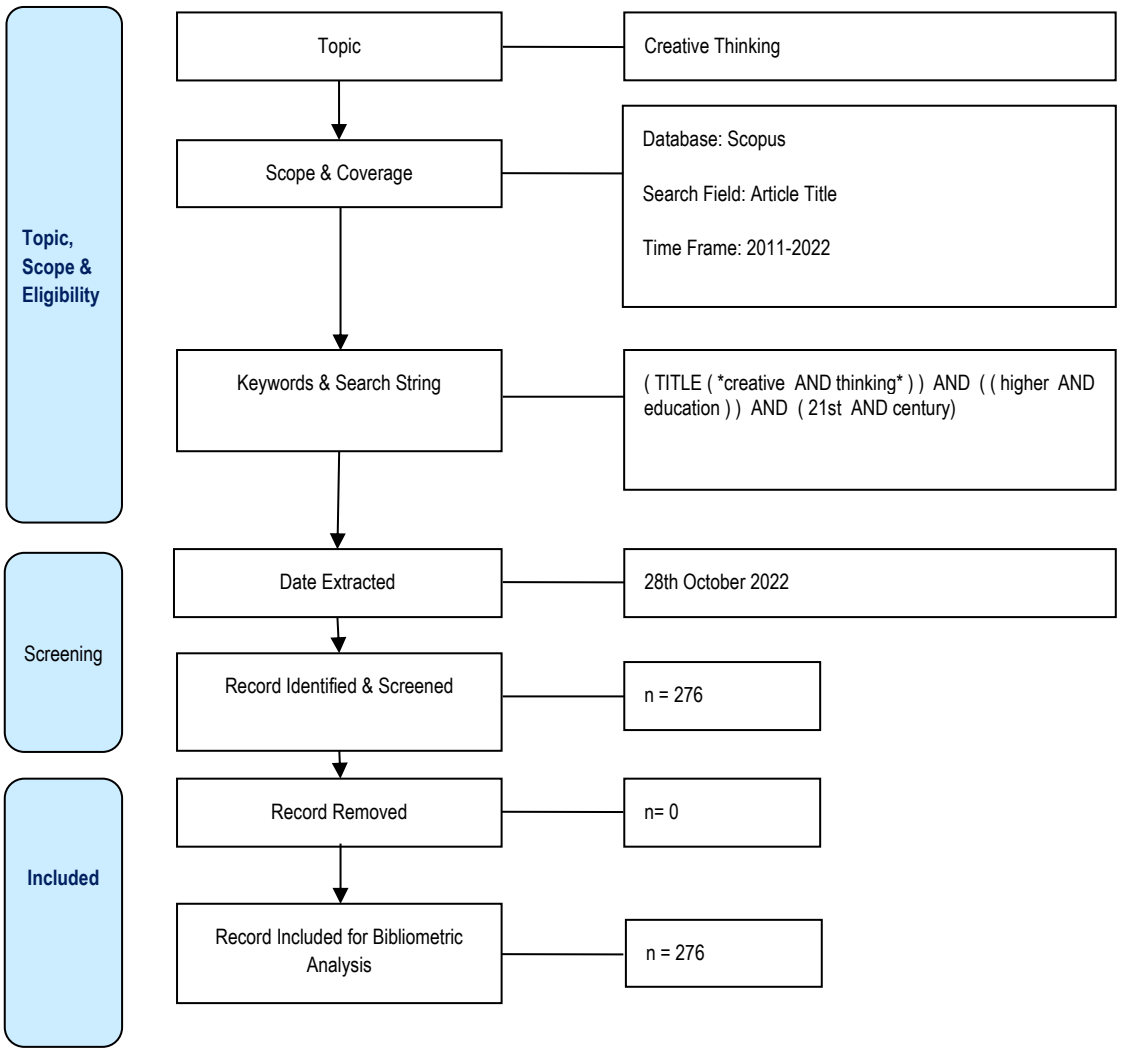

Figure 1. Flow Diagram of the Search Strategy

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. https://doi.org/10.1080/07420528.2020.1838534

This study used the Scopus database's analysis feature and programs like Microsoft Excel to create pertinent charts and graphs and calculate published documents' frequency. For publication impact and performance depending on chosen metrics, use Publish or Perish. For mapping and visualizing bibliometric networks, use VOSViewer. Free software for building and viewing bibliometric maps based on network data is available at www.vosviewer.com (Waltman, Van Eck, & Noyons, 2010).

3.0 Findings

The results were discussed in this section based on the research questions from the study's introduction.

3.1 Development of Creative Thinking and Its Distribution

This study analyses the following data to answer RQ1 regarding the current development of creative thinking: (a) publications by year, (b) source and document type, and (c) source title.

(a) Publication by Year

From 2011 to 2022, Figure 2 depicts the annual growth rate of innovative research publications. From 2016 to 2022, there was a substantial increase in the number of creative thinking documents. This demonstrates the growing interest, relevance, and significance of creative thinking as a key to the future.

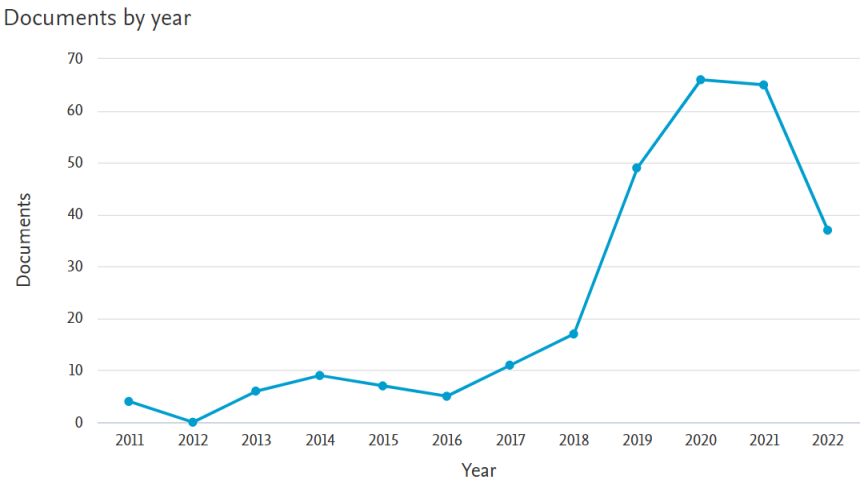

Figure 1: The Growth of Creative Thinking Studies from 2011 to 2022

Table 1: Year of Publication

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**

(b) The Source and Types of Documents

This study also aims to pinpoint where creative thinking research papers are published by breaking down the data into several source document types. 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**

Additionally, the data in this study are broken down by document type. Table 3 shows that research publications account for the majority of the 276 creative thinking items, 151 of which are articles and 103 of which are conference papers. Among the total number of documents, 15 (5.43%) are book chapters, 5 (1.81%) are reviews, and 1 (0.36%) is editorial or retracted.

Table 3: Document Type of 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**

(c) Most Active Source Titles

The most popular source title for creative thinking is listed in Table 4. The most publications, 54 (19.57%), came from the Journal of Physics Conference Series. Thinking Skills And Creativity, AIP Conference Proceedings, and International Journal Of Instruction are listed in order two.

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%

3.2 Topic Areas

In terms of a) subject categories and b) author's keywords, this result analyses the subject fields of creative thinking. Additionally, this conclusion addresses the RQ2 on the literature on creative thinking.

(a) Subject Area

Based on the subject area in which they were published, this study classifies papers by their field of study. Table 5 displays the result. According to the data, there is now research on creative thinking in many academic fields. The majority of research on creative thinking is published in the journal's categories in the fields of social science, with 158 papers (57.25%), physics and astronomy, with 65 (23.55%), and computer science, with 48 (17.39%). The outcome also reveals that a study on creative thinking has been published in a journal under Engineering, Psychology, Arts and Humanities, Business, Management and Accounting, Mathematics, and many more topics.

Table 5: Top 10 Subject Areas

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%

(b) Keyword Analysis

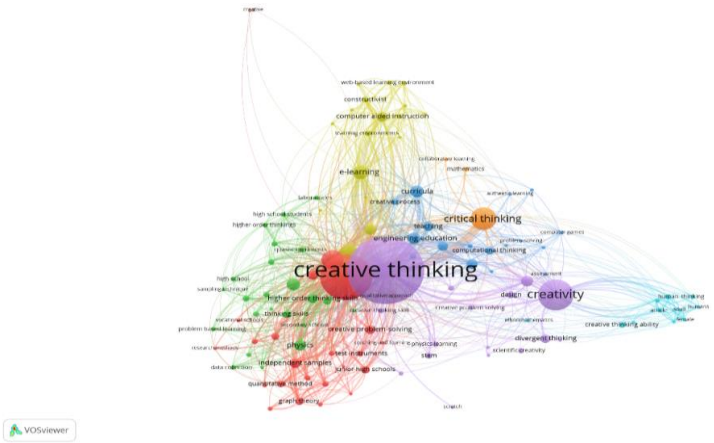

Figure 3: Network visualization map of at least three-occurrence author keywords.

The author's keyword network, each with at least three occurrences, is visualized in Figure 3. A bibliometric network is constructed and visualized in this study using VOSviewer and software. The connecting line's thickness, color, circle size, and text size indicate

relationships with other phrases. For instance, words that share the same color are frequently used together. The term "creative thinking" is the one most frequently linked to both creativity and critical thought, according to Figure 3. A total of 114 items with 8 clusters, 1222 links, and 2399 total link strengths were produced using the author's keyword network visualization map.

Figure 2: Word cloud of the keywords

In this study, 92 words representing unique author keywords were discovered. Table 6 lists the top 10 keywords used in the literature on creative thinking. With 127 publications and a 46.01% share, the top keyword is "creative thinking."

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%

According to Figure 5, there are five stages in the development of creative thinking research between 2017 and 2021. Dark blue, light blue, green, orange, and red are the five colors that stand for each stage of evolution. Each hue stands for an evolved keyword for creative thinking. In 2017, the research term was symbolized by the color dark blue.

2018 saw a shift in the color associated with creative thought from dark blue to light blue. Researchers frequently employ keywords like "e-learning," "creative problem-solving," and "divergent thinking". The third evolution of creative thinking keyword changed to green in 2019. 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 frequently used when the color of the keywords changes from green to yellow in 2020.

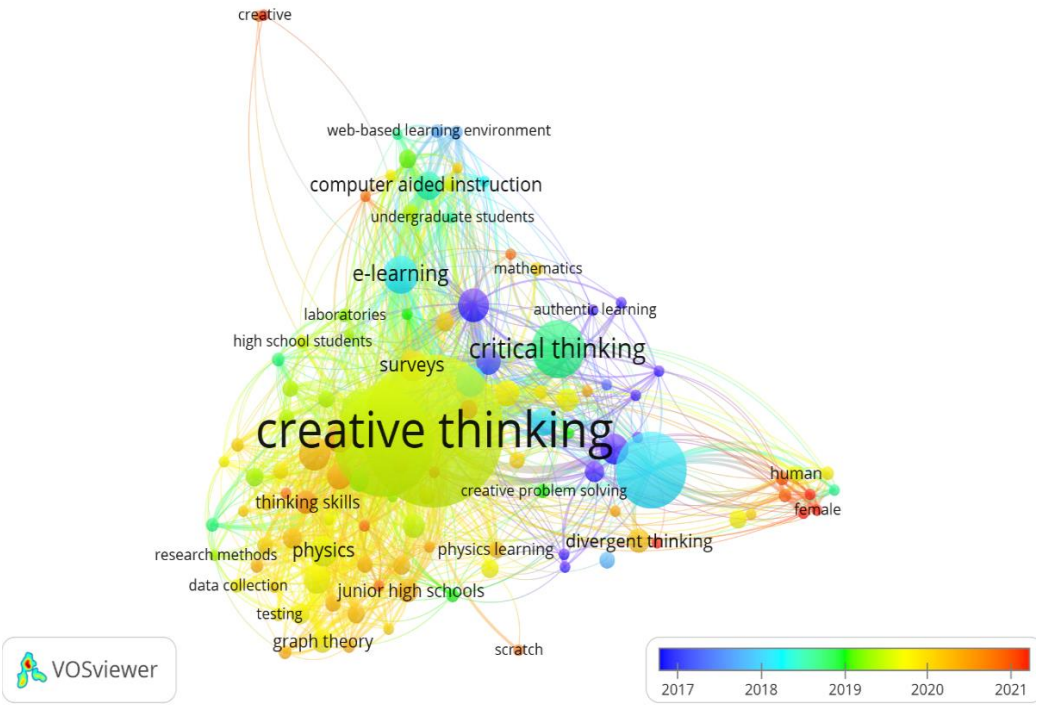

Figure 3: Overlay Visualization Map of Author Keywords with at Least Three Occurrences.

A discussion on keywords in 2021 focused on convergent thinking, human experimentation, collaborative learning, learning environment models, and qualitative approaches. The usage of creative and convergent thinking is common, and it is connected to the research topic of creative thinking that will be conducted in the upcoming years.

3.3 Most Productive Contributors in Creative Thinking Studies

We analyze the productive (a) authors, (b) institutions, and (c) countries that produce the most articles on creative thinking up until 2022 to address the RQ3 on the top contributors in creative thinking studies.

(a) Most Productive Author

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

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%

(b) Most Influential Institutions

Table 8 shows that most institutions contributed the most creative thinking research documents. The top 10 come from Universities in Indonesia, with 126 total publications from 276 documents.

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%

(c) Geographical Distribution of Publications

Table 9 shows the countries that provided the most publications. Interestingly, the largest contribution comes from Indonesia, with 126 documents (45.65%). The United States became the second largest, with 26 (9.42%) and Thailand 16 (5.80%). China 13 (4.71%), Turkey 11 (3.99%) and 10 from Taiwan and United Kingdom (3.62%). The rest produce below than 10 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%

4.0 Discussion

In response, the study reports the trend of previous studies using bibliometric indicators from the Scopus database and 276 documents extracted from the database. Findings indicate that English has become the dominant language. Moreover, the results reveal that creative thinking has emerged as a popular subject since 2011, drawing significant interest among scholars. The majority of articles are published in journals, with English serving as the predominant language of research.

Besides, this study presents a comprehensive analysis of the development and present state of research on creative thinking and higher education between 2011 and 2022, employing data extracted from the Scopus database. The findings indicate that the study of creativity and higher education research is a rapidly developing topic of interest that has had significant growth in the past 10 years.

This development has primarily been attributed to the efforts of a small group of scholars from Indonesia, the United States, and other Asian countries. These scholars have maintained close collaborative connections and have been instrumental in the distribution of publications. However, the scientific literature shows a significant constraint in terms of the research output from Malaysia, Australia, and Canada. The dissemination of creativity and higher education research primarily occurs in specialized publications that focus on creativity. This research stems from the integrated knowledge produced in the field of social sciences.

Finally, the findings suggest that scholars in this particular domain have explored a diverse range of topics that can be categorized into four main areas: creative thinking, students, creativity, and critical thinking. Overall, these results are encouraging and demonstrate the typical trends of an emerging discipline that is still in the process of maturing and will further evolve in the next years. Another advantageous element is that the study on creativity and higher education is inherently multidisciplinary, incorporating the progress made by academics from all areas and perspectives. In addition, experts in the field have analyzed a wide range of subjects pertaining to creativity and higher education.

5.0 Future Direction

For further research, the review recommends that other accessible databases such as Web of Science, Google Scholar, and Dimensions probably be used. Additionally, more research is required to determine whether creativity enhances students' employability in the future, and students must understand the importance of creativity competencies in the twenty-first century.

6.0 Conclusion & Recommendations

According to the study's findings, this paper uses bibliometric analysis to look at the direction of research on creative thinking. This study focuses on the publications of creative thinking gathered from the Scopus database. Since creativity is

seen as a crucial skill for the 21st century, bibliometric analysis has been used to determine the trend in publications as a suitable predictor of the advancement of the subject.

6.1 Contribution

Despite this limitation, this study has contributed to the gain of knowledge by presenting the current trend of research on creative thinking. The results of this review provide useful information and insight for educators to thought and focus on developing students' creativity as creative thinking becomes a vital skill for the 21st century.

6.2 Limitations of the study

This study focused only on the Scopus databases as the main source of documents since Scopus has become the largest database indexing all scholarly works (Sweileh et al., 2017; Ahmi & Mohamad, 2019). Overall, no search query is 100% perfect for capturing all scholarly work in this field and it is expected to return inconsistent results.

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