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# Bibliometric Analysis of Scientific Creativity Studies in WoS and Scopus Databases

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**To cite this article:**

Sarıkaya, Ö., & Deniş-Çeliker, H. (2022). Bibliometric analysis of scientific creativity studies in WoS and Scopus databases. *International Journal of Research in Education and Science (IJRES), 8*(4), 728-751. https://doi.org/10.46328/ijres.2789

International Journal of Research in Education and Science
2022, Vol. 8, No. 4, 728-751 https://doi.org/10.46328/ijres.2789

# Bibliometric Analysis of Scientific Creativity Studies in WoS and Scopus Databases

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## Article Info

***Article History***

Received:
12 March 2022
Accepted:
10 September 2022

***Keywords***

Bibliometric analysis
Scientific creativity
Scopus database
WoS database

## Abstract

The purpose of this study is to examine the trends in recent years by focusing on the bibliometric results of previous studies on scientific creativity. For this purpose, a total of 370 publications on scientific creativity obtained from Web of Science and Scopus databases were examined in terms of different bibliometric variables, and they were presented with visuals and tables. Bibliometric analyses of the publications in both databases were performed separately. Afterwards, a comparison of the top 10 studies that stand out in terms of scientific creativity studies in both databases was made and they were integrated with each other. Tables and images were created using the VOSviewer package program. The results of the study showed that the most frequently used keywords in research in both databases were "scientific creativity" and "creativity". In both databases, the countries that had the highest number of studies and whose scientific studies were most cited were determined as USA and China. In addition, it was also determined that the top three most cited authors in scientific creativity studies in both databases were D. K. Simonton, W. Hu, and R. J. Sternberg.

## Introduction

Creativity is the ability of every individual to create a new product by using their imagination and it is a process that can be developed with the appropriate training (Kilic & Tezel, 2012; Rawat, Qazi, & Hamid, 2012). It will be difficult for societies consisting of individuals who cannot use their creativity and reveal their original ideas to move forward in the modern world (Denis Celiker, & Balim, 2012). Creativity is an individual trait that allows people to adapt to the environment in which they live and to improve themselves (Yurdakal, 2019).

While creativity has been considered a concept used in the art for many years (Denis Celiker, & Balim, 2012), different definitions have been introduced to the concept of creativity used in science (Koray, 2004). Although scientific creativity is an important concept both individually and socially, there is no single definition of it (Demirhan, Onder, & Besoluk, 2018). According to Aktamis and Ergin (2007, p.13), scientific creativity "depends on what steps are used when developing a new product or developing an existing product, how the problem is solved, and how the problem is recognized". In addition, scientific creativity can be defined as sensitivity to problems and problem solutions, understanding the fascinating nature of science, and developing new, extraordinary, and useful scientific information, experiments, theories, and products (Usta & Akkanat, 2015).

In the 21st century, scientific creativity is both the condition of life and the skill expected to be found in individuals (Kirana, 2020). In order for societies to constantly develop and adapt to changes, their individuals need to have scientific creativity (Sternberg, 2010). Scientific creativity allows individuals to integrate information that exists in everyday life, create solutions to problems encountered, and bridge between daily life and their knowledge (Lin, Hu, Adey, & Shen, 2003). As well as the role of an observer during research, individuals who are allowed to use their scientific creativity can recognize others that may be missing (Meador, 2003).

Structuring and solving problems encountered is a process of creativity. Therefore, individuals who can use scientific process skills in the problem-solving process are considered to have more scientific creativity (Bakac, 2018; Hu & Adey, 2002; Mumford, Reiter-Palmon, & Redmond, 1994). The fact that scientific process skills, problem-solving skills, and scientific creativity are related to each other in the science course (Aktamis & Ergin, 2007; Cheng, 2004) shows that science education and scientific creativity have a common point (Liang, 2002). Therefore, the scientific creativity of individuals is expected to increase as their academic achievements in terms of education levels and science studies increase (Demirhan et al., 2018). When the studies in the literature were examined, it was observed that as students' achievements in science class increased, their scientific creativity also increased, and there was a significant relationship between scientific process skills and scientific creativity (Baysal, Kaya, & Ucuncu, 2013; Ceran, Gungoren, & Boyacioglu., 2014; Sahin-Pekmez, Aktamis, & Can, 2010; Yang, Lin, Hong, & Lin 2016). The use of the skills gained in science courses in the process of scientific creativity shows that science education is important in developing scientific creativity. Accordingly, it is believed that the importance given by countries to science education will also lead to the development of individuals who can use scientific creativity, and these individuals will play important roles in the development of societies (Hacioglu & Kutru, 2021; İkikat, 2019).

## Literature Review and Conceptual Framework

### Creativity

It is known that as a term, the first use of creativity dates back to Pluto (Maba, 2019). In his speech to the American Psychology Association in 1950, Guilford described creativity as an option to focus on individual characteristics, motivations, and behaviors, and since then, the conceptualization of creativity has changed (Kurtzberg & Amabile, 2001). Creativity has become a complex concept that affects individuals' lives even when they are not aware of it, and contains certain processes and applications (Barnett, 2019; Robinson, 2008). Creativity has conceptualized the forms of person-centered approaches and context-centered approaches; while the person-centered approaches emphasize more the inner aspects of creative performance, the context-centered approaches focus on the interaction of the individual with the external context in which he/she lives (Sternberg & Lubart, 1992). Differently, the concept of creativity has also been defined as a behavior that each individual can have and can be used in any domain (Koray, 2004).

Torrance (1968) defined creativity as a new product that is introduced to the solution of the problem faced by the individual. Creativity is a skill that exists in every individual and can be found in every aspect of human life, a whole of processes, an attitude, and behavior that covers a vast area from daily life to scientific studies (San, 1979). Dowd (1989), who defined creativity as the process of putting a new product in the middle, did not characterize a non-outcome process as creativity. Creativity is also defined as seeing and combining details (Cellek, 2003). Although there are many definitions of creativity, contrary to conventional and stereotyped ideas, creativity, in general, can be defined as a form of behavior, an ability to produce a new product that is effective in all problem-solving processes, and an ability to take problems from a wide perspective without limiting them (Karakus, 2001; Koray, 2004).

Creativity has been defined as the key to achieving a better standard of living, which makes creativity an important element in education (Robinson, 2008). The fact that creativity is a skill that can be developed through education has also enabled it to be integrated into education systems over the world (Kilic, 2017). In their study, Wyse and Ferrari (2015) determined that the importance of creativity had been included in all 27 European Union countries' national curricula and that politicians and curriculum developers accepted the importance of creativity for education. The development of creativity and creative thinking skills is included in the primary education programs prepared in Turkey as a purpose, strategy, and method (MEB, 2018). In addition, in China, creativity has been integrated into the education system as a skill that has to be gained in education programs since 2001 (Vong, 2008).

**Scientific Creativity**

Creativity is specific to the domain and includes a scientific background (Mukhopadhyay & Sen, 2013; Sak & Ayas, 2013). Science consists of creative efforts and creativity play an important role in the process of producing scientific information (Hadzigeorgiou, Fokialis, & Kabouropoulou, 2012; Hu & Adey, 2002; Kanli, 2014). If scientific efforts and ideas do not have a specific background and do not create original content, they cannot be considered creative ideas (Huang & Wang, 2019; İnel-Ekici, 2020). Progresses in science and technology are regarded as a significant reflection of creativity (Heller, 2007). Scientific creativity in the 21st century can be shown as a skill that individuals must have to face the problems of the globalized world and produce solutions to these problems (Vries & Lubart, 2017). Therefore, today's education systems have made scientific creativity an important factor in the teaching and learning process (Rasul, Zahriman, Halim, & Roseamnah, 2018). Individuals tend to solve problems that occur in their environment as long as they become interested; therefore, finding and solving scientific problems is unique to scientific creativity (Ayverdi, 2012).

Scientific creativity is an important concept for both individuals and societies, but like creativity, there is no single definition (Demirhan et al., 2018). Scientific creativity has described as "developing theories always requires adding to previous known ones to produce a new product or process" (Denis Celiker, Tokcan, & Korkubilmez, 2015, p.170). Scientific creativity can be defined as the "ability to learn scientific knowledge and solve scientific problems" (Wang & Yu, 2011, p.4179). It is believed that the development of scientific creativity was based on the studies of Hu and Adey (Kilic & Tezel, 2012). In their study, Hu and Adey (2002, p.392) defined scientific creativity as "kind of intellectual trait or ability producing or potentially producing a certain product that is original and has social or personal value, designed with a certain purpose in mind, using given information". They stated that scientific creativity is based on scientific knowledge and skills, and is composed of static structure and developmental structure. They also proposed "The Scientific Structure Creativity Model (SSCM)" (Hu & Adey, 2002) (See Figure 1).

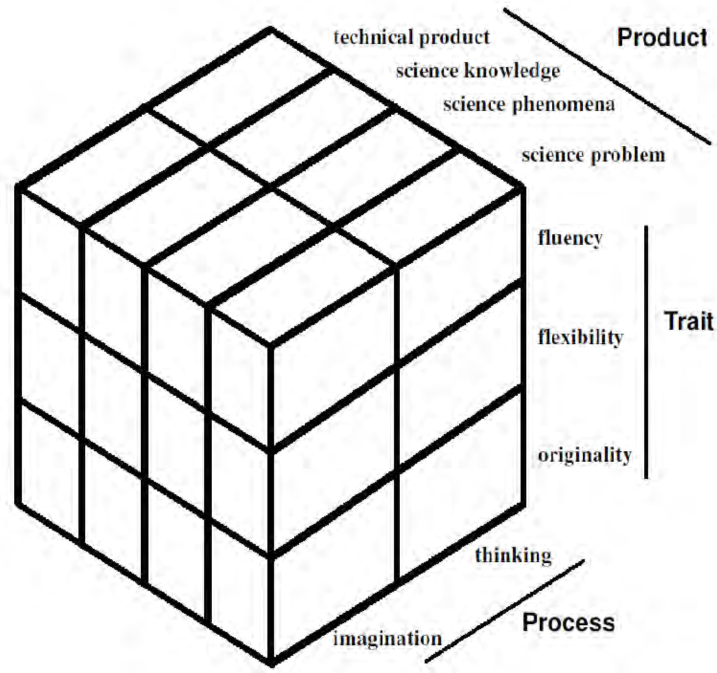


Figure 1. The Scientific Structure Creativity Model (SSCM) (Hu & Adey, 2002)

According to this model, scientific creativity consists of a three-dimensional dynamic structure. Scientific creativity in the model consists of three dimensions: process, trait, and product. The process dimension consists of the sub-dimensions of thinking and dreaming. Hu and Adey (2002) emphasized that scientific creativity is a process and it includes imagination and thinking abilities in the process. The trait dimension includes sub-dimensions of originality, flexibility, and fluency. The scholars emphasized the importance of being fluent, flexible, and original thinking to produce products at the end of the process. The product dimension consists of sub-dimensions of technical product, science knowledge, science phenomena, and scientific problem. The products that will emerge at the end of the scientific creative process should be designed to solve a scientific problem, designed to be a technical product, and associated with scientific knowledge and a scientific phenomenon (Hu & Adey, 2002).

Literature has shown that the contents of the recent studies related to scientific creativity are as follows: impact and relationships of different learning and teaching approaches and activities on scientific creativity (Akcanca & Cerrah Ozsevgec, 2017; Astutik, Susantini, Madlazim, Mohamad, & Supeno, 2020; Dewantara, Mahtari, Nur, Yuanita, & Sunarti, 2020; Karademir, 2016; Kozhevnikov, Kozhevnikov, Yu, & Blazhenkova 2013; Panjaitan & Siagian, 2020; Siew & Ambo, 2020; Wicaksono, 2020; Wulansari, Rusnayati, Saepuzaman, Karim, & Feranie, 2019; Zhao, Zhang, Heng, & Qi, 2021; Zhou, 2021), the effects of STEM and STEAM applications on scientific creativity (Calisici & Benzer, 2021; Genek & Doganca Kucuk, 2020; Rasul et al., 2018; Siew & Ambo, 2020), the effects of different thinking models on scientific creativity and the relationships between them (Demir, 2015; Forthmann, Szardenings, & Dumas, 2020; Vries & Lubart, 2017; Wulansari et al., 2019; Zhu, Shang, Jiang, Pei,

& Su, 2019), perceptions, attitudes, and beliefs related to scientific creativity and the impact of scientific creativity on academic achievement (Calisici & Benzer, 2021; Demirhan & Sahin, 2021; Lee & Park, 2021; Ndeke, Okere, & Keraro, 2016), evaluation of the relationship between problem-solving skills, questioning skills, and scientific process skills, and scientific creativity (Chen, Hu, & Plicher 2016; Panjaitan & Siagian, 2020; Utemov et al., 2020; Yang et al., 2016; Dewantara et al., 2020), effects of science games and toys, animations, and WEB tutorials on scientific creativity (Atesgoz & Sak, 2021; Demir Kacan, 2015; Lupu, Irimia, & Bobric, 2019), and the studies developed by tools to measure scientific creativity and the adaptation of these tools (Aktamis, Pekmez, Can, & Ergin 2005; Bhat & Siddiqui, 2017; Denis Celiker & Balim, 2012; Hu & Adey, 2002; Siew & Lee, 2017).

Since studies on scientific creativity are new, detailed information about these studies is also new (Saptono & Hidayah, 2020). When the literature on scientific creativity was examined, it was seen that there were studies conducted to analyze scientific creativity studies (Boxenbaum, 1991; Stumpf, 1995; Saptono & Hidayah, 2020), but there was no bibliometric analysis in the Google Scholar, ERIC, Scopus, and Web of Science databases.

The accumulated literature records that emerge as a result of increased studies on a particular topic can be summarized using bibliometric methods (Ozkaya, 2019). In bibliometric studies, data resources are international scientific reference indexes. Since these indexes can be accessed via the Web of Science (WoS) or Scopus databases, WoS and Scopus are considered databases that contribute significantly to bibliometric studies (Guz & Rushchitsky, 2009; Guzeller & Celiker, 2017). WoS is a reference database that contains more than 10,000 journals and different information collected from journals, conferences, reports, books, and book series (Aghaei Chadegani et al., 2013). Scopus is a database that contains more than 16,000 journals and more than 4,000 publishers and offers quote-based measurements (Guz & Rushchitsky, 2009). Therefore, the bibliometric analysis of document types such as articles, books, thesis, statements, and reports in the WoS and Scopus databases can be performed using these resources (Sonmez, 2020).

In the current study, the resources in the international reference indexes were used to analyze the studies on scientific creativity. Revealing the scope of the studies of scientific creativity and finding out which studies lead to scientific creativity is the necessity of current research and its main purpose. Based on this purpose, the following research problems were sought in Web of Science and Scopus databases;

1. What are the WoS categories and Scopus categories of the publications scanned using the keyword “scientific creativity”?
2. What are the 10 most cited publications in the scientific creativity studies?
3. Within the scope of published studies on scientific creativity;
    a. Who are the 10 most cited contributors?
    b. Who are the 10 authors with the most studies?
4. Which are the 10 most active journals within the scope of published studies on scientific creativity?
5. Which are the 10 countries with the most publications within the scope of scientific creativity?
6. What are the 10 most active institutions within the scope of published studies on scientific creativity?
7. What are the 10 most common keywords used in scientific creativity studies?

## Method

### Design

Bibliometric analysis was preferred as a data analysis technique in the current research. Bibliometric is an analysis method that allows statistically visualization of trends specific to the area being investigated in order to obtain information about the activities and specific features of scientific publications (number of studies published every year, multi-studies topics, co-references, journals where studies are published, keywords, countries and institutional co-operation, etc.) (Al, 2008; Al & Costur, 2007; Ciftci et al., 2016; Ozkaya, 2019). Bibliometric analysis is also a method used to provide quantitative analysis of written publications (Ellegaard & Wallin, 2015), improve access to information, and learn more about the structure of the information (Carter-Templeton, Frazier, Wu, & Wyatt, 2018).

Social network analysis is used to determine co-citation relationships in bibliometric analyses (Guzeller & Celiker, 2017). Social network analysis can visualize co-citation networks and identify key actors in the field of research (Karagöz & Yüncü, 2013). In a social network analysis image, the size of the nodes reflects the frequency of the common quote (Van Eck & Waltman, 2014). In the images, nodes that are too close to each other have more frequent quotation rates. The links connecting the two nodes refer to quotations made by other researchers. The closely connected color node sets represent important research themes in the field of research (Hallinger, 2020).

### Collection of Data

The scientific documents analyzed in this study were first obtained from the WoS database by scanning with the keyword “scientific creativity”. During the scanning process, the concept of scientific creativity was limited to be in the “title” section of the documents. No restrictions were made in terms of publication years. Bibliometric data of 192 studies from 1975 to 2021 were recorded in the format to be analyzed in the VOSviewer (Version 1.6.17) package program (Van Eck & Waltman, 2010). Secondly, the Scopus database was scanned using the keyword “scientific creativity”. During the scanning process in the Scopus database, the concept of scientific creativity was limited to be in the “title” section of the documents. Bibliometric data of 178 documents from 1975 to 2021 in the Scopus database were recorded in the format that could be processed in the VOSviewer package program. The process of reaching the documents analyzed in the current study was terminated on December 27, 2021.

## Findings

In this section, the findings determined as a result of the analysis of the data obtained from the WoS and Scopus databases were compared and integrated in the framework of research problems and presented in visual and table formats.

### Categories of Publication in Scientific Creativity Studies

Within the scope of the first sub-problem of the current study, in which categories the studies on scientific creativity in the WoS and Scopus databases had been conducted was determined. In this context, the determined top-10 categories are presented in Table 1.

Table 1. Top-10 WoS and Scopus Categories of Publications

| WoS Database Categories | N | Scopus Database Categories | N |
|---|---|---|---|
| Education/Educational Research | 43 | Social Sciences | 81 |
| Psychology Multidisciplinary | 28 | Art and Humanities | 38 |
| Psychology Educational | 19 | Psychology | 38 |
| History Philosophy of Science | 18 | Computer Science | 20 |
| Philosophy | 14 | Medicine | 10 |
| Multidisciplinary Sciences | 12 | Engineering | 13 |
| Computer Science Interdisciplinary Applications | 6 | Physics and Astronomy | 12 |
| Education Scientific Disciplines | 6 | Mathematics | 9 |
| Engineering Electrical Electronic | 6 | Business, Management and Accounting | 8 |
| Humanities Multidisciplinary | 5 | Economics, Econometrics and Finance | 8 |

As seen in Table 1, while the scientific creativity studies in the WoS database were mostly included in the "Education/Educational Research" category (N=43), studies on scientific creativity in the Scopus database were mostly included in the "Social Sciences" category (N=81). It was observed that the number of scientific creativity studies in the "Psychology Multidisciplinary" and "Psychology Educational" categories in the WoS database were higher than in other categories. In the Scopus database, it was determined that scientific creativity studies in the categories "Art and Humanities" and "Psychology" were more than in other categories. These results show that scientific creativity studies are generally in the categories of "Education/Education Research" and "Social Sciences". In addition, the fact that scientific creativity studies in the field of psychology rank second in both databases shows that scientific creativity is an interdisciplinary subject. The fewest studies related to scientific creativity in the WoS database were included in the category of "Humanities Multidisciplinary", while the fewest studies in the Scopus database were included in the category of "Economics, Econometrics, and Finance".

**Most Cited Studies in Scientific Creativity**

As a result of the analyzes conducted within the scope of the second sub-problem of the research, the 10 most cited sources on scientific creativity in the WoS and Scopus databases are presented in Table 2. When Table 2 was examined, it was observed that the article entitled "Scientific creativity as constrained stochastic behavior: The integration of product, person, and process perspectives" published by Simonton (2003) had 367 citations in the WoS database, while it had 438 citations in the Scopus database. Because of the high interest in a study, it can be said that the study is comprehensive in the field of scientific creativity. On the other hand, the study titled "a scientific creativity test for secondary school students" published by Hu and Adey (2002) was the second most cited field article in both the WoS database (129 references) and the Scopus database (159 references), and this shows that it is an effective study on scientific creativity. The researchers who contribute to scientific creativity are discussed in more detail below as a part of the third sub-problem of the research.

Table 2. Top-10 Most Cited Sources for Scientific Creativity Studies

| Information of Studies (Wos Database) | Total Citations | Information of Studies (Scopus Database) | Total Citations |
|---|---|---|---|
| Scientific creativity as constrained stochastic behavior: the integration of product, person, and process perspectives. (Simonton, 2003) | 367 | Scientific creativity as constrained stochastic behavior: The integration of product, person, and process perspectives. (Simonton, 2003) | 438 |
| A scientific creativity test for secondary school students. (Hu & Adey, 2002) | 129 | A scientific creativity test for secondary school students. (Hu & Adey, 2002) | 159 |
| Creativity. (Simonton, 2009) | 106 | Age dynamics in scientific creativity. (Jones & Weinberg, 2011) | 100 |
| Age dynamics in scientific creativity. (Jones & Weinberg, 2011) | 90 | Ability differences among people who have commensurate degrees matter for scientific creativity. (Park, Lubinski & Benbow, 2008) | 96 |
| Ability differences among people who have commensurate degrees matter for scientific creativity. (Park, Lubinski & Benbow, 2008) | 84 | General, artistic and scientific creativity attributes of engineering and music students. (Chartyon & Snelbecker, 2007) | 61 |
| The janusian process in scientific creativity. (Rothenberg, 1996) | 74 | Increasing students' scientific creativity: the “learn to think” ıntervention program. (Hu, Wu, Jia, Yi, Duan, Meyer & Kaufman, 2013) | 58 |
| General, artistic and scientific creativity attributes of engineering and music students. (Chartyon & Snelbecker, 2007) | 47 | The relative influences of domain knowledge and domain-general divergent thinking on scientific creativity and mathematical creativity. (Huang, Peng, Chen, Tseng & Hsu, 2017) | 38 |
| Increasing students' scientific creativity: the “learn to think” ıntervention program. (Hu, Wu, Jia, Yi, Duan, Meyer & Kaufman, 2013) | 44 | The influence of CASE on scientific creativity. (Lin, Hu, Adey & Shen, 2003) | 36 |
| Objective measure of scientific creativity: psychometric validity of the creative scientific ability test. (Ayas & Sak, 2014) | 32 | Objective measure of scientific creativity: psychometric validity of the creative scientific ability test. (Ayas & Sak, 2014) | 35 |
| Veblen on scientific creativity: the influence of Charles S. Peirce. (Dyer, 1986) | 31 | Effectıveness of creative responsibility based teaching (crbt) model on basic physics learning to increase student’s scientific creativity and responsibility. (Suyidno, Nur & Yuanita, 2018) | 32 |

**Researchers Contributing to Scientific Creativity Studies**

*Most Cited Authors in Scientific Creativity Studies*

Within the scope of the third sub-problem of the research, the authors who had studied scientific creativity were examined. Firstly, the most cited authors were analyzed. Images obtained from the analysis of WoS and Scopus databases are presented below (see Figure 2 and Figure 3).

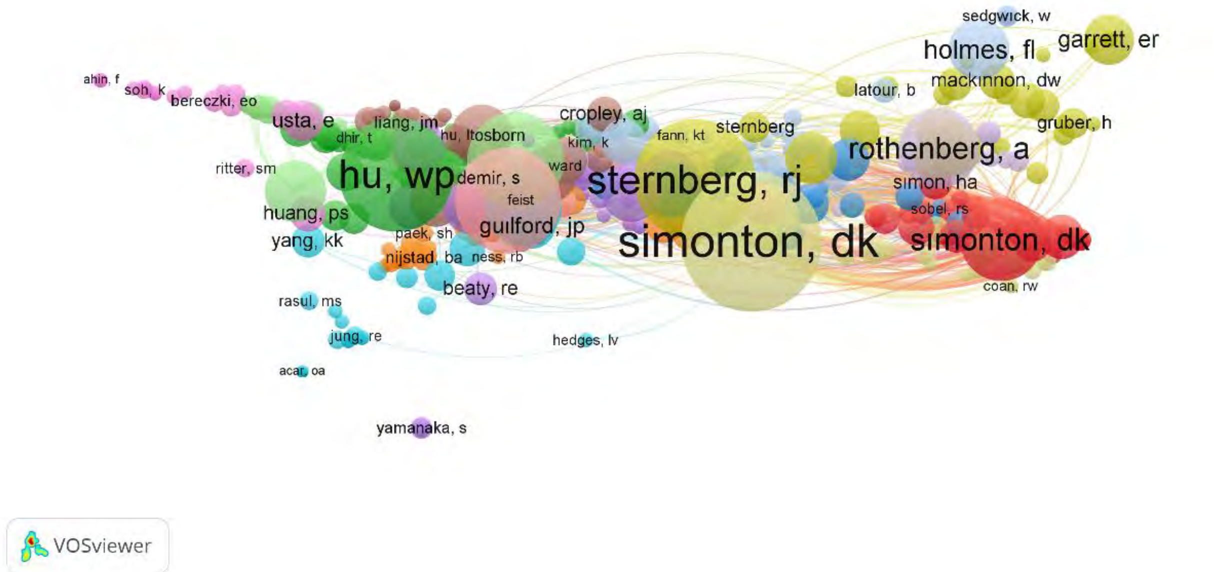


Figure 2. Most Cited Authors in Scientific Creativity Studies in WoS Database

As the size of the nodes in the figure shows, the most co-cited authors in scientific creativity studies in the WoS database are Simonton, D. K., Hu, W., Sternberg, R. J., Runco, M. A., and Torrance, E. P.

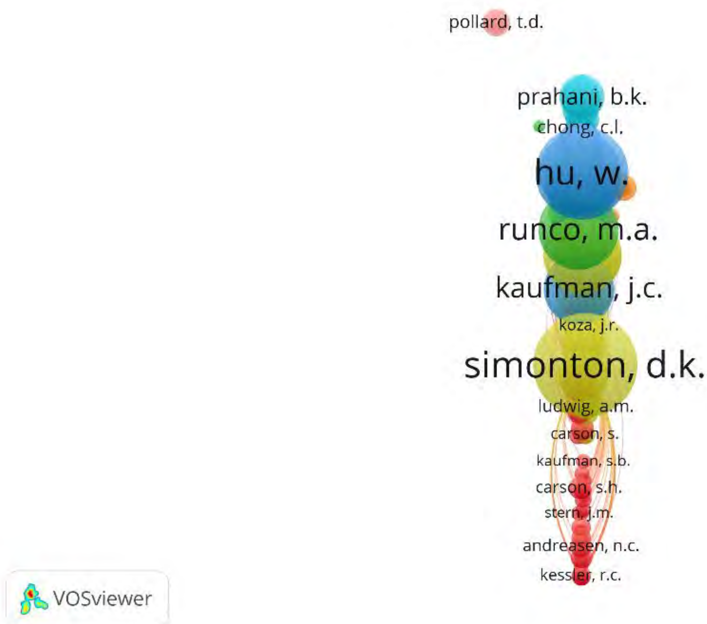


Figure 3. Most Cited Authors in Scientific Creativity Studies in Scopus Database

Analysis conducted based on the size of the nodes showed that the most co-cited authors in the Scopus database were Simonton, D. K., Hu, W., Adey, P., Sternberg, R. J., Runco, M. A., and Kaufman, J. C. The fact that the most cited authors in both databases are joint shows that these authors have done effective studies in scientific creativity field.

*Authors with the Most Studies in Scientific Creativity Field*

Within the scope of the third sub-problem of the research, secondly, the Top-10 authors who published the most studies on scientific creativity in both databases were analyzed. The authors and number of their studies are shown in Table 3.

Table 3. Top-10 Authors Contributing to the Scientific Creativity Field Most and number of their Publications

| **Author (WoS Database)** | **Number of Study** | **Author (Scopus Database)** | **Number of Study** |
|---|---|---|---|
| Siew, Nyet Moi | 5 | Siew, Nyet Moi | 5 |
| Adey, Philip | 3 | Hu, Weiping | 4 |
| Simonton, Dean Keith | 3 | Park, Jongwon | 4 |
| Suyidno, M. Nur | 3 | Huang, Chin-Fei | 3 |
| Nur, Mohamad | 3 | Astutik, Sri | 3 |
| Sahin, Fatma | 3 | Lin, Huann-Shyang | 3 |
| Park, Jongwon | 3 | Prahani, Binar Kurnia | 3 |
| Huang, Chin-Fei | 3 | Simonton, Dean Keith | 3 |
| Jones, Benjamin F. | 2 | Holmes, Frederic Lawrence | 3 |
| Rothenberg, Albert | 2 | Adey, Philip | 2 |

When Table 3 was examined, it was seen that N. M. Siew contributed the most to the field with 5 studies registered in both databases. In the WoS database, P. Adey, D. K. Simonton, M. N. Suyidno, M. Nur, F. Sahin, J. Park, and C-H. Huang were found to be the second most influential scientists with 3 published articles. In the Scopus database, on the other hand, W. Hu and J. Park (4 articles each) were determined to be the second-ranked authors contributing to the field. Since most of the scientific creativity studies were conducted more than one author, it was determined that the number of single-author studies is low.

**Active Journals in Scientific Creativity Studies**

Within the context of the fourth sub-problem of the current study, in which journals the studies on scientific creativity were published in WoS and Scopus databases were determined. In terms of scientific creativity studies, the active journals in the WoS and the Scopus databases are given in Figure 4 and Figure 5.

As seen in Figure 4, it was determined that the journal publishing scientific creativity studies mostly was the

"Journal of Baltic Science Education" in the WoS database. This was followed by "Creativity Research Journal", "Journal of Creative Behavior", "Thinking Skills and Creativity" and "International Journal of Psychology", respectively.

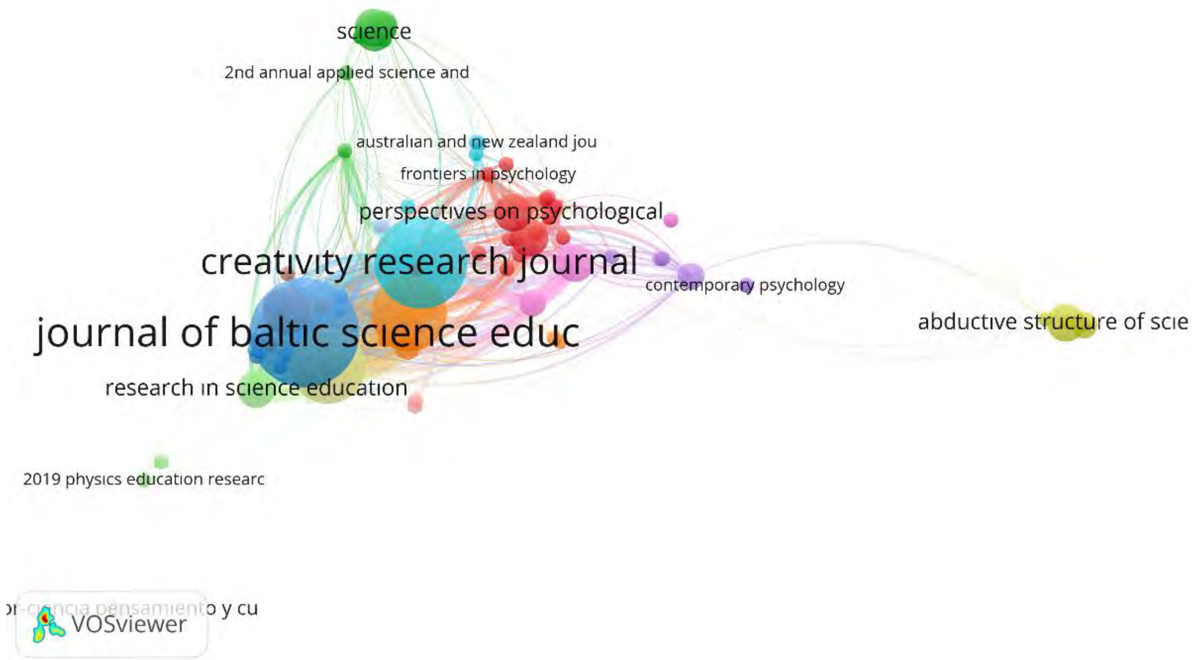


Figure 4. Active Journals Publishing on Scientific Creativity in WoS Database

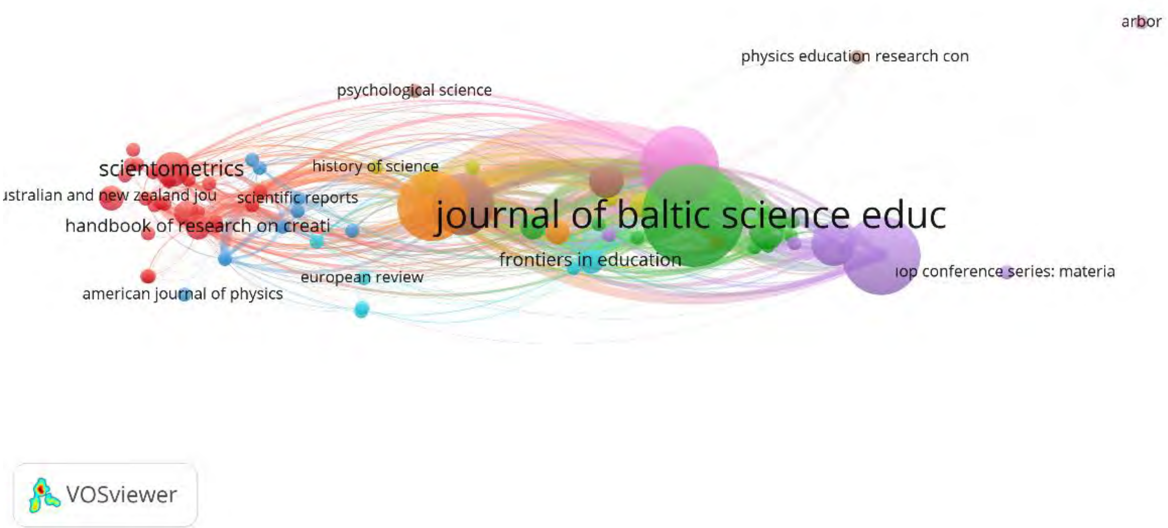


Figure 5. Active Journals Publishing on Scientific Creativity in Scopus Database

Similar to the WoS database, the "Journal of Baltic Science Education" was determined as the journal publishing the most studies on scientific creativity in the Scopus database too. When the sizes of the nodes in the figure were examined, it was seen that in terms of the number of publications, the "Journal of Baltic Science Education" was followed by "Thinking Skills and Creativity", "Journal of Physics: Conference Series", "Creativity Research Journal" and "Journal of Creative Behavior", respectively.

The Top-10 most active journals in terms of publications on scientific creativity in both databases are given in Table 4.

Table 4. Top-10 Most Active Journals in terms of Publications on Scientific Creativity in WoS Database and Scopus Database

| **Journals of Articles Published (WoS Database)** | **N** | **Journals of Articles Published (Scopus Database)** | **N** |
|---|---|---|---|
| Journal of Baltic Science Education | 11 | Journal of Baltic Science Education | 11 |
| Creativity Research Journal | 9 | Thinking Skills and Creativity | 8 |
| Journal of Creative Behavior | 7 | Journal of Physics: Conference Series | 8 |
| Thinking Skills and Creativity | 7 | Creativity Research Journal | 7 |
| International Journal of Psychology | 5 | Journal of Creative Behavior | 6 |
| International Journal of Instruction | 4 | International Journal of Instruction | 4 |
| Perspectives on Psychological Science | 3 | Research in Science Education | 3 |
| Research in Science Education | 3 | Journal of Turkish Science Education | 3 |
| Scientometrics | 3 | Scientometrics | 3 |
| International Journal of Science Education | 2 | International Journal of Science Education | 2 |

Eight journals (Journal of Baltic Science Education, Creativity Research Journal, Journal of Creative Behavior, Thinking Skills and Creativity, International Journal of Instruction, Research in Science Education, Scientometrics, and International Journal of Science Education) were scanned in both databases. It was determined that these were among the Top-10 journals publishing the most studies in the creativity field. Publication of studies in different journals shows that there are alternatives to the journals in which scientific creativity-related studies can be published and that the studies are not collected in a single journal.

### Active Countries in terms of Scientific Creativity Studies

Within the scope of the fifth sub-problem of the research, countries, where scientific creativity studies had been published, were analyzed. Images obtained from the analyses of WoS and Scopus databases are presented below (see Figure 6 and Figure 7). When Figure 6 was examined, it was seen that the most studies on scientific creativity in the WoS database were published in the United States. The figure also shows that the USA is followed by China, Indonesia, Turkey, and Malaysia, respectively.

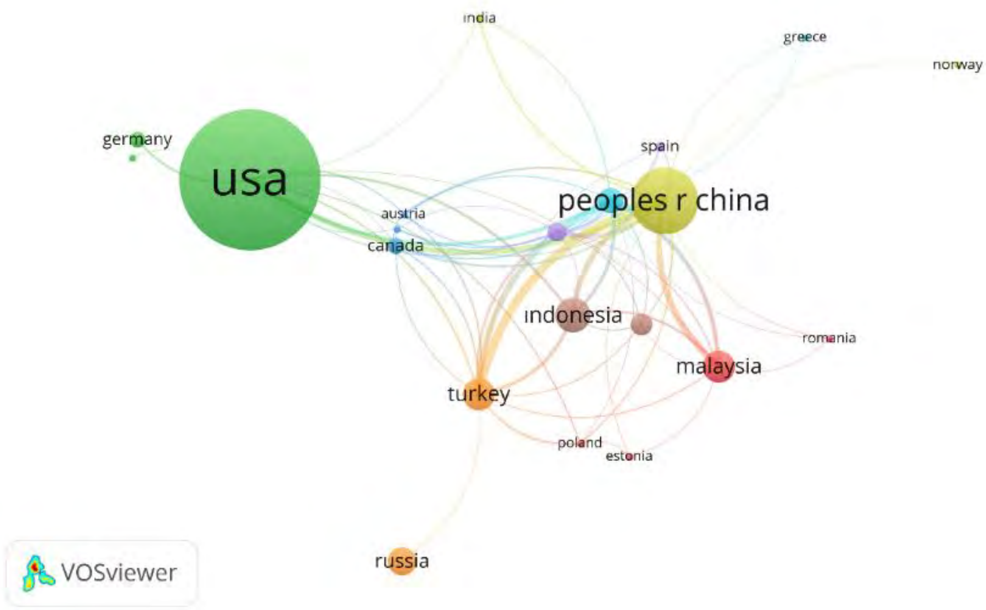


Figure 6. Active Countries in terms of Scientific Creativity Studies in WoS Database

As shown in Figure 7, in the Scopus database, it was seen that the most studies on scientific creativity were published in the United States. It was also determined that the USA was followed by China, Indonesia, Turkey, and the United Kingdom, respectively.

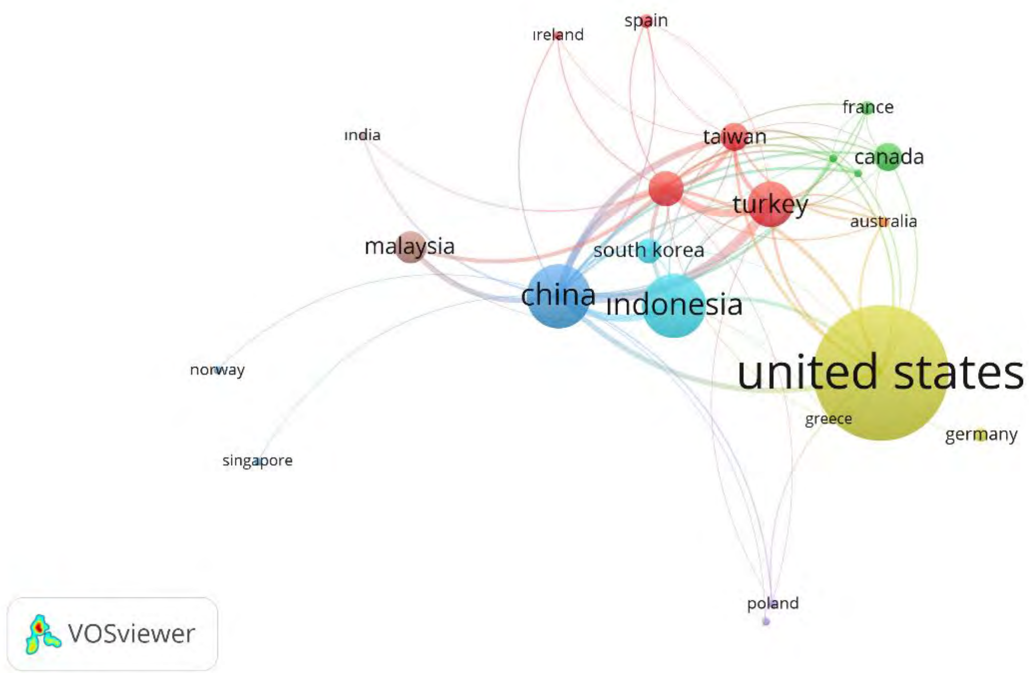


Figure 7. Active Countries in terms of Scientific Creativity Studies in Scopus Database

Table 5 shows the Top-10 countries with the most publications on scientific creativity in the WoS and the Scopus databases and the number of their citations.

Table 5. Countries that have Publications on Scientific Creativity in Wos and Scopus Databases

| Country / Region (WoS Database) | N | Citations | Country / Region (Scopus Database) | N | Citations |
|---|---|---|---|---|---|
| United States of America | 44 | 917 | United States of America | 38 | 942 |
| China | 21 | 267 | China | 18 | 341 |
| Indonesia | 11 | 73 | Indonesia | 18 | 130 |
| Turkey | 10 | 69 | Turkey | 13 | 57 |
| Malaysia | 10 | 34 | United Kingdom | 10 | 244 |
| Russian Federation | 9 | 4 | Malaysia | 9 | 44 |
| United Kingdom | 8 | 166 | Taiwan | 8 | 86 |
| South Korea | 7 | 12 | Canada | 8 | 23 |
| Taiwan | 6 | 68 | South Korea | 7 | 16 |
| Italy | 6 | 0 | Russian Federation | 7 | 0 |
| Canada | 5 | 13 | Spain | 4 | 28 |

When the databases were compared, it was seen that the top 4 countries in both databases (United States of America, China, Indonesia, and Turkey) had the highest number of publications and the highest number of citations in terms of scientific creativity studies. It was observed that articles on scientific creativity published in Italy in the WoS database and in the Russian Federation in the Scopus database received 0 citations.

**Active Institutions in terms of Scientific Creativity Studies**

Institutions that had publications on scientific creativity were analyzed. Images obtained from the analyses of WoS and Scopus databases are presented in Figure 8 and Figure 9.

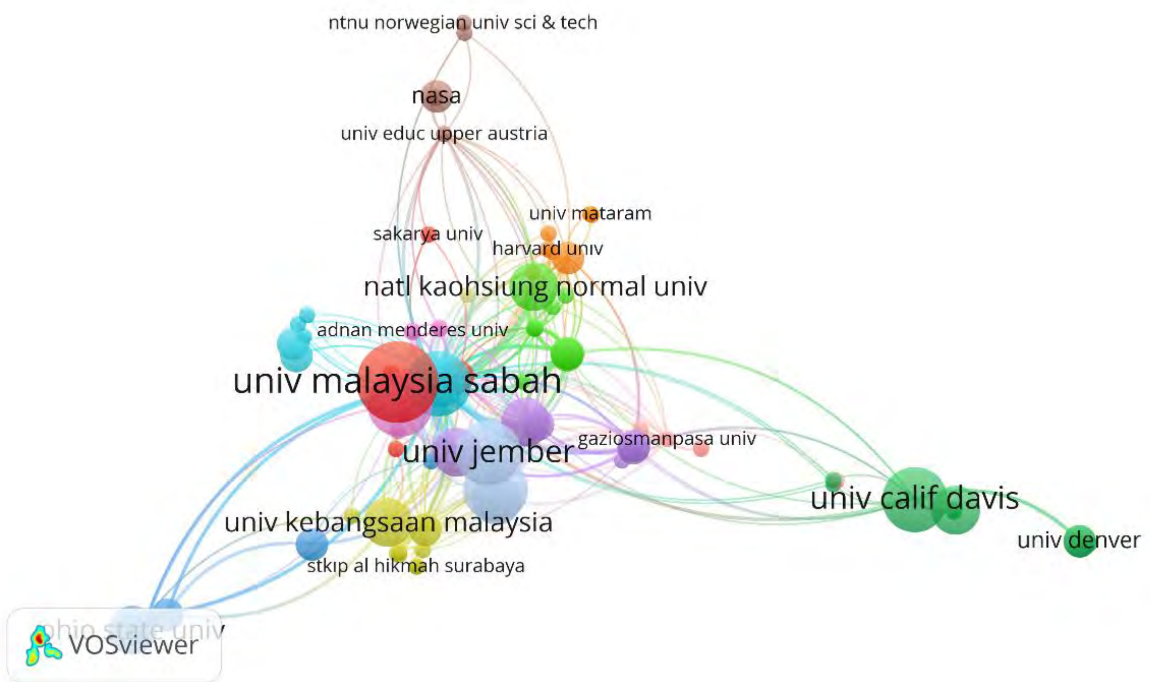


Figure 8. Active Institutions in terms of Scientific Creativity Studies in WoS Database

As seen in Figure 8, it was determined that the institution with the highest number of published studies related to scientific creativity was the University of Malaysia Sabah, and it was followed by California State University and King's College London. The fact that there are more connections and cooperation between the institutions that are active in terms of studies on scientific creativity in the WoS database shows that the work efficiency in this field has increased.

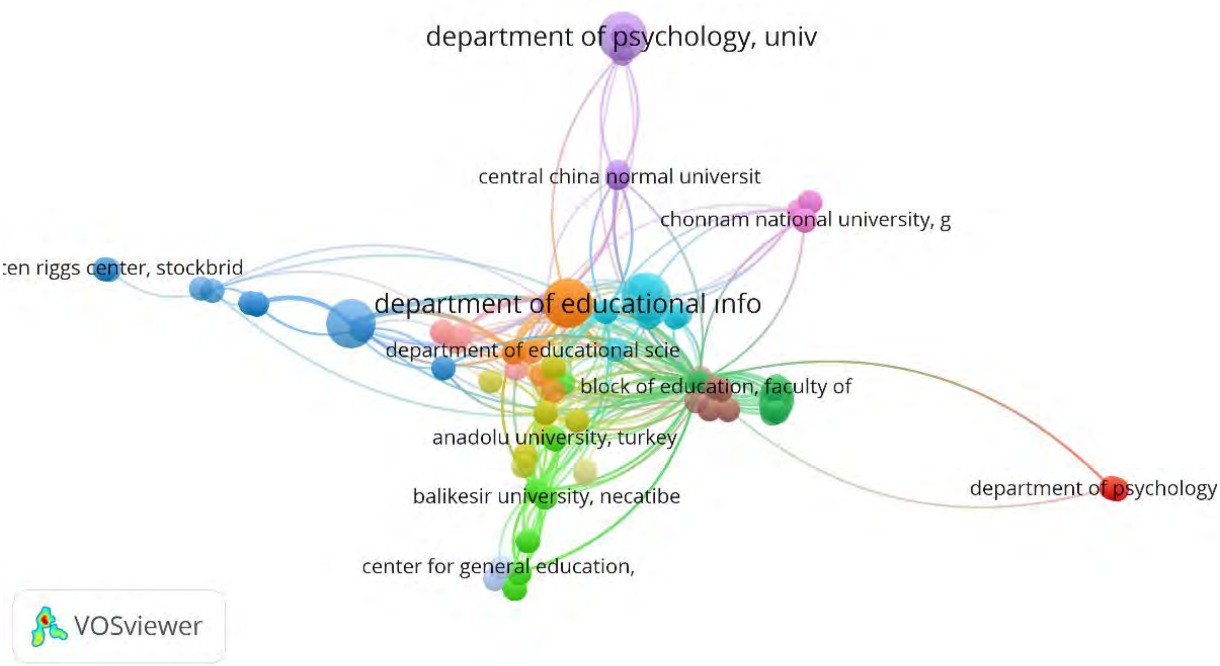


Figure 9. Active Institutions in terms of Scientific Creativity Studies in Scopus Database

Based on Figure 8, it was found that the institution that had the most study on scientific creativity in the Scopus database was the "University of Jember", and it was followed by "East China Normal University", "University of Cambridge", "KTH Royal Institute of Technology", and "Jönköping International Business School", respectively.

Table 6 shows the Top-10 institutions active in scientific creativity studies in both databases, the number of their publications on this issue, and the number of their citations. In Table 6, it is seen that institutions publishing studies on scientific creativity in the WoS and the Scopus databases are mostly different. When the institutions in the WoS database were examined, it was determined that University of Malaysia Sabah had the most publications (N=5) related to scientific creativity, but the number of their citations (citation: 30) was less compared to citations of other institutions.

It was also seen that the highest number of citations belonged to California State University (citation: 485) although it had only 4 publications. Similarly, it was determined that although the numbers of their publications were low, the numbers of citations were high for Shanxi University (N=3; citation:157) and Ohio State University (N=3; citation:137). When the active institutions in terms of scientific creativity studies in the Scopus database were examined, it was also determined that although King's College London and Shanxi University had only 1 publication, the numbers of their citations were higher compared to citations of other institutions.

Table 6. Top-10 Active Institutions in terms of Scientific Creativity Studies

| Institutions (WoS Database) | N | Citations | Institutions (Scopus Database) | N | Citations |
|---|---|---|---|---|---|
| University of Malaysia Sabah | 5 | 30 | University of Jember | 2 | 11 |
| California State University | 4 | 485 | East China Normal University | 2 | 11 |
| King's College London | 4 | 159 | University of Cambridge | 2 | 2 |
| University of Jember | 4 | 34 | KTH Royal Institute of Technology | 2 | 2 |
| Peking University | 4 | 31 | Jönköping International Business School | 2 | 28 |
| Surabaya State University | 4 | 19 | National Kaohsiung Normal University | 2 | 1 |
| Russian Academy of Sciences | 4 | 0 | Kazan Federal University | 2 | 0 |
| Shanxi University | 3 | 157 | Western University | 2 | 2 |
| Ohio State University | 3 | 137 | King's College London | 1 | 159 |
| Marmara University | 3 | 11 | Shanxi University | 1 | 159 |

**Keywords Preferred By Authors in Studies Related to the Scientific Creativity**

Related to the seventh sub-problem of the research, the keywords used in studies on scientific creativity were analyzed. The analysis results obtained in this context are given in Figure 10 and Figure 11.

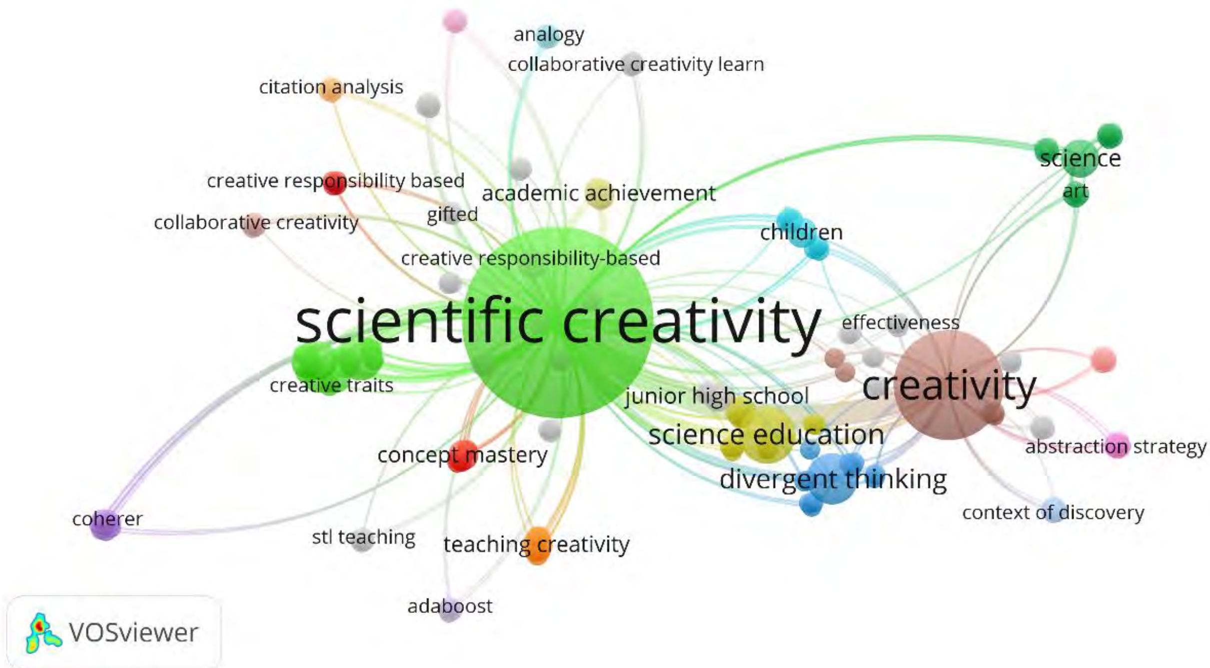


Figure 10. Most Relevant Keywords in WoS Database

When the nodes were examined in Figure 10, it was determined that the most used keywords in the studies in the WoS database were "scientific creativity, creativity, science education, and divergent thinking", respectively.

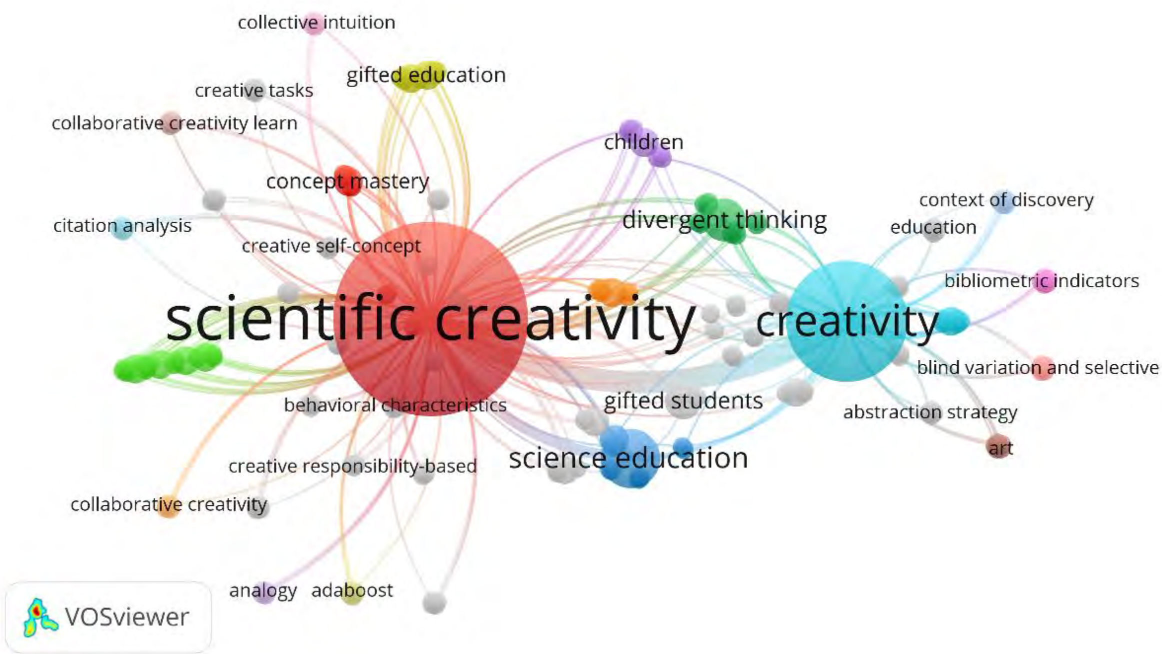


Figure 11. Most Relevant Keywords in Scopus Database

When the nodes in Figure 11 were examined, it was determined that the most used keywords in the studies in the Scopus database were also "scientific creativity, creativity, science education, and divergent thinking", respectively.

The analysis of the Top-10 most used keywords in scientific creativity studies in WoS and Scopus databases is given in Table 7.

Table 7. Top-10 Keywords in Scientific Creativity Studies in WoS and Scopus Databases

| **Analysis of Top-10 Keywords (WoS Database)** | **N** | **Analysis of Top-10 Keywords (Scopus Database)** | **N** |
|---|---|---|---|
| scientific creativity | 50 | scientific creativity | 55 |
| creativity | 19 | Creativity | 24 |
| science education | 6 | science education | 7 |
| divergent thinking | 5 | divergent thinking | 4 |
| stem | 4 | Gifted students | 3 |
| science | 3 | Children | 2 |
| cooperative learning | 3 | cooperative learning | 2 |
| children | 2 | problem based learning | 2 |
| pre-schoolers | 2 | Effectiveness | 2 |
| problem based learning | 2 | Steam | 2 |

Based on the analysis, it was determined that the words “scientific creativity, creativity, science education, and divergent thinking” were the most used keywords in scientific creativity studies in both databases. It was concluded that the keywords used in studies on scientific creativity were similar in both databases, and the words “cooperative learning, children, and problem-based learning” are among the Top-10 most used keywords.

## Discussion and Conclusion

In this research, studies on scientific creativity from 1975 to 2021 in the WoS and Scopus databases were analyzed by using bibliometric analysis. Results of the analysis showed that studies on scientific creativity had been conducted mostly in education/educational research and social science categories. The development of scientific creativity through education (Rasul et al., 2018) and the increase in studies in order for it to be supported by different learning-learning approaches (Astutik et al., 2020; Karademir, 2016; Kozhevnikov et al., 2021) explains why the education/education research and social sciences categories are in the first ranks.

It was found in both databases that the most cited study was “the integration of product, person, and process perspectives” published by Dean Keith Simonton in 2003. The results of the study also showed that Nyet Moi Siew (5 studies) was the author who had the most publications on scientific creativity. It was determined that the most cited authors due to their studies in the field of scientific creativity are “Simonton, D. K., Hu, W., Sternberg, R. J., Runco, M. A., Torrance, E. P., and Kaufman, J. C.”. It can be concluded that the most cited authors are active in the scientific creativity field and conduct studies that lead the field. It was also determined that the journal that published the most studies on scientific creativity in both databases was the Journal of Baltic Science Education. In addition, it was revealed that the Creativity Research Journal and Thinking Skills and Creativity journals had substantial studies on scientific creativity. Based on this, it can be concluded that these journals are competent and active journals in the field of scientific creativity. As another result of the research, it was determined that the countries with the most studies on scientific creativity in both databases were the United States of America, China, Indonesia, and Turkey. It was concluded that the number of citations was higher in all four countries depending on the number of studies. It was observed that although the number of studies in United Kingdom was low in both databases, the number of citations was high. Based on this result, it can be said that in the United Kingdom, essential studies in the field of scientific creativity are carried out. The obtained finding is similar to the findings of the study of Saptono & Hidayah (2020) in which different dimensions of scientific creativity studies were analyzed.

The results of the analysis showed that the University of Malaysia Sabah was the institution with the most scientific creativity studies in the WoS database. In the Scopus database, on the other hand, it was determined that the University of Jember had more studies on scientific creativity compared to other institutions. Also, institutions with the highest number of citations were determined as California State University, King's College London, Shanxi University, and Ohio State University, respectively. This finding shows that even though these institutions’ number of studies on scientific creativity is low, they carry out effective studies in this field.

In terms of the keywords issue, which was the last sub-problem of the research, it was determined that the words “scientific creativity, creativity, science education, and divergent thinking” were the most used keywords in scientific creativity studies in both databases.

In this research, studies focusing on scientific creativity and standing out in the WoS and Scopus databases were examined. In this context, the fact that this study only includes publications found in the WoS and Scopus databases can be shown as the most important limitation of it. In terms of future studies, researchers can conduct bibliometric analyzes of scientific creativity by using other existing databases or by incorporating further analysis methods into their research.

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