Journal of Mathematics and Mathematics Education
https://jurnal.uns.ac.id/jmme

p-ISSN 2089-8878; e-ISSN 2715-8276
Vol. 12, No. 01, June 2022

CONSTRUSIONISM AND CONSTRUCTIVSM IN COMPUTATIONAL THINKING AND MATHEMATICS EDUCATION: BIBLIOMETRIC REVIEW

Edi Supriyadi[1,2] *, **and Jarnawi Afgani Dahlan**[2]

[1]Sekolah Tinggi Teknologi Bandung, Bandung, Indonesia
[2]Universitas Pendidikan Indonesia, Bandung, Indonesia

* Correspondence purposes, email: edipmatematika@gmail.com, edisupriyadi@upi.edu

Abstrak: Studi ini bermaksud melakukan analisis bibliometrik untuk menjawab pertanyaan penelitian berikut: Berapa peningkatan tahunan publikasi *constructionism*, *constructivism*, dan *computational thinking*?; Siapa penulis *constructionism*, *constructivism*, dan *computational thinking* yang paling produktif?; Manakah negara yang paling banyak dalam bidang *constructionism*, *constructivism*, dan *computational thinking*?; Siapa ilmuwan yang paling sering dikutip? Pada akhirnya, fungsi biblioAnalysis menghasilkan data deskriptif dari data bibliografi. Dengan demikian, uraian ini telah menjelaskan bahwa kata kunci tersebut sudah cukup untuk menggambarkan penggunaan teori dalam pembelajaran berpikir komputasional dan matematika. Setelah kami menyelesaikan pemetaan kami, kami akan memiliki kerangka kerja gabungan yang kami miliki, yang akan memungkinkan kami untuk mendapatkan pemahaman yang lebih dalam tentang kemungkinan hubungan yang ada antara konstruksionisme, konstruktivisme, pemikiran komputasi, dan pendidikan matematika.

Kata kunci: *Konstruksionisme, Konstruktivisme, Berfikir komputasi, Pendidikan matematika*

Abstract: This study intends to carry out a bibliometric analysis to answer the following research questions: What is the annual increase in publications of constructionism, constructivism, and computational thinking, and mathematics education?; Who are the most prolific writers of constructionism, constructivism, computational thinking, and mathematics education?; Which the most countries in the fields of constructivism, constructivism, computational thinking, and mathematics education?; Who are the most frequently cited scientists? In the end, the biblioAnalysis function generates descriptive data from bibliographic data. Thus, this description has explained that these keywords are sufficient to describe the use of theory in learning computational thinking and mathematics. After we have completed our mapping, we will have a combined framework at our disposal, which will allow us to gain a deeper understanding of the possible connections that exist between constructionism, constructivism, computational thinking, and mathematics education.

Keywords: *Constructionism, Constructivism, Computational thinking, Mathematics education*

Accepted: March 01, 20222 Approved: April 23, 2022 Published: June 30, 20222
DOI: 10.20961/jmme.v12i1.61946

p-ISSN 2089-8878; e-ISSN 2715-8276

INTRODUCTION

The educational theory of constructivism was first proposed by Jean Piaget. Piaget was a firm believer in the idea that knowledge isn't simply passed down from one person to another, but rather is created by the learner in their own mind (Piaget, 1968). When it comes to cognitive constructivism, students actively create new ideas or concepts based on their prior knowledge (Connolly and Begg, 2006). When people are involved in the creation of things that have personal significance to them, constructivists believe they can learn more effectively. Constructivism relies on students "constructing" their own understanding through active participation (Peters et al., 2003).

MIT Media Lab researcher Seymour Papert developed the constructionism learning theory. As part of an educational activity, Papert argued, students learn best when they create a tangible or meaningful object (Papert, 1980). Constructionism can be traced back to Jean Piaget because of the influence he had on the work of Papert himself. To be truly meaningful for a learner, constructionism asserts that the learner must put forth the effort required to create something, but also that others must participate in both the creation process and the final product in order for learning to be truly meaningful (Amineh and Asl, 2015). Students' interactions with their artifacts, as well as the ways these interactions support self-directed learning and the creation of new knowledge, were of particular interest to Papert. On the importance of instruments, media and circumstances for human development he emphasized (Ackermann, 2001).

Ackerman (2001) examined the similarities and differences between Piaget's constructivism (Piaget & Duckworth, 1970) and the constructionist elaboration of this constructivism proposed by Papert. We are inclined to provide opportunities for children to engage in hands-on investigations that fuel the construction process. This is because, when we draw the two perspectives together as constructionism, we know that 'as Piaget and Papert do, that knowledge is actively produced by a child in connection with its surroundings,' we are aware that knowledge is actively produced by a child in connection with its surroundings (Ackerman, 2001). According to Papert, the projection of the learner's inner thoughts and ideas is the essential component of effective learning. Expression makes ideas tangible and communicable, which in turn informs, or shapes and sharpens, these ideas and enables us to communicate with others through our expressions. Expression also makes ideas tangible and communicable. (Ackermann, 2001) This suggests that new insights are the sum of individual experiences gained through the application of existing knowledge in an effort to improve it.

Piaget's constructivism serves as the foundation for constructionism, which focuses on technology and how it can be used to assist students in acquiring knowledge. A lot of people think that computers

are an invaluable resource for coming up with new ideas and points of view, as well as putting those ideas and points of view to use, and for expanding on what we already know (Papert, 2000).

This study intends to carry out a bibliometric analysis to answer the following research questions: What is the annual increase in publications of constructionism, constructivism, computational thinking, mathematics education?; Who are the most prolific writers of constructionism, constructivism, computational thinking, and mathematics education?; Which the most countries in the fields of constructivism, constructivism, computational thinking, and mathematics education?; Who are the most frequently cited scientists?

RESEARCH METHOD

We performed a topical search and downloaded 71 bibliographic documents from the Scopus online database containing the textual phrases "constructionism" and "constructivism" and "computational thinking" between 1994 and 2022. Although we downloaded 71 documents, the total number of files may fluctuate as articles are released. addition. All types of documents, including articles, conference proceedings, meeting abstracts, editorial content, and proofreading and editing. Selected Initially, we installed Windows 10 with RStudio 2022.02.3-492. Second, we install the bibliometrix package in the R environment to analyze and map bibliographic data, if it doesn't already exist. Then, we use the bibliometrix features to develop descriptive and co-citation networks, respectively. In the end, the biblioAnalysis function generates descriptive data from bibliographic data. The general function R (plot) can be used to display the findings.

RESULTS AND DISCUSSION

Between 1994 and 2022, 192 writers contributed to 71 documents, averaging 5.72 publications each year. Incentives to produce scientific publications have increased as a result of funding (This is an assumption). In 2021, the pace of scientific output growth was 13 articles per year higher than in 2020, placing it in second place. (Table 1. and Figure 1.)

Authors with keywords that are in the top 5 constructionism are Bhavani RR from the United States, followed by key words, constructivism, computational thinking and mathematics education. Sources relevant to the keywords searched for in this study ranked 1 to 3 were obtained from the ACM International Conference, the British Journal of Educational Technology and the International Journal of science and mathematics education. The authors with the most articles obtained from Ng O-L,

p-ISSN 2089-8878; e-ISSN 2715-8276

Kynigos C, Cui Z, Noss R and Bhavani RR. Meanwhile, the authors most cited were Chandler Jlr, Micule I, Pipere A, Chang Cw and Chen Gd. (Figure 3., Table 2., Table 3, Table 4.)

United States scientists have produced a total of 113 articles, followed by Sweden as many as 103 articles with countries with over 100 articles. Under these two countries, it looks very unequal by producing 28 and 25 articles from Brazil and the United Kingdom. The keywords relevant to this research were constructionism with 48 units, followed by computational thinking and constructivism with 10 each and mathematics education with 9 points. Thus, this description has explained that these keywords are sufficient to describe the use of theory in learning computational thinking and mathematics. (Figure 4., Figure 5.)

Table 1. Main Information About Data

Description	Results
Timespan	1994:2022
Sources (Journals, Books, etc)	55
Documents	71
Average years from publication	5.72
Average citations per documents	6.056
Average citations per year per doc	0.8429
References	2313
DOCUMENT TYPES	
article	38
book chapter	4
conference paper	26
note	1
review	2

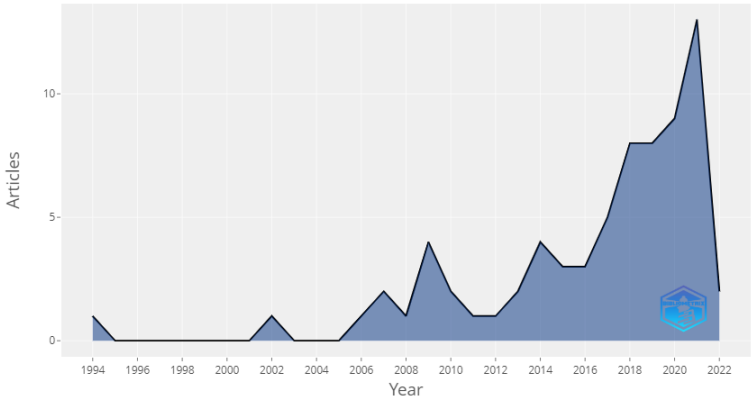

Figure 1. Annual Scientific Production

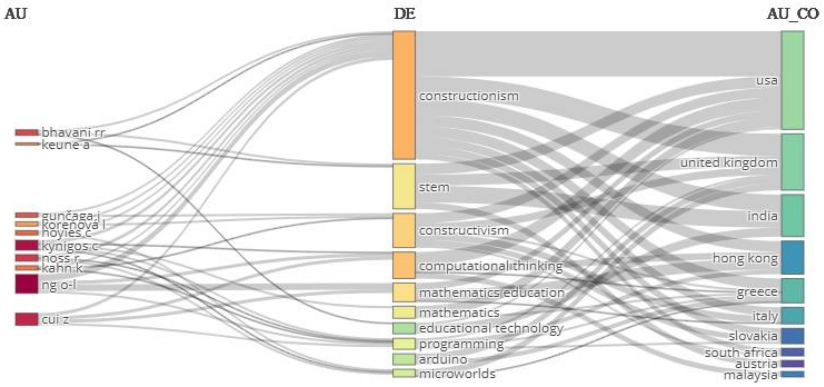

Figure 2. Three-fields Plot

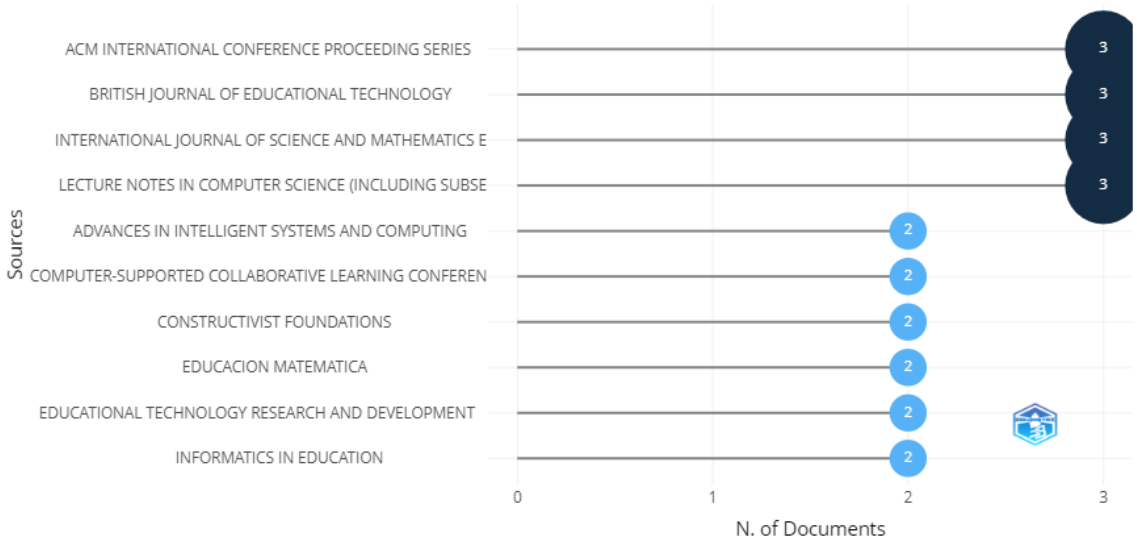

Figure 3. Most Relevand Sources

Table 2. Most Local Cited Authors

Authors	Articles
NG O-L	6
KYNIGOS C	5
CUI Z	3
NOSS R	3
BHAVANI RR	2

p-ISSN 2089-8878; e-ISSN 2715-8276

Table 3. Most Local Citation

Authors	Local Citations
CHANDLER JLR	4
MIČULE I	2
PIPERE A	2
CHANG C-W	1
CHEN G-D	1

Table 4. Most Relevant Affiliations

Authors	Articles
AMMACHI LABS	7
NORTHWESTERN UNIVERSITY	7
THE CHINESE UNIVERSITY OF HONG KONG	7
SANT'ANNA SCHOOL OF ADVANCED STUDIES	6
UNIVERSITY OF WYOMING	5

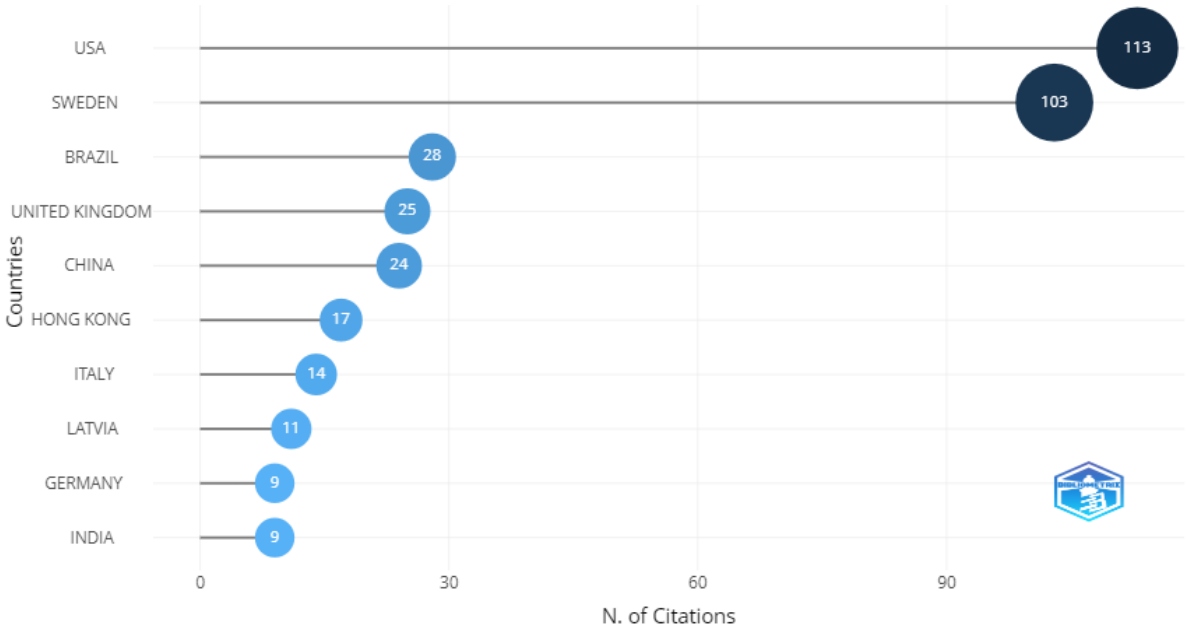

Figure 4. Most Cited Countries

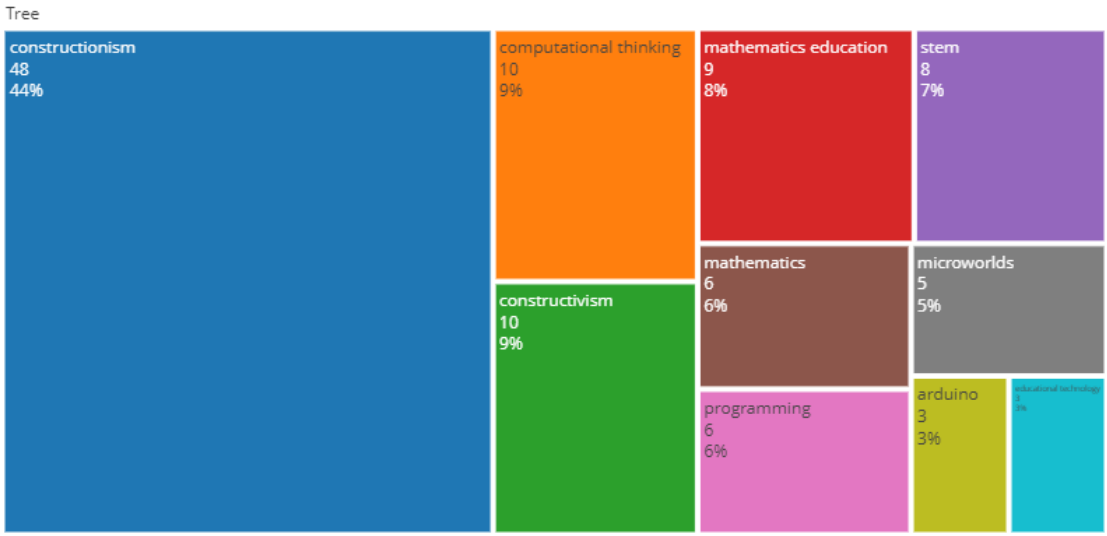

Figure 5. Treemap of Author Keywords.

CONCLUSIONS AND SUGGESTIONS

Bibliometix is a program for bibliometric analysis that is built on top of R. R is a piece of software that operates within an ecosystem, which indicates that it functions within an integrated environment made up of open libraries, open algorithms, and open graphics software. In order to investigate the bibliometrix package, we used Scopus data to look at the growth of graphene over a longer period of time between the years 1994 and 2022. According to the findings of this research, constructionism and constructivism have a strong connection to computational thinking as well as mathematics education. This is evidenced by the growing number of articles from a variety of journals that are published each year.

In a conclusion, the contribution of this paper is the presentation of a mapping tool that combines constructionism and constructivism with a new framework for reviewing activities used in the teaching and learning of computational thinking in mathematics education. In other words, the paper's contribution is the mapping tool. We suggest that additional work be done to further refine the missing aspects of integrating or combining the learning of mathematics with computational thinking. This is suggested for future work. After we have completed our mapping, we will have a combined framework at our disposal, which will allow us to gain a deeper understanding of the possible connections that exist between constructionism, constructivism, computational thinking, and mathematics education.

p-ISSN 2089-8878; e-ISSN 2715-8276

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