Critical thinking in higher education: a bibliometric analysis

Ita Nuryana
Faculty of Economics and Business, Universitas Negeri Malang, Malang, Indonesia and
Faculty of Economics and Business, Universitas Negeri Semarang, Semarang, Indonesia, and
Bambang Sugeng, Etty Soesilowati and Endang Sri Andayani
Universitas Negeri Malang, Malang, Indonesia

Abstract

Purpose – Critical thinking (CT) in higher education institutions (HEIs) is rarely examined using bibliometric methods to provide a better reference path for future research. This study aims to provide a broad survey of the bibliometric literature on CT in HEIs.

Design/methodology/approach – Compiled from the Scopus database, there were 670 articles published from 2018 to 2022 analyzed in the study. VOSviewer software was also used to analyze co-authorship, co-occurrence and citation.

Findings – The results showed that the CT research literature was mainly published in the US. However, the highest number of citations was from Australian authors. The most frequent keywords were CT, skills and higher education.

Research limitations/implications – Due to the high variability of assessment strategies for each study, the current study suggests that further research focuses on the global assessment model of CT in HEIs.

Originality/value – To the best of the research’s knowledge, the study on CT in higher education with bibliometric analysis is rarely explored.

Keywords CT, Higher education institutions, High-order thinking

Paper type Research paper

Background

21st-century learning is a solution to prepare a superior generation to compete in the global challenges of the 21st century. Critical thinking (CT) is typically related to other vital skills in the learning process of students’ 21st-century skills. All aspects of life need CT, including metacognition, motivation, and creativity (Moeti et al., 2016). Most people use the CT concept of logical reflective thinking and focus on the decision-making process that must be done (Ennis, 2018). Over the past 2 decades, students in higher education institutions (HEIs) have become more exposed to the concept of CT as a way to improve not only their professional skills but also their competencies as members of the global community (Facione, 2011; Moore, 2013). Educational practitioners provide empirical evidence that developing CT skills is challenging for HEIs (Campo et al., 2023). CT is one of the soft skills, a high-level thinking skill needed in the learning process and in preparing graduates ready to face global demands (Guljakhon and Shakhodat, 2020; Rasid et al., 2021).

The sophisticated development of technology and information has created a culture of accessing data with one click without analyzing it thoroughly. A phenomenon often occurs among students where students rely more on the copy-and-paste feature of information obtained on the Internet easily (Ismail and Elihami, 2019). It makes students need more motivation to use their CTs in analyzing the information obtained.

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In recent years, one area that has done much research on CT is health services, particularly nursing. In this case, PubMed indexes more than 2,800 articles on nursing with CT either in the title or abstract (Sharples et al., 2017). For example, bibliometric analysis focuses on nursing education (Sommers, 2018) and social health (Onchonga and Mohamed, 2023). Further, Aktoprak and Hursen (2022) also conducted CT research in primary education using bibliometric analysis. However, only a few pay attention to CT in education, especially in higher education. Despite abundant research on CT, this competency has yet to have a universal definition (Facione, 2011). In addition, there is an open discussion about whether HEIs improve this competence (Huber and Kuncel, 2016). Arum and Roksa (2011) believe students can only obtain CTs through the experience and maturity gained.

Today, Z Generation experiences less CT and a tendency to give up or move forward when faced with obstacles (Seibert, 2021). Several surveys conducted by Anugraheni (2020) and Idris (2018) also revealed that the CTs possessed by students still need to be improved. The main competency of higher education is to promote CT to develop effective online learning programs (Varenina, 2021), how teachers teach essential competencies of thinking, and the extent to which teaching practices are informed by academy research (Kumral et al., 2022; Zhang et al., 2023). A responsive and adaptive generation appears from students who have high critical, creative and metacognitive thinking skills (Fadilla et al., 2021; Sholihah and Lastariwati, 2020; Ulger, 2018).

In this developing era, higher education should prepare its students to face the emerging problems and challenges in a global age (Djaja et al., 2023). One of the essential components of practical learning at the university level is CTs because they can be helpful in students’ academic lives (Bankole-Minaflinou, 2019). Further, Arnyana (2019) added that this CT ability is the basis for academic progress, problem-solving, innovation and effective decision-making.

College graduates should have new professional thinking, high mobility, competence, tolerance and focus on intra-group activities carried out in teams (Plotnikova, 2019). Therefore, lectures should be designed to improve students’ critical and creative thinking (Kardoyo et al., 2020). Further, Istigfarin and Andayani (2023), Puspitasari et al. (2016), Saiful et al. (2020), Silviariza and Handoyo (2021), Sugeng and Suryani (2020) investigated the importance of CT in higher education.

So far, there still needs to be more literature that discusses CTs in higher education using bibliometric analysis. The specific goal of this study is to identify the following questions:

**RQ1.** who are the most prominent authors on the topic of CTs?

**RQ2.** what are popular keywords related to the research topic of CTs?

**RQ3.** who are the researchers who get the most citations?

**Methodology**

The study of bibliometric literature uses systematic and detailed methods (Garza-Reyes, 2015). The bibliometric analysis also uses the establishment of thought that focuses on the limits of knowledge (Churiyah et al., 2022; Tranfield et al., 2003). In this study, the researchers implemented a five-stage method (Setyaningsih et al., 2018; Tranfield et al., 2003), as presented in Figure 1 below.

![Figure 1](image.png)

**Source(s):** Authors’ own work
Search keywords determination
At this stage, database selection is used to search for articles by selecting appropriate search terms in the research using keywords chosen (Sa’adah and Zagladi, 2023). Electronic databases are used as a source of information. The keywords that researchers used in collecting articles were “CT” OR “CTs” AND “higher education,” conducted in March 2021 in the Scopus database.

Initial search results
Initial search results are obtained from searching for keywords for the first time. The initial search results show the number of articles with the required keywords. After getting the initial results, the researchers then screened all articles based on the criteria determined in this study (Kurnia et al., 2023).

In this study, the researcher searched for articles specifically for “journals” and “proceedings,” only “title words” and the year “2018–2022”. The initial research found a total of 670 articles. The results are compiled in comma separated value (CSV) format to input all-important article information such as titles, abstracts, keywords, author and affiliate names, and references.

Search results refinement
Refining search results is a step taken to retrieve data with more accurate results according to what the researcher needs. In other words, it is an article selection for the analysis (Utami and Karlina, 2022). Furthermore, to make relevant improvements, each article metadata is further processed on the Excel file, which is then resaved as on the CSV file for further use for further data analysis.

Preliminary data statistics compiling
In this stage, the collected data is stored in CSV form. In the early stages, components of journal articles and complete proceedings (year of publication, volume, number, page, etc.) are examined, and the researcher adds the necessary information if incomplete data is found. Data analysis is done to group articles by source, year of publication and publisher.

Data analysis
This bibliometric literature study is used to analyze and visualize bibliometric networks using VOSviewer software because it can work efficiently with large data sets and provides a variety of exciting analyses, visuals and investigations (Van Eck and Waltman, 2010). VOSviewer can also create author, publication or journal maps based on network-shared citations or keyword maps based on shared networks (Hudha et al., 2020). Bibliometric data saved in CSV format will be visualized using VOSviewer. VOSviewer can be applied to analyze and create graphical representations in the form of bibliometric maps.

Results and discussions
Trends in publications and citations
A good indicator of the development pattern of a field or discipline is trends in publications and citations. Six hundred seventy articles in the database have been cited 2,100 times, with an average of 420 citations per year. Figure 2 shows the dynamic growth in the number of publications and sources on CT in higher education research from 2018 to 2022 (April). The bubble position represents the number of publications for a given year. The size of the bubble shows the number of citations in publications in that year.
Core journals and publications

As many as 670 articles in the database are in 385 journals. The journal-title with the highest number of documents about CTs is “Sustainability and “thinking skill and reativity.”

Based on Table 1, the Sustainability and Thinking Skills and Creativity journals have collected about 23% of all publications in the database. However, articles published in the Journal of Studies in Higher Education have more citations than those in the Sustainability and Thinking Skills and Creativity journals. Journal of Physics: Conference Series ranked third; the fourth journal is the Association for Computing Machinery (ACM) International Conference Proceedings Series.

Top region countries ranked by number of publications

Table 2 illustrates that out of 670 articles worldwide, the country leading the spread of articles on CT in higher education is the United States, followed by the United Kingdom, Spain and Indonesia. The result is that the United States is a pioneer in producing articles, and the

<table>
<thead>
<tr>
<th>Journal</th>
<th>Document</th>
<th>Citation</th>
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<tbody>
<tr>
<td>Sustainability (Switzerland)</td>
<td>19</td>
<td>97</td>
</tr>
<tr>
<td>Thinking Skills and Creativity</td>
<td>19</td>
<td>95</td>
</tr>
<tr>
<td>Journal of Physics: Conference Series</td>
<td>15</td>
<td>21</td>
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<tr>
<td>ACM International Conference Proceeding Series</td>
<td>14</td>
<td>5</td>
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<tr>
<td>Studies in Higher Education</td>
<td>13</td>
<td>103</td>
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<tr>
<td>Education Science</td>
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<td>Teaching in Higher Education</td>
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<td>30</td>
</tr>
<tr>
<td>Journal of Applied Research in Higher Education</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>Higher Education Research and Development</td>
<td>7</td>
<td>96</td>
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<tr>
<td>International Journal in Higher Education</td>
<td>7</td>
<td>64</td>
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<tr>
<td>IEEE Global Engineering Education Conference, Ducon</td>
<td>6</td>
<td>31</td>
</tr>
<tr>
<td>International Journal of Higher Education</td>
<td>5</td>
<td>28</td>
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<tr>
<td>Assessment and Evaluation in Higher Education</td>
<td>5</td>
<td>19</td>
</tr>
<tr>
<td>Frontiers in Education</td>
<td>5</td>
<td>15</td>
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<tr>
<td>Higher Education</td>
<td>5</td>
<td>9</td>
</tr>
<tr>
<td>Journal of Chemical Education</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>ASEE Annual Conference and Exposition, Annual Proceeding</td>
<td>5</td>
<td>2</td>
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</tbody>
</table>

Table 1. Core journal on critical thinking

Source(s): Authors’ own work
progress of CTs in the early stages is related to the contribution of psychologists emerging from this country. In addition, the US has better access to funding than other countries.

**Co-authorship**

A co-authorship analysis was carried out to see the authorship network. It means analyzing the author’s collaboration with other authors. For example, writer A writes together with anyone. So, it can be seen that a writer networks with anyone in writing articles (Soesanto and Handalani, 2023). Later, VOSviewer will visualize the author's name, organization and country of origin (Zakiyyah et al., 2022).

Figure 3 illustrates five clusters of authors on the research topics analyzed. This study implements co-authorship analysis to test patterns in scientific collaboration between authors, institutions and countries of CT research. Each author has a connected network, meaning that each author has a relationship with the other in researching the topic of CT in higher education. The data is analyzed using the complete calculation method, and each co-authorship is given the exact weight of the number of items (authors, institutions, countries) in the publication. This co-authorship analysis shows a node size relationship representing the number of publications in a data set of authors, institutions or governments. The more comprehensive the co-authorship network, the closer the items that appear on the map and the thicker the lines connecting them will be (Hernández-torrano and Ilrayeva, 2020).

Figures 2 and 4 explain that most authors on the topic of CT in higher education study are from the United States, followed by the United Kingdom and Spain. Following the trending level of education in these countries, the government began to focus on CT (Ennis, 2018). Today’s educational interest in CT in the United States supports CT as an educational goal. In his foreword to America 2000 (US Office of Education 1991), President George H.W. Bush supported six specific academic goals, including more students having advanced CTs. Similarly, President Barack Obama stated in his State of the Union Address in 2014 that the president listed CT as one of the six primary goals of education.
Co-occurrence analysis is used to study the potential relationship of two co-occurring bibliographic items (Zhou et al., 2022). Co-occurrence analysis methods in bibliometrics have matured over the last 2 decades (Ahlgren et al., 2003; Leydesdorff and Vaughan, 2006). These methods are beneficial for studying and identifying a scientific cluster to have academic value (Bazydlowski, 2015; Zhou et al., 2022).
This analysis shows that many clusters are developed, meaning researchers can one day connect crucial thinking in higher education more thoroughly. An interesting item in this analysis is keywords taken from abstract titles and keyword lists from all documents. The more keywords appear simultaneously in one document, the stronger the relationship (Hernández-torran and Ibrayeva, 2020).

Based on Figure 5, there are six clusters of research results with the keyword CT. The first cluster consists of 44 items related to action research, such as active, blended, and collaborative learning; artificial intelligence and CTS. The second cluster reflects a broader aspect of teaching adults CT, such as controlled studies, human experiments, outcome assessments, problem-based learning (PBL) and self-direction learning. At the same time, the third cluster highlights 21st-century skills, such as communication, creativity, CT pedagogy, CT disposition, education development and sustainable development. The fourth cluster focuses on assessment and contains collaboration, CT, learning outcomes and teacher education. The fifth cluster comprises keywords related to academic performance, including educational performance, performance assessment and procedures. The sixth cluster focuses on curriculum.

The three groups in the data set show that most publications are about implementing learning to enhance CT, including action research (cluster one), teaching CT to adults (cluster two) and 21st-century skills. It implies the importance of CT in higher education. Active teaching methods have been placed as a hope for changing education at different levels, transiting from passive lecture-centered to student-centered learning (Rossi et al., 2021). One of the significant issues related to higher education’s CT is how educators teach and inspire students to develop more excellent CTS. Highlighting that CT is an essential part of the formation of university students as critical citizens (Davies and Barnett, 2015).

PBL is a widely adopted educational approach in medical education that aims to promote CT and problem-solving in authentic learning situations. Constructive PBL models allow
students to cultivate high-level thinking skills such as critical, systematic and creative thinking (Zhou et al., 2023). CT is widely regarded as an essential competence to acquire in education. Students’ exposure to problems and collaboration has been proven helpful in promoting CT processes (Loyens et al., 2023). HEI has a vital role in the development of students, as the teaching methods used can lead to the formation of skills and abilities of students to act on the things in their environment, to analyze and research different situations, to ask questions and to search for truth, based on the information gained, developing their personality and successfully integrating into the labor market. The teaching method is mental training and exercise, and its intervention on students materializes in the formation of new cognitive or behavioral structures (Cerghit, 2006; Dumitru and Minciu, 2023).

The fourth cluster focuses on CT assessment, and the fifth cluster explains academic performance assessment. The assessment design should be more comprehensive to increase CT. The CT disposition Scale is a valid and reliable tool for assessing individual attitudes toward CT (Nguyen et al., 2023). Online peer assessment (OPA) is increasingly being adopted to develop higher-order thinking (HOT) (Zhan et al., 2023).

The last cluster is the curriculum. Most of the publications in this cluster talk about the curriculum in teaching CT. It contributes to career and higher education (Hsu, 2021). “The comprehensive review of the curricula ensures the inclusion of the basic cross-curricular contents in sustainability in all the degrees in agreement with the competencies defined” (Moreno-Pino et al., 2021).

Figure 6 shows an evaluation of the theme of CT from 1944 entitled an experiment in eaching certain skills of CT, which was published in the Journal of Educational Research written by Howard C. Anderson from Cornell University, meaning that 79 years ago, the idea of introducing CT to students already appeared in different terms. This article (Anderson et al., 1944) states that the purpose of education is for students to think critically in solving social problems. This idea developed, and 39 years later, in 1983, the concept of CT in higher education.
education, as described in several articles, was mainly under psychology. Intellectual development and the ability to think critically have long been stated aims of formal education. Students at higher educational levels achieved higher scores on the reflective judgment measure (Brabeck, 1983).

From 2018 until now, CT research themes have continued to develop. Research on teaching CT in higher education is becoming more popular, especially in the US. Several authors have attempted to find the best practices of CT in tertiary institutions (Ennis, 2018). Apart from America recently, CT has spread throughout the world. Some of them are from Australia (Oliver and Jorre de St Jorre, 2018), Ireland (Noone and Hogan, 2018), Spain (Bezanilla et al., 2019), Indonesia (Utama et al., 2022), Tukey (Ulger, 2018), US (Crittenden et al., 2019; Straková and Cimermanová, 2018), Spain (Glasserman-Morales and Portuguez Castro, 2021), Ethiopia (Tiruneh et al., 2018), Romania (Dumitru, 2019).

Co-similarities and research flows in the literature are identified through bibliometric co-citation analysis. The analysis of the most citations in this CT in higher education research topic is to determine which articles influence knowledge development in the field. The co-citation analysis was to test the disciplines underlying research on CT in higher education. The higher the number of publications that cite a pair of journals, the higher the co-citation relationship of the journal pair (Hernández-torrano and Ibrayeva, 2020). It reflects the number of authors who, in the previous analysis produced from the United States, contributed only to the top 10 cited articles. It can be a reflection for researchers from Indonesia to create pieces that are more likely to contribute to the development of scientific characteristics in the field of CT in higher education. More details of the top 10 cited articles are in Table 3 below.

Table 3 shows that the top 10 cited articles ranked first are from Deakin University, Geelong, Australia (Oliver and Jorre de St Jorre, 2018). As of March 2022, the article has been seized on a total of 78 and addresses the attributes of graduates for 2020 and beyond recommendations for Australian higher education providers. His research emphasizes details related to global citizenship, teamwork and communication; it emphasizes independence, CT and problem-solving and basic written and oral communication skills. Then the second most cited is an article written by Ennis (2018), University of Illinois, Urbana, IL 61801, USA. As of March 2022, the article, which has been seized by as many as 75, examines CT Across the Curriculum: A Vision. The results offer a comprehensive vision for a higher education program incorporating cross-curriculum CT (CTAC) at the hypothetical Alpha College, using a rigorous, detailed conception of CT called the “Alpha Concept of CT. “The program begins with a 1-year first-year course, two-thirds focusing on a series of dispositions and general CTs. The last third used subject matter problems to reinforce available CT dispositions and abilities, teach sample subject matter and introduce subject-specific CT.

As for the third, most citations are articles written by Noone and Hogan (2018). The School of Psychology, National University of Ireland Galway, Newcastle Road, Galway, Ireland. In March 2022, the article was published 49 times, discussing the effects of online mindfulness interventions on executive function, CTs and related thinking dispositions. No evidence has been found to suggest that engaging in guided mindfulness practices for six weeks using the online intervention methods applied in this study improved CT performance.

The three findings regarding the number of citations are by far the most influential. Even the article (Oliver and Jorre de St Jorre, 2018) is the most seized on the network of articles in the literary source the researcher collected. The other seven articles also contributed through the many citations obtained. These findings can be reference sources for using CT in higher education.

Figure 7 illustrates the name with the largest cluster (Oliver and Jorre de St Jorre, 2018). They are researchers interested in conducting studies on CT in higher education. The implications of this finding can be a reference for an expert in giving public lectures or others on related topics.
<table>
<thead>
<tr>
<th>No</th>
<th>Publication year</th>
<th>Author</th>
<th>Title</th>
<th>Journal</th>
<th>Cites</th>
<th>Publisher</th>
</tr>
</thead>
<tbody>
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<td>1</td>
<td>2018</td>
<td>Oliver, B., Jorre de St Jorre, T.</td>
<td>Graduate attributes for 2020 and beyond recommendations for Australian higher education providers</td>
<td>Higher Education Research and Development</td>
<td>78</td>
<td>Routledge</td>
</tr>
<tr>
<td>2</td>
<td>2018</td>
<td>Ennis, R. H.</td>
<td>Critical Thinking Across the Curriculum: A Vision</td>
<td>Topoi</td>
<td>75</td>
<td>Springer Netherlands</td>
</tr>
<tr>
<td>3</td>
<td>2018</td>
<td>Noone, C., Hogan, M. J.</td>
<td>A randomized active-controlled trial to examine the effects of an online mindfulness intervention on executive control, critical thinking, and key thinking dispositions in a university student sample</td>
<td>BMC Psychology</td>
<td>49</td>
<td>BioMed Central Ltd</td>
</tr>
<tr>
<td>4</td>
<td>2019</td>
<td>Bezanilla, M. J., Fernández-Nogueira, D., Poblete, M., Galindo-Domínguez, H., Ulger, K.</td>
<td>Methodologies for teaching-learning critical thinking in higher education: The teacher’s view</td>
<td>Thinking Skills and Creativity</td>
<td>44</td>
<td>Elsevier Ltd</td>
</tr>
<tr>
<td>5</td>
<td>2018</td>
<td>Straková, Z., Cimermanová, I.</td>
<td>Critical thinking development—a necessary step in higher education transformation toward sustainability</td>
<td>Sustainability (Switzerland)</td>
<td>34</td>
<td>MDPI</td>
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<tr>
<td>7</td>
<td>2018</td>
<td>Mora, H., Signes-Pont, M. T., Fuster-Guilló, A., Pertegal-Felices, M. L.</td>
<td>A collaborative working model for enhancing the learning process of science and engineering students</td>
<td>Computers in Human Behavior</td>
<td>28</td>
<td>Elsevier Ltd</td>
</tr>
</tbody>
</table>

Table 3. Top 10 cited articles (continued)
Implication

Reviewing the importance of CT research in higher education, it is also necessary to conduct cross-country collaboration conducted by researchers. So far, the partnership has only occurred between universities in one country. Geographical boundaries should be merged to produce meaningful empirical findings on human resource development in many countries. In this case, the United States is a leader in CT (Ennis, 2018). In some countries, demographic bonuses must be utilized, one of which is through the government’s seriousness in designing learning to improve CT. In 2012, the European higher education region stressed the importance of students thinking critically as part of student-centered learning, as seen in many university curricula (Bezanilla et al., 2019). The article with the most significant number of citations is the largest contributor to this study and can be a primary reference source for researchers and academics in studying and making new findings in CT in higher education.
For higher education, the findings from this research are helpful in providing an empirical picture of the importance of CT in higher education as a basis for evaluating higher education policies and their implementation, especially in selecting alternative learning models based on CT to improve the quality of students’ CT. This information is also essential for educators to become a reference for teaching education to students so that they can improve their CT processes as much as possible. Also, it is to improve or increase the quality of learning that encourages CT.

**Conclusion**

The number of publications on CT has been increasing and is not expected to reach a saturation point for the next few decades. In tertiary institutions, CT has been implemented into several more specific and practical courses. The learning methods are also varied, primarily based on problem-based and project-based learning. The general theme in teaching CT implies that most papers discuss best practices and challenges of learning CT in the classroom. This encourages other studies to discuss improving the CT learning process.

This study has a limitation in that the analysis was conducted only within the last five years (2018–2022). In 2022, there will be a lot of research relevant to CT. CT in higher education is necessary for 21st-century skills. Furthermore, further support research findings on this related topic should use another database such as the Web of Science. Collaboration between authors from various parts of the world is essential to produce more meaningful empirical results.

**References**


Corresponding author
Ita Nuryana can be contacted at: ita.nuryana.2104319@student.um.ac.id

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