## Students' critical thinking skills (2011-2020): A bibliometric analysis

Iwan Iwan[1,*], Sutiman Bambang Sumitro[2], Ibrohim Ibrohim[3], Fatchur Rohman[3]

[1]Universitas Papua, Indonesia
[2]Universitas Brawijaya, Indonesia
[3]Universitas Negeri Malang, Indonesia

**Abstract:** The purpose of this study is to identify and analyze articles that examine students' critical thinking abilities that have been published in several reputable international journals published in period 2011-2020 using bibliometric analysis. The research was conducted using a systematic mapping method in 4 stages: (1) searching articles using the Publish or Perish (PoP) application in the Scopus database, (2) classifying articles for bibliometric analysis, (3) checking and filling in article metadata and (4) conducting bibliometric analysis using the VOSviewer application. The results of the bibliometric analysis yielded 5 findings, as follows: (1) the trend of publication of critical thinking skills has fluctuated from 2011-2020; (2) the ten most contributing journals have published 46 articles up to 2020; (3) the ten most cited articles resulted in 669 citations; (4) The four highest order keywords that are most widely used in critical thinking skills articles are critical thinking abilities, thinking abilities and students; (5) There are 6 writers who research critical thinking skills the most but have not seen collaboration between the 6 writers; It can be concluded that student critical thinking abilities in the world of education are being researched even though they have fluctuated over the last 10 years.

**Keywords:** Bibliometric analysis, publication trend, students critical thinking skills

## Keterampilan berpikir kritis siswa (2011-2020): Sebuah analisis bibliometrik

**Abstrak:** Tujuan Penelitian ini adalah untuk mengidentifikasi dan menganalisis artikel penelitian terkait keterampilan berpikir kritis peserta didik yang telah diterbitkan di beberapa jurnal internasional bereputasi dalam kurun waktu 2011-2020 dengan metode analisis bibliometrik. Penelitian dilakukan dengan metode pemetaan sistematis 4 tahap: (1) pencarian artikel menggunakan aplikasi Publish or Perish (PoP) di database Scopus, (2) pengklasifikasian artikel untuk analisis bibliometri, (3) pengecekan dan pengisian metadata artikel dan (4) melakukan analisis bibliometri menggunakan aplikasi VOSviewer. Hasil analisis bibliometri menghasilkan 5 temuan, sebagai berikut: (1) tren publikasi keterampilan berpikir kritis mengalami fluktuasi dari tahun 2011-2020; (2) 10 journal dengan kontribusi terbesar telah menerbitkan 46 artikel pada tahun 2020; (3) 10 artikel yang paling banyak dikutip memiliki 669 kutipan; (4) 4 kata kunci yang paling banyak digunakan penulis dalam artikel keterampilan berpikir kritis adalah keterampilan berpikir kritis, bepikir kritis, keterampilan dan peserta didik; (5) Terdapat 6 penulis yang paling banyak meneliti keterampilan berpikir kritis namun belum terlihat kolaborasi antar 6 penulis. Kesimpulan penelitian ini yaitu keterampilan berpikir kritis siswa dalam dunia pendidikan banyak yang meneliti meskipun mengalami fluktuasi selama 10 tahun terakhir.

**Kata Kunci:** Analisis bibliometrik, tren publikasi, keterampilan berpikir kritis siswa

## INTRODUCTION

Critical thinking skills are categorized as 21st century talents. These abilities must be strengthened through education. The ability to think critically is one of the competences and skills that have been identified in accordance with the Partnership for 21st Century Learning as being crucial for success in life and the workplace (P21, 2015). Everyone in the Critical thinking skills are necessary in the twenty-first century (Saputra, 2019). To select what information is trustworthy and what steps to take during reasoning and issue solving, critical thinking abilities are the ability to reflect and make wise decisions (Kong, 2014; Cretu, 2017). Critical thinking, problem-solving, communication, and cooperation abilities are prerequisites for learning (Kardoyo et al., 2020; Tican & Deniz, 2019).

Critical thinkers are able to see issues, pose inquiries, put up arguments with ease, and locate numerous sources of information. One can solve social, scientific, and practical issues successfully by using critical thinking. Critical thinking promotes the proper method of thinking and functioning, makes it possible to identify significant information with more accuracy and specificity, and aids in project management and problem solving. Because ability to think critically are considered crucial talents in higher education, they help students succeed there (Saenab et al., 2021; Iwan et al., 2020). One requirement for pupils to succeed in the classroom nowadays is the capacity for critical thought. Because thinking critically is useful in resolving variety of issues, both those that are specific study subject they are pursuing and issues that they will run into in their daily lives (Miterianifa et al.,2019; Saputro et.al., 2020).

Many scholars have recently studied critical thinking skills of students, like Saenab et al. (2021) who found that students' critical thinking skills have improved and can help students think more clearly. According to research by Chen and Chuang (2021), critical thinking abilities help people improve other abilities including communication, problem-solving, and computer literacy. Additionally, research by Cruz et al, (2020) demonstrates that critical thinking abilities are a collection of interrelated abilities that graduates need in order to find employment. According to the conclusions of a study by Fajari et.al (2020), there are disparities in students' learning styles and critical thinking abilities across various learning media. The results of this study by Ristanto (2020) demonstrate that pupils that receive instruction based on the CIRC learning paradigm critical thinking skills those who are taught using the standard learning method.

According to Kavenuke et al. (2020) study, potential teachers score highly on critical thinking tasks. The most recent research particularly on critical thinking abilities from literature analysis (meta-analysis) has been completed. The study intends to synthesize the findings of studies on the contribution of using problem-based instruction to help pupils build their capacity for critical thought in biology, chemistry, and physics. They assessed the best practicability of critical thinking abilities using a meta-analysis. 57 papers in all were found using the title as the foundation of the electronic search. The publications were then categorized and evaluated, and 20 papers that fit the criteria were chosen for the meta-analysis (Miterianifa et al., 2019).

Several research findings relevant to bibliometric analysis of critical thinking abilities of students show that by using Bibliographic metrics such in terms of research output of publication, type of document, field of study, keyword analysis, An overall rise in the quantity of critical thinking education materials in terms of authorship and citation analysis

shows the growing awareness of the importance and special prerequisites for education in the twenty-first century carried out (Jatmiko et al., 2021; Mohamed & Sihes, 2021; Machmud et al., 2023). However, research related to critical thinking skills is still very limited. Consequently, doing a bibliometric study is required. Bibliometric analysis is a statistical tool that is much needed in mapping the state of scientific knowledge, because its role can assist in identifying important information needed starting from research objectives, research opportunities, and in strengthening research or scientific publications. The use of bibliometrics in this study is expected to be able to find out trends in a study, so that researchers can relate research results to other studies. As the expected role in a research is to create progress and develop knowledge in a particular scientific family (Triansyah et al., 2023).

Bibliometrics has the principle that research must be connected or related to other research. Thus, to find out research trends related to critical thinking skills to how opportunities for further research on this topic can be studied using bibliometrics. This is supported by the explanation) regarding several reasons for using the bibliometric method in research: first, research using data is considered more relevant. Second, reviews on It is simple to find subjective and critical scientific works or articles. Thirdly, this method helps in obtaining scientific reviews. In addition, the use of bibliometric analysis can help find out from the year the highest domain of the article and how big it is (Hufiah et.al., 2021). Knowing the increase and the country of origin with the most publications (Jatmiko et al., 2021) helps find data from a journal house with writing criteria dominated by individuals or collaborations, productive authors and popular research questions (Mohamed & Sihes, 2021). Furthermore, the use of bibliometrics can review research trends and opportunities in the futusre as well as become references and preferences on certain topics in a field of science.

From the various literatures that have been presented, bibliometric studies related to students' critical thinking skills the previous ten years are still lacking, specifically for bibliometric analyses that use Scopus as their sole database. According to researchers, bibliometric studies are important for mapping bibliographic information in certain fields (Fernáández et al., 2019; Bonafide et al., 2021).

Therefore, this article aims to find out the important aspects in the research map of students' critical thinking skills so that they get a more comprehensive mapping. This research focuses on bibliometric data examination of students' critical thinking abilities in light of five factors, including publishing trends, the most influential journals, citation patterns, author keywords, and author collaboration. As a result, the following formulation of the problem served as the foundation for the research:

1. What is the trend in publishing articles on students' critical thinking skills between 2011 and 2020?
2. Which journals publish the most articles on students' critical thinking abilities between 2011 and 2020?
3. How are papers on students' critical thinking skills cited between 2011 and 2020?
4. What are the keyword trends used by the author in the publications on students' critical thinking abilities from 2011 - 2020?
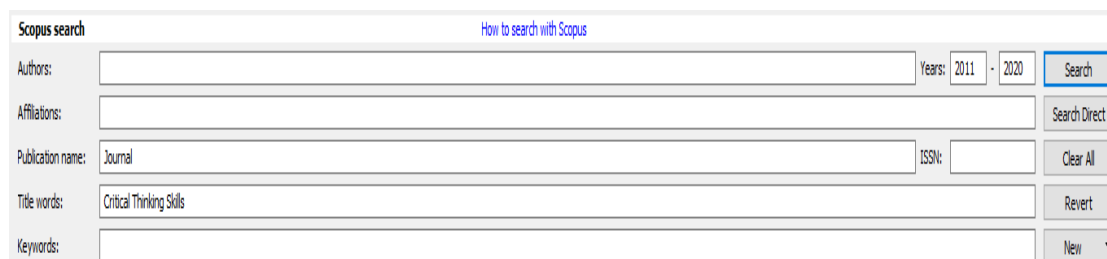5. Who else worked on the 2011–2020 students' critical thinking abilities article with the author?

## METHOD

### Research Design

This study employs a systematic and explicit mapping strategy employing a bibliographic study design (Garza, 2015;Fernsáández et al., 2019; Hudha et al., 2020; Haryandi et al., 2021). According to research Julia et al., (2020), the four stages of the bibliographic study are: (1) search processes; (2) bibliographic filters; (3) complete bibliography; and (4) bibliometric analysis.

### Sample and Data Collection

Publish or Perish (PoP) software is the application employed in this study for searching bibliographic databases. While Scopus is a database source for bibliographic searches using the PoP application and is one of the largest databases that provides peer reviewed literature (Ballew, 2009). Scopus was chosen as the only database for this investigation as a result. In comparison to other repositories, Scopus has a much greater variety of goods Salisbury ( 2009) and  Shareefa and Moosa (2020), and it has around more publications than WoS by 70%.  All literature included in the study has to meet a number of requirements, which span the following three areas: Only journals may be used for bibliographies, and the title of the article must refer to "critical thinking skills" in some way. Additionally, the search year is restricted to the years 2011 through 2020 (the previous 10 years). The search is conducted in February 2021 since searches in the Scopus database through PoP are restricted to a maximum of 200 articles. Figure 1. illustrates the process of searching for bibliography in the PoP application.



Fig 1. Bibliographic search of PoP applications

The saved bibliographic search results are saved into an Excel application called RIS Manager and a CSV file. Files that have been saved are examined and given metadata.

### Analyzing of Data
*Filtering for Citations.*

The bibliography was chosen and arranged according to a number of criteria, including: (1) the usage of English; (2) the inclusion of a context for critical thinking abilities; and (3) publication by a respectable or well-established publisher of bibliographic databases. By exploring the Scopus database that was extracted from the PoP application, each bibliography that will be included in or excluded from the bibliometric analysis procedure is examined. Only the journal type was considered when choosing the type of bibliography. Because they are Conference Articles, Erratums, Notes, Editorials, Reviews, Clones, or articles without an abstract, some of the bibliographies that surface during the search process in the PoP application are not chosen.

200 bibliographies were found in the initial PoP search results, which were then divided into 163 chosen bibliographies. 37 bibliographies were passed through because they failed to satisfy the requirements. The number of bibliographies from the PoP application's search results for each year.

Table 1. Results of a bibliographic

| Publication Year | Number of Article | Selected | Non Selected |
|---|---|---|---|
| 2020 | 6 | 6 | 0 |
| 2019 | 30 | 25 | 5 |
| 2018 | 38 | 25 | 13 |
| 2017 | 23 | 17 | 6 |
| 2016 | 30 | 27 | 3 |
| 2015 | 15 | 12 | 3 |
| 2014 | 13 | 11 | 2 |
| 2013 | 16 | 14 | 2 |
| 2012 | 14 | 14 | 0 |
| 2011 | 15 | 12 | 3 |
| Total | 200 | 163 | 37 |

*Complete Bibliography*

Metadata was verified and finished in order to conduct a filtered bibliographic analysis. The title of the article, the author's name, agency, and country, the abstract, the author's keywords, the article links, the publisher, and the year of publication are among the exam's elements that will be examined. After all metadata had been collected, bibliometric analysis was done.

*Bibliographic Evaluation*

The following 5 factors formed the basis for the bibliometric analysis: The most referenced articles, the journals with the most articles on critical thinking, the publication trends, and the author's most often used keywords in terms of thinking skills are all included below. important, (5) writer cooperation. To do bibliometric analysis and view the results of bibliometric analysis, utilize the VOSviewer program (Hudha et al., 2020). VOSviewer includes a number of distinct views, analyses, and observations and is operated to work effectively with enormous amounts of data (Eck & Waltman, 2014). Additionally, using shared citation platforms or keyword maps focused on channels, VOSviewer can generate publication, author, or journal maps (Hudha et al., 2020). A bibliographic file is the sort of file that is used in the VOSviewer application for analysis.

## RESULTS

**Trend-Based Analysis of Publications**

Figure 2 shows the pattern of journal articles published between 2011 and 2020 on the subject of critical thinking abilities. The trend of publications from 2011 and 2020 is one of ascending (up) - declining (down) - ascending (up) - descending (down). Between 2015 and 2016, a significant the number of publications has increased. even if 2016 saw the most

publications overall. As a result, the existence of journal publications on the subject of critical thinking abilities indicates that scholars are still uninterested in the subject.
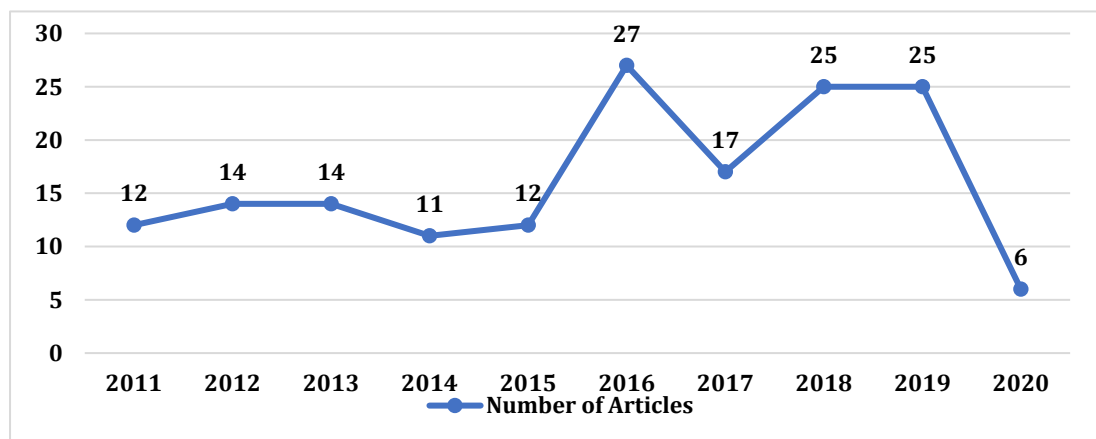


Fig. 2. Publication trend per year

Figure 2 demonstrates the consecutive variations (up and down) in the number of papers published. Up to 12 papers were published in 2011, and 6 papers were published up till 2020. The years 2015–2016 saw the most publications.

**Analysis Based on Journals**

Table 2. The most widely published journal article on critical thinking skills

| No | Journal Name | Number of Article | Publisher |
|---|---|---|---|
| 1. | International Journal of Instruction | 11 | Faculty of Education, Eskisehir Osmangazi University |
| 2 | Nurse Education Today | 9 | Churchill Livingstone |
| 3 | Jurnal Pendidikan IPA Indonesia | 8 | Universitas Negeri Semarang (UNNES) |
| 4 | Computers and Education | 4 | Elsevier Ltd. |
| 5 | Thinking Skills and Creativity | 4 | Elsevier BV |
| 6 | International Journal of Emerging Technologies in Learning | 3 | Kassel University Press |
| 7 | Eurasian Journal of Educational Research | 3 | ANI Publishing |
| 8 | Eurasia Journal of Mathematics, Science and Technology Education | 3 | Modestum Ltd |
| 9 | Journal of Chemical Education | 2 | American Chemical Society |
| 10 | European Journal of Educational Research | 2 | Eurasia Society of Educational Research |

The top 10 journals that publish the most publications on critical thinking abilities are listed in Table 2. a total of 11 articles published, the International Journal of Instruction

holds the top spot. The publication Nurse Education Today, Having a total of 9 articles, is second to last. The Indonesian Science Education Journal, with 8 papers published, is in third position. The fourth-placed journal is followed by two others that each publish four articles: Computers and Education, critical thinking, and creativity. The Eurasia Journal of Educational Research and Journal of Mathematics, Science, and Technology Education in Eurasia, each of which published three papers, are located in the third position. The Journal of Chemical Education and the European Journal of Educational Research, each of which publishes two papers, have the fewest publications.

According to Table 2, all of the journals mentioned in positions 4-5 published four papers. The journals listed in numbers 6 through 8 then publish 3 papers apiece, while journals in numbers 9 through 10 only publish 2.

**Based on Citation Analysis (Number of Citations Each Year)**

The amount of citations to articles on critical thinking skills is shown in Figure 3. An ascending-descending-ascending (down)-ascending pattern may be seen in the quote. Between 2011 and 2012, 2013 and 2014, 2015 and 2016, and 2017 and 2018 there is an upward trend. From 2012 to 2013, 2014 to 2015, 2016 to 2017, 2018 to 2019, and from 2019 to 2020, a declining trend is observed. The year with the most citations a total of 485 from 27 articles was 2016, and the year with the fewest 32 from 6 articles was 2020. From 2018 to 2020, there is a rise in the number of citations.
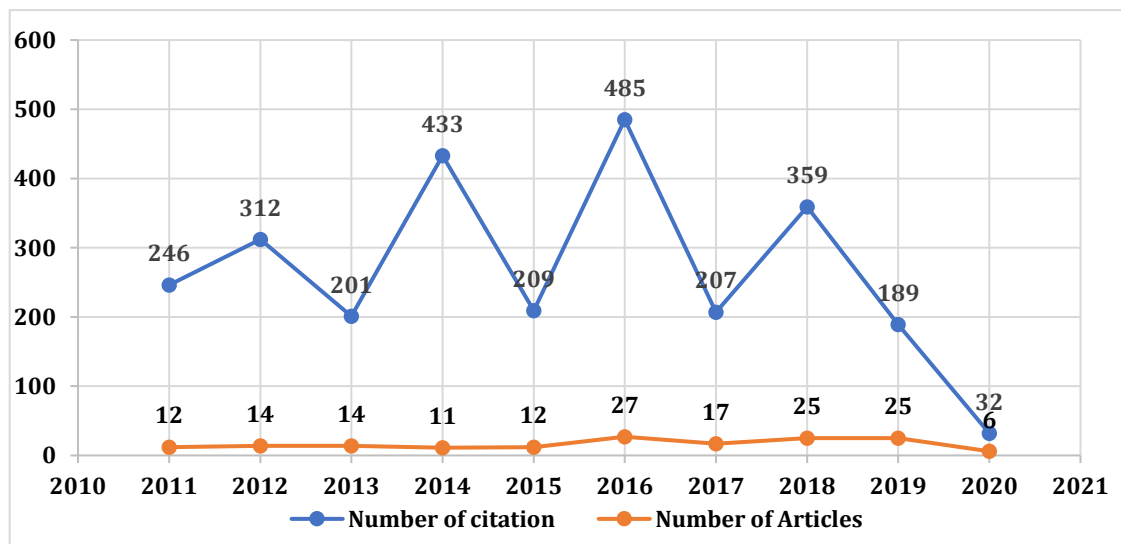


Fig. 3. Number of citations per year

Figure 3 demonstrates that while there were 12 published papers in both 2011 and 2015, the two years' citation counts were different (246 in 2011 and 209 in 2015). Similar to this, 14 publications were published in both 2012 and 2013, yet in 2012 there were 312 citations, while in 2013 there were only 201 citations. Similarly, while there were 25 publications published in each of the years 2018 and 2019, there were fewer citations in 2019 than there were in 2018. In 2018, there were 359 citations. This suggests that the study's publication that year had a big influence on other investigations.

**Top 10 Most Cited Article**

The top ten critical thinking articles are shown in Table 3 along with their most popular citations. S. Kong's essays, which were published in 2014, received 179 citations, which put them in top place. N.M. Fuad took second with 65 citations. A substantial amount of citations are above the number of 50 and below the number of 100 in the third, fourth, fifth, sixth, and seventh sequences. While the sequences eight through ten display average citations under 50. In this article the themes that are being researched are critical thinking skills, current learning models and literacy. Therefore, many people make citations related to the article

Table 3. The most cited article

| No | Authors | Article Title | Year | Citations | Journal Name |
|----|---------|---------------|------|-----------|--------------|
| 1 | Kong | enhancing critical thinking and information literacy through domain knowledge learning in digital classrooms: An experience of practicing flipped classroom strategy | 2014 | 179 | Computers and Education |
| 2 | Fuad et al. | Improving junior high schools' three different learning models were used to measure the critical thinking abilities | 2017 | 65 | International Journal of Instruction |
| 3 | D.Corebima and Dökme | The effect of the inquiry-based approach to teaching critical-thinking to students | 2016 | 64 | Eurasia Journal of Mathematics, Science and Technology Education |
| 4 | Kek and Huijser | The power of problem-based educating pupils to become critical thinkers and preparing them for digital futures in today's classrooms | 2011 | 62 | Higher Education Research and Development |
| 5 | Flores et al. | Lack of Critical Thinking Capabilities Among College Graduates: Leadership Implications | 2012 | 58 | Educational Philosophy and Theory |
| 6 | Loes et al. | Who benefits from the impact of diversity experiences on critical thinking abilities? | 2012 | 58 | Journal of Higher Education |
| 7 | Lee et al. | Cooperation starts with employing a mobile learning game to promote cooperative reciprocity and critical thinking abilities | 2016 | 52 | Computers and Education |

| 8 | Naber and Wyatt | The impact of reflective writing interventions on baccalaureate nursing students' critical thinking abilities and attitudes | 2014 | 47 | Nurse Education Today |
| 9 | Çavdar and doe | Developing critical thinking abilities through writing tasks | 2012 | 43 | PS - Political Science and Politics |
| 10 | Gholami et al. | In a critical care nursing course, nursing students will compare the effects of problem-based learning versus the conventional lecture technique on their ability to think critically and their knowledge of their own thinking. | 2016 | 41 | Nurse Education Today |

According to Table 3, the 10 publications with the greatest impact were all published between 2011 and 2017: in 2011, one paper, in 2012, three papers, in 2014, two papers, in 2016, and in 2017.
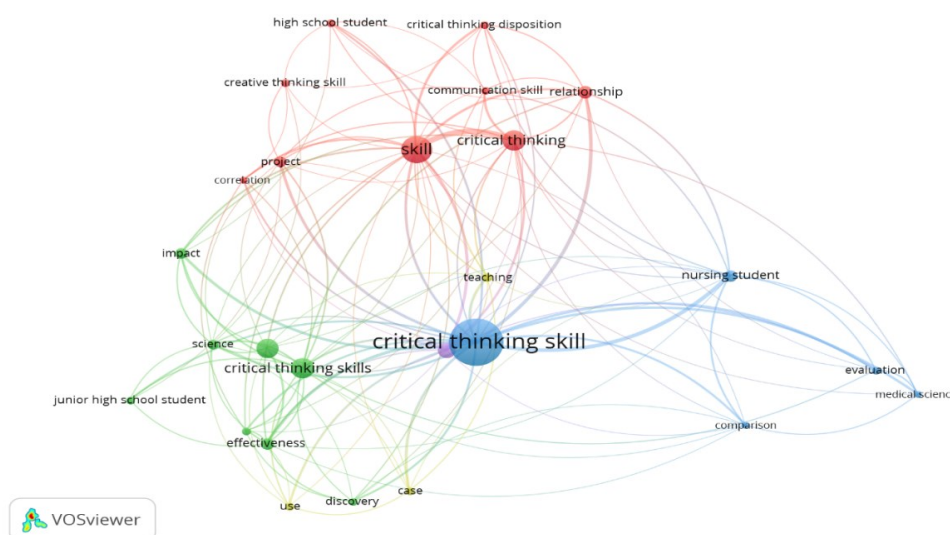
**Writer of Keyword Analysis**



Fig. 4. Network visualization of author keyword

The VOSviewer program was used to conduct the author's keyword analysis. Figure 4 shows the analysis of 163 authors' keywords and the 26 authors' strongly linked terms. The author's 26 keywords are divided into 5 clusters which are presented in different colors. Cluster 1 (red) consists of 9 items, cluster 2 (green) consists of 8 items, cluster 3

(blue) consists of 5 items, cluster 4 (yellow) consists of 3 items, cluster 5 (purple) consists of 1 item.

**Author Collaboration**

The findings of the investigation of the authors' collaboration using VOSViewer with a minimum number of occurrences of one document, from 163 authors produced 6 authors, but there is no collaboration between one another. The pattern of collaboration of the authors is depicted in Figure 5.
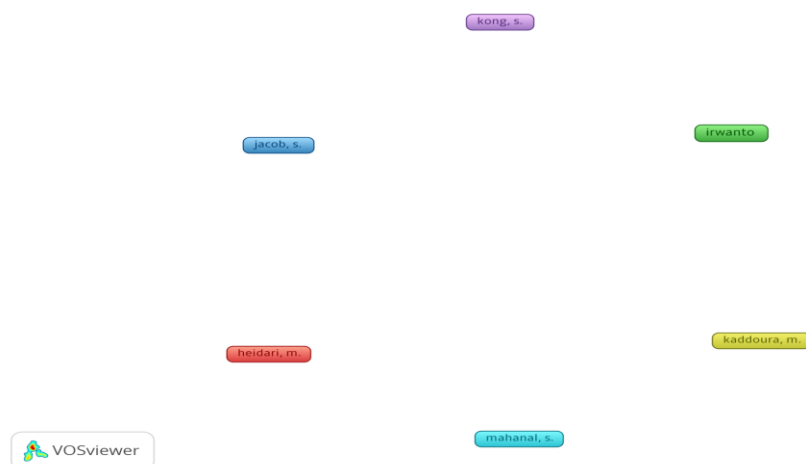


Fig. 5. Network visualization of author collaboration

## DISCUSSION

Since 2011, established study findings on students' critical thinking abilities have been published in journals with Scopus indexes. The number of publications in the critical thinking skills research has fluctuated or changed every year since 2011 through 2020. A total of 163 articles were published. This demonstrates that despite the fact that critical thinking abilities are crucial for students to possess in order to thrive in their lives in the future, they have not been widely used in educational practice for many years.

There will be a down-up-flat-up-down-flat-up-down pattern in the publication trend. There were 12 articles in 2011, followed by an increase to 14 articles in 2012 and 2013 accordingly. Then, as many as 11 articles plummeted again in 2014. There was a noticeable increase from 12 articles in 2015 to 27 articles in 2016. Then it decreased once more in 2017, dropping to 17 articles, but it surged once again in 2018 and 2019, reaching 25 articles each. 2020 fell to just 6 items last year. This publishing trend's pattern changes with time, reflecting changes in research production. This article's variation can be attributed to a number of variables, including organizational size, organizational requirements, incentive structures, reputation, and the trend in the publication of ability to think critically. Given that encouraging critical thinking among students a crucial component of the educational process to develop the abilities required for the 21st century, this publication trend will likely continue to rise in the coming years (Sumarni & Kadarwati, 2020).

It is impossible to separate the contributions of the several journals that consistently map research areas related to critical thinking abilities from the great quantity of

112

publications. The ten journals included in Table 2 are those with a Scopus index and have made the biggest contributions to publishing critical thinking skills articles during the previous ten years. The journal that the researcher has decided to publish in also demonstrates the reputation and credibility of the journal, as well as the credibility of the publisher. The articles with the greatest influence on other studies can be found among all those that have been published. One metric to gauge a scientist's brilliance is their number of citations. According to research by Qi et al, (2017) outstanding scientists are judged by the quantity of citations they receive. Figure 3 demonstrates that the publications on critical thinking abilities with the most influence were those with a total of 485 citations from 27 articles and were published in 2016. Kong S.C. specifically wrote the piece with the greatest impact. A study was carried out to improve information literacy and critical thinking abilities through the use of reverse classroom tactics in digital classroom learning.

Four middle grade 1 students from secondary schools in Hong Kong totaling 107 were selected to take part in the study. Every three students in a 13-week teaching experiment share a Tablet PC to learn two topics in the Integrated Humanities course. Students' domain knowledge, information literacy, and critical thinking skills showed statistically significant development in the two subject areas tested before and after (Kong, 2014). This article also shows how well-developed the field of computer education and learning technology is in terms of study on the subject of critical thinking abilities. According to Table 3's journal titles, there is a lot of research on critical thinking abilities in the domains of political science, computer science, nursing, education, and education and learning technology.

The writers of studies on critical thinking abilities most frequently utilize a few keyphrases when publishing their findings. According to Hao and Zhao (2014), keywords capture the essence of the sentence and reflect the meaning of the entire sentence. Some of the keywords that researchers (authors) employ in research articles capture the spirit of the entire subject under study. The term "Critical thinking skills" froms cluster 1 with 137 links is the author's most utilized keyword in the ability to think critically research, as shown in Figure 4. '' critically analyzing '' cluster 2 is the second-largest order, with 36 linkages. 'Students' from cluster 3 is the third-highest order, with 49 linkages. The phrase "Skills" is arranged in the fourth-highest order, with 53 links. Through the use of these four key phrases, the author can show how the principles of 21st-century educational practices, which incorporate critical thinking abilities of students, are strongly connected to the critical thinking skills in his research.

Based on the bibliometric analysis conducted research on critical thinking abilities of students experienced a process of ups and downs so it needs to be done continuously regarding critical-thinking abilities in education. Given that students' critical thinking skills are very urgent to do in the future as a provision for 21st century learning.

## CONCLUSION

The first five problems can be resolved in the manner that follows. First, throughout the past 10 years, there have been varying numbers of articles on critical thinking abilities in journals with Scopus indexes. Second, 49 of the articles from the top ten journals have been released. The number one journal released 11 articles, while the tenth-ranked magazine only released 2. Third, with a total of 485 citations, the majority of the citations took place in works that were published in 2016. Kong wrote the articles that received the

most citations. has 179 citations in the Department of Mathematics and Information Technology. Fourth, critical thinking talents, skills, and critical thinking are the author's three most frequently used buzzwords. Fifth, the six authors who have studied critical thinking skills the most do not work together.

These findings demonstrate that research trends related to critical thinking skills have experienced a shift and future opportunities related to students and evaluation. Therefore, it is better for further research to discuss students and evaluation and be able to follow trends that have opportunities.

## REFERENCES

Ballew, B. S. (2009). Elsevier's Scopus® database. *Journal of Electronic Resources in Medical Libraries*, *6*(3), 245–252. https://doi.org/10.1080/15424060903167252

Bonafide, D. Y., Yuberti, Saregar, A., & Fasa, M. I. (2021). Problem-based learning model on students' critical-thinking skills: A meta-analysis study. *IOP Conference Series: Earth and Environmental Science*, *1796*(1). https://doi.org/10.1088/1742-6596/1796/1/012075

Chen, H. L., & Chuang, Y. C. (2021). The effects of digital storytelling games on high school students' critical thinking skills. *Journal of Computer Assisted Learning*, *37*(1), 265–274. https://doi.org/10.1111/jcal.12487

Cretu, D. (2017). Fostering 21st century skills for future teachers. *The European Proceedings of Social & Behavioural Sciences*, 23, 672-681. http://dx.doi.org/10.15405/epsbs.2017.05.02.82

Cruz, G., Payan-Carreira, R., Dominguez, C., Silva, H., & Morais, F. (2020). What critical thinking skills and dispositions do new graduates need for professional life? Views from Portuguese employers in different fields. *Higher Education Research and Development*, 4*0*(4), 721–737. https://doi.org/10.1080/07294360.2020.1785401

Eck, N. J. Van, & Waltman, L. (2014). Visualizing bibliometric networks. In Y. Ding, R. Rousseau, & D. Wolfram (Eds.),. In *Measuring Scholarly Impact*. https://doi.org/10.1007/978-3-319-10377-8

Fajari, L. E. W., Sarwanto, & Chumdari. (2020). Improving elementary school's critical thinking skills through three different PBL-assisted learning media viewed from learning styles. *Journal of E-Learning and Knowledge Society*, *16*(1), 55–64. https://doi.org/10.20368/1971-8829/1135193

Fernáández Batanero, J. M., Reyes Rebollo, M. M., & Montenegro Rueda, M. (2019). Impact of ICT on students with high abilities. Bibliographic review (2008–2018). *Computers and Education*, *137*(January), 48–58. https://doi.org/10.1016/j.compedu.2019.04.007

Garza-Reyes, J. A. (2015). Lean and green-a systematic review of the state of the art literature. *Journal of Cleaner Production*, *102*, 18–29. https://doi.org/10.1016/j.jclepro.2015.04.064

Hao, W., & Zhao-Hui, L. (2014). The research of popular topic mining method based on microblogging text. *Proceedings - 2014 4th International Conference on Instrumentation and Measurement, Computer, Communication and Control, IMCCC 2014*, 888–892. https://doi.org/10.1109/IMCCC.2014.186

Haryandi, S., Suyidno, S., Misbah, M., Dewantara, D., Mahtari, S., & Ibrahim, M. A. (2021).

Scientific creativity: A bibliometric review and analysis. *Momentum: Physics Education Journal*, *5*(1), 10–20. https://doi.org/10.21067/mpej.v5i1.5002

Hudha, M. N., Hamidah, I., Permanasari, A., Abdullah, A. G., Rachman, I., & Matsumoto, T. (2020). Low carbon education: A review and bibliometric analysis. *European Journal of Educational Research*, *9*(1), 319–329. https://doi.org/10.12973/eu-jer.9.1.319

Hufiah, A., Afandi, A., & Wahyuni, E. S. (2021). Analisis Bibliometrik Domain Keterampilan Berpikir Tingkat Tinggi Dalam Pendidikan Abad 21 Menggunakan Vosviewer. *Js (Jurnal Sekolah)*, *6*(1), 1. https://doi.org/10.24114/js.v6i1.29841

Iwan, I., Istisaroh, I., Sirait, S. H. K., & Damopolii, I. (2020b). The development of teaching materials oriented problem-based learning integrating Tifa to train student's critical thinking skills. *AIP Conference Proceedings*, *2215*(1), 030006. https://doi.org/10.1063/5.0000587

Jatmiko, B., Sunarti, T., Prahani, B. K., Hariyono, E., Dwikoranto, Wibowo, F. C., Mahtari, S., Misbah, M., & Asy'Ari, M. (2021). Critical thinking skills on physics learning during COVID- 19 Pandemic: A bibliometric analysis using VOS viewer. *Journal of Physics: Conference Series*, *2110*(1). https://doi.org/10.1088/1742-6596/2110/1/012020

Julia, J., Afrianti, N., Soomro, K. A., Supriyadi, T., Dolifah, D., Isrokatun, I., Erhamwilda, E., & Ningrum D. (2020). Flipped classroom educational model (2010-2019): A bibliometric study. *European Journal of Educational Research*, *9*(4), 1377–1392. https://doi.org/10.12973/eu-jer.9.4.1377

Kardoyo, Nurkhin, A., Muhsin, & Pramusinto, H. (2020). Problem-based learning strategy: Its impact on students' critical and creative thinking skills. *European Journal of Educational Research*, *9*(3), 1141–1150. https://doi.org/10.12973/EU-JER.9.3.1141

Kavenuke, P. S., Kinyota, M., & Kayombo, J. J. (2020). The critical thinking skills of prospective teachers: Investigating their systematicity, self-confidence and scepticism. *Thinking Skills and Creativity*, *37*, 100677. https://doi.org/10.1016/j.tsc.2020.100677

Kong, S. (2014). Developing information literacy and critical thinking skills through domain knowledge learning in digital classrooms: An experience of practicing flipped classroom strategy. *Computers and Education*, *78*, 160–173. https://doi.org/10.1016/j.compedu.2014.05.009

Machmud, W. S., Nurbayani, E., & Ramadhan, S. (2023). Analisis Bibliometrik Kemampuan Berpikir Kritis Menggunakan R Package. *Judika (Jurnal Pendidikan Unsika)*, *11*(1), 45–68. https://doi.org/10.35706/judika.v11i1.8582

Miterianifa, Trisnayanti, Y., Khoiri, A., & Ayu, H. D. (2019). Meta-analysis: The effect of problem-based learning on students' critical thinking skills. *AIP Conference Proceedings*, *2194*(December). https://doi.org/10.1063/1.5139796

Mohamed Nor, H., & Sihes, A. J. (2021). Critical Thinking Skills in Education: A Systematic Literature Review. *International Journal of Academic Research in Business and Social Sciences*, *11*(11). https://doi.org/10.6007/ijarbss/v11-i11/11529

Niu, L. (2013). Do instructional interventions influence college students' critical thinking skills? A meta-analysis. *Educational Research Review*, Vol. 9, pp. 114–128. https://doi.org/10.1016/j.edurev.2012.12.002

Partnership21 (P21). (2015). P21 framework definitions. Retrieved from http://www.p21.org/storage/documents/docs/P21_Framework_Definitions_New _Logo_2015.pdf

Qi, M., Zeng, A., Li, M., Fan, Y., & Di, Z. (2017). Standing on the shoulders of giants: the effect of outstanding scientists on young collaborators' careers. *Scientometrics*, *111*(3), 1839–1850. https://doi.org/10.1007/s11192-017-2328-8

Ristanto, R. H. (2020). Enhancing students' biology-critical thinking skill through CIRC-based scientific approach (CIRSA). *Universal Journal of Educational Research*, *8*(4), 1–8. https://doi.org/10.13189/ujer.2020.081801

Saenab, S., Zubaidah, S., Mahanal, S., & Lestari, S. R. (2021). Recode to re-code: An instructional model to accelerate students' critical thinking skills. *Education Sciences*, *11*(1), 1–14. https://doi.org/10.3390/EDUCSCI11010002

Salisbury, L. (2009). Web of Science and Scopus: A Comparative Review of Content and Searching Capabilities. *The Charleston Advisor*, *11*(1), 5–18.

Saputra, M. (2019). Developing critical-thinking skills through the collaboration of Jigsaw model with problem-based learning model. *International Journal of Instruction*, *12*(1), 1077–1094. https://doi.org/10.29333/iji.2019.12169a

Saputro, A. D., Atun, S., Wilujeng, I., Ariyanto, A., & Arifin, S. (2020). Enhancing pre-service elementary teachers' self-efficacy and critical thinking using problem-based learning. *European Journal of Educational Research*, *9*(2), 765–773. https://doi.org/10.12973/eu-jer.9.2.765

Shareefa, M., & Moosa, V. (2020). The Most-cited Educational Research Publications on Differentiated Instruction: A bibliometric analysis. *European Journal of Educational Research*, *9*(1), 331–349. https://doi.org/10.12973/eu-jer.9.1.331

Sumarni, W., & Kadarwati, S. (2020). Ethno-stem project-based learning: Its impact to critical and creative thinking skills. *Jurnal Pendidikan IPA Indonesia*, *9*(1), 11–21. https://doi.org/10.15294/jpii.v9i1.21754

Tican, C., & Deniz, S. (2019). Pre-service teachers' opinions about the use of 21st century learner and 21st century teacher skills. *European Journal of Educational Research*, *8*(1), 181–197. https://doi.org/10.12973/eu-jer.8.1.181

Triansyah, F. A., Suwatno, S., & Supardi, E. (2023). Fokus Penelitian Berpikir Kritis Siswa dalam Pembelajaran Ekonomi: Bibliometrik Analisis 2019-2023. *Jurnal Simki Pedagogia*, *6*(1), 130–139. https://doi.org/10.29407/jsp.v6i1.226