

## **A BIBLIOMETRIC ANALYSIS: RESEARCH TREND OF CRITICAL THINKING IN SCIENCE EDUCATION**

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### **Abstract**

This study aims to analyze research trends related to CTS topics in 2017-2022\* through bibliometric analysis with the Scopus database. Based on the criteria obtained 191 articles from 1788 documents. The articles have already been analysed from the international journal indexed Scopus. The selected references are then managed to utilize reference manager software, namely Mendeley. After working on the database, this research classifies and visualizes it using VOSviewer software. The results show that CTS research is increasing every year gradually. The US contributes the most research globally, and Indonesia ranks second. Visualizing the trend of CTS research in 2017-2022\*, there are four clusters. The results of this study can support researchers related to CTS research trends in the world and provide direction in further research. Overall, this review provides an excellent reference point for further research on CTS.

Keywords: Bibliometric analysis, Critical thinking, Research trend, Science education.

## 1. Introduction

The 21<sup>st</sup> -century is marked by the evolution of technology independently, Information, Communication, and Technology (ICT) integration, globalization, and the need for innovation. It is necessary to develop relevant skills and competencies of learners [1]. Students need to be equipped with 21<sup>st</sup>-century skills to prepare themselves for the world of work [2]. One of the 21<sup>st</sup>-century skills is critical thinking skill (CTS) [3]. CTS involves analysing, evaluating, assessing, and providing justification for wrong information [4]. In this educational context, the potential for critical thinking has been enhanced and developed [5]. Developing this critical capacity is not limited to one particular discipline area or various experiences [6]. The CTS has often been discussed and researched around the world. In terms of searching articles results through the *Scopus* database in the period 2017-2022\*, numerous articles have already studied CTS, both on aspects of the learning model, learning media, or the assessment [7-11]. Nevertheless, bibliometric analyses on CTS are precise little found constantly.

This article intends to provide a comprehensive explanation through a bibliometric analysis of the literature on CTS in Science Education. Literature obtained from the *Scopus* database is the point in time analysed and categorized related to/regarding specific criteria. This research has been conducted to answer questions:

- (i) How did the numbers of publications on CTS topics in 2017-2022\*?
- (ii) What is the top tenth contribution of CTS research publications regarding the journal publications?
- (iii) What is the pattern of spreading CTS publications (countries) globally?
- (iv) How do visualize the results of CTS research trends?

## 2. Literature Review

Critical thinking is rational, and reflective thinking focused on what is believed and done. Critical thinking skills include interpretation, analysis, evaluation, conclusion, inference, and self-regulation [12]. The components of knowledge mastery ability into 5 skills referred to CTS: basic clarification, basic support, drawing conclusions, further clarification, and strategies and tactics [13]. Students' CTS can be improved by using learning strategies that focus on aspects of the process where students are active in the learning process [14]. Students must possess CTS to face various personal and social problems in their lives [15].

## 3. Methods

This study utilizes a bibliometric analysis step consisting of five stages (see Fig. 1), including 1) study design; 2) data collection; 3) data analysis; 4) visualization of data; and 5) interpretation [16]. Data collection was conducted in May 2022, based on the criteria obtained, 191 articles were from 1788 documents. The articles have already been analysed from the international journal indexed by *Scopus*. Data from *Scopus* has ever been stored in RIS and CSV, and more over *Mendeley Desktop* has been utilized to reorganize article metadata. Furthermore, *VOS viewer* software as a visualization of research trend data with the topic CTS in the range 2017-2022\* has been implemented.

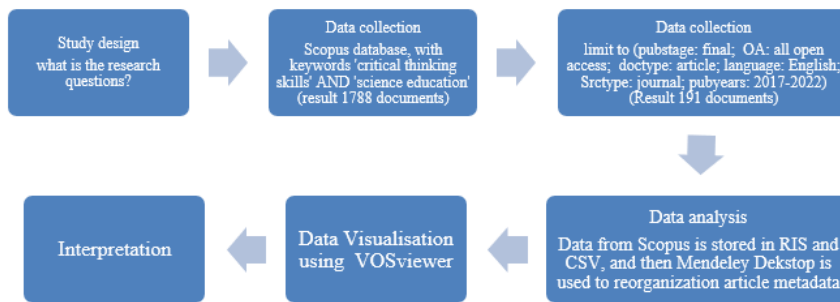


Fig 1. Research scheme of bibliometric in CTS topics.

## 4. Results and Discussion

### 4.1. Publications on CTS topics in 2017-2022\*

The number of CTS publications for 2017-2022\* is presented in Fig. 2. In Fig. 2, it is obtained that the number of publications has increased periodically, and in 2022 it is predicted that there will be an increase. This result is in line with research on other topics which states that there is an increase in the number of publications every year, such as on the topic of Industry 4.0 in Management Studies [17], 21<sup>st</sup>-century skills and competencies in primary education [18], and online e-Learning and cognitive disabilities [19].

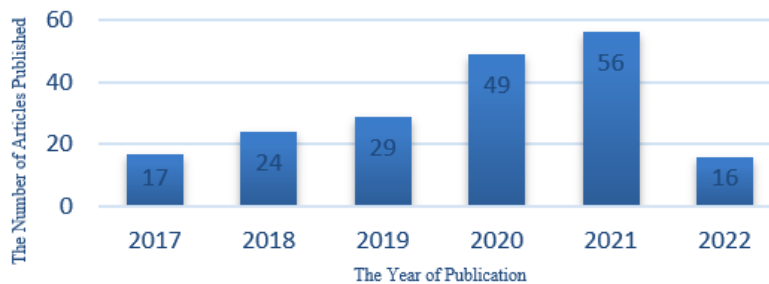


Fig 2. The number of CTS publications for 2017-2022\*.

### 4.2. The pattern of disseminating CTS research publications based on the source (journal)

The types of publications used in this study are journals indexed on Scopus, and the 10 best journals that publish articles on CTS are obtained. Top 10 Journals with CTS Publications (2017-2022\*) are listed in Fig. 3.

Figure 3 shows that the journals that publish articles about CTS are dominated by journals with Q1 quartiles such as (1) International Journal of Instruction, (2) European Journal of Educational Research, (3) Jurnal Pendidikan IPA Indonesia, (4) Sustainability Switzerland, (5) CBE Life Sciences Education, and (6) BMC Medical Education. In addition, there are journals from Q2 quartiles such as (1) Journals of Food Science Education, (2) Frontiers in Psychology, and (3) American Journal of Physiology-advances in physiology education; and Q4 quartiles such as

International Journal of Higher Education. Figure 3 shows that the topic of CTS does not only focus on specific science education but is also related to the Journal of Food Science Education [20], Frontiers in Psychology [21], Sustainability Switzerland [22], and BMC Medical Education [23].

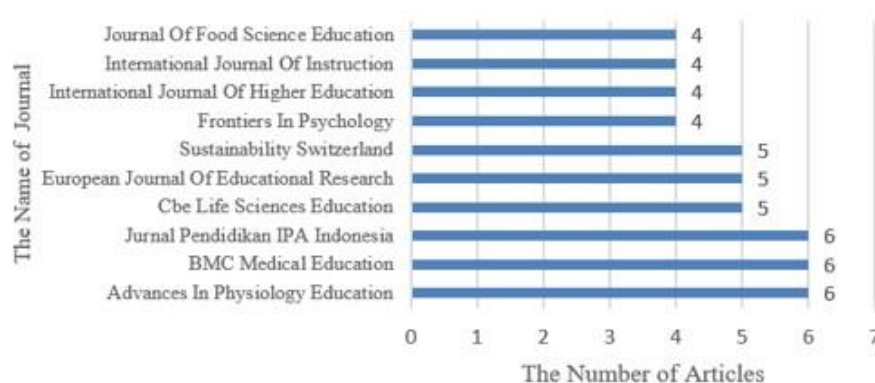


Fig 3. Top 10 journals with CTS publications (2017-2022\*).

#### 4.3. The pattern of spreading CTS publications (countries)

Figure 4 describes the number of CTS by country in 2017-2022\*. The USA found the top spot with 53 publications on CTS, second place being Indonesia with 21 documents, the third place being Malaysia and Spain with 13 documents each, the fourth place being Turkey with 11 documents, the fifth place being Australia with 10 documents; the sixth place is the UK with 9 documents; seventh place being the Netherlands with 7 documents; eighth place being Iran and South Africa with 6 documents each. Based on Scopus data, Indonesian researchers are actively involved in CTS research in international coverage.

The US was ranked the first country to publish the most articles on CTS. This is in line with the research on the topic of mobile learning in higher education, the US is ranked first in the most research on the topic [24].

#### 4.4. Visualization of CTS research trends

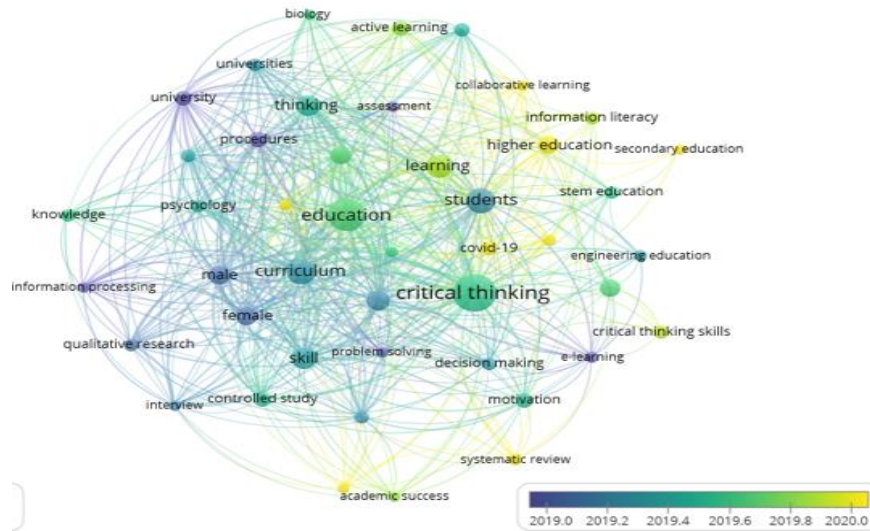
*VOS viewer* provides bibliometric analysis mapping with three different visualizations, namely network visualization listed in Fig. 5. The visualization was obtained through the help of *VOS viewer* software by extracting as many as 191 predefined articles based on the title, keywords, and abstracts of the article. There are 45 identifiable items of 4 clusters characterized by different colors namely red, green, blue, and yellow.

Each cluster shows the development of CTS research in science education which can be observed in Table 1. *VOS viewer* provides bibliometric analysis mapping with 3 different visualizations, namely, overlay visualization listed (see Fig. 6). Based on Fig. 6, research on CTS research is more related to collaborative learning [25], information literacy [26], academic success [27], and covid-19 [28]. In addition, CTS research is implemented at both the secondary and higher education levels. And recently, CTS research has also been presented in the form of a systematic review, although the number of publications is still minimal. This



**Table 1. Research development of each cluster.**

No.	Cluster	Number of Items	keywords
1	Red	17	Collaborative learning, covid-19, critical thinking, CTS, decision making, e-Learning, engineering education, high education, learning, motivation, outcome assessment, problem solving, science education, secondary education, stem education, students, systematic review
2	Green	13	Academic success, controlled study, curriculum, female, information processing, interview, knowledge, male, qualitative research, questionnaire, skill, teaching, training
3	Blue	11	Active learning, assessment, Problem based learning, problem-based learning, procedures, psychology, thinking, universities, university
4	Yellow	4	Educational measurement, information literacy, literacy, pedagogics



**Fig 6. The overlay visualization of CTS research.**

**5. Conclusion**

CTS research is growing annually. The US makes the greatest research contributions, followed by Indonesia. Four clusters can be seen when the CTS research trend in 2017-2022 is visualized. The findings of this study can aid academics looking at global CTS research trends and give guidance for future research. This analysis offers a great starting point for future CTS research.

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