

Bibliometric Analysis of Higher Order Thinking in 2012-2021

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Abstract—Currently, we are in a new era, namely the era of digital industrialization. Almost all needs from human are based on digital and internet. Therefore, in a world that is constantly changing, teachers in schools must train student's HOTS so that they are trained solving problems. The goal of this research to analyze information about HOTS publications, author productivity levels, country, keywords, and citations from higher order thinking skills article in 2012-2021. Data collection is done using Publish or Perish (POP). Researcher use google scholar as a data source. Data from POP then analyzed using VOS Viewer software and other map visualizations that do not appear in VOS viewer were explored and analyzed manually. The results showed that the most productive writer was Retnowati, H with 11 publications, keyword visualization resulted in 8 clusters, the highest publication was in 2019 with a percentage of 22.12%, the most cited articles were articles with the title "Teaching to Test or Testing to Teach : Exams Requiring Higher Order Thinking Skills Encourage Greater Conceptual Understanding" written by JL Jensen, MA McDaniel, SM Woodard was cited 301 times and the country with the highest number of documents was occupied by Indonesia with 694 documents.

Keywords: Bibliometric, higher order thinking skill, Publish or Perish (POP), VOS Viewer.

1. INTRODUCTION

We are in an era of globalization, where human needs many apply the use of the internet and the digital world, as a tool transactions and interactions. All aspects of people's lives today have been affected by information and communication technology. The effect unlocks new competition in the world of work (Nasution, 2011). One way to facing competition in the world of work in the current era of globalization is by creating quality human resources (Oktarina, 2011; Wijaya et al., 2016). Skills in technology, social emotional and higher order thinking, such as creativity and completion Problem solving is a necessary skill in this era. Education is one way to achieve skills (Mukminan, 2014). To be able to educate and generate quality graduates who can compete in the globalization era, education is essential.

According to Budiarta (2018), HOTS may be defined as a complicated thinking process that involves breaking down material, critiquing, and developing solutions to a problem. Previous research demonstrates that pupils in Indonesia still have low higher-order thinking skills (Purbaningrum, 2017). It was recorded that in 2015 Indonesia was ranked 64th out of 72 countries that participated in PISA (Nugroho, 2018). These low results require the Indonesian education sector to prepare to face the rapid development of 21st century knowledge and technology, such as equipping students with HOTS in learning.

According to (Dulay, 2018) bibliometrics is a mathematical method or method that functions and is used to identify academic publications related to citations and scientific matters and is intended for use in libraries or other fields (Dulay, 2018). Hufiah et al. (2021) conducted previous research on bibliometric studies on higher order thinking skills using Bibliometric Vos viewer to assess the domain of HOTS 21st century education. The study used data sourced from Scopus. The variables of the research are (1) the development of the number of international journal publications on higher order thinking skills from 2010-2020 at Scopus; (2) Researcher productivity; (3) Top articles with the most citations; (4) The relationship between research topics; (5) Research trends; (6) Research topics that are frequently researched. The difference between the previous research and what the researcher is doing now is that the researcher uses google scholar as a data source and there are differences in the variables used, namely the researcher uses productive country variables in research publications on higher order thinking skills while previous research does not use productive country variables in research publications on HOTS. HOTS. In this study, a bibliometric analysis of research on higher order thinking skills from 2012-2021 based on Google Scholar data was carried out in terms of: (1) how the number of publications on higher order thinking skills from 2012-2021 on Google Scholar was developed; (2) how is the productivity of writers in the field of HOTS; (3) what countries are included in the top ten publications of HOTS in the world; (4) What are the keywords that most often appear in research publications on HOTS; (5) Which articles are included in the top ten most cited

2. METHODS

The goal of this research was to collect and analyze information. on bibliometric mapping of scientific research publications on higher order thinking skills for the period 2012-2021. This study uses a quantitative descriptive method with a bibliometric approach. This study uses numerical and statistical data obtained from the Google Scholar database, which will then be further analyzed using bibliometric analysis. The sample used is a search result from the Google Scholar database and obtained 999 articles. The variables of this research consist of (1) the number of publications HOTS in 2012-2021 on Google Scholar; (2) Author productivity; (3) Productive country in the publication of HOTS; (4) Keywords most frequently in research publications on HOTS; (5) Most cited articles. Bibliometric analysis in this study consisted of five stages (Schmeisser, 2013) which are shown in Figure 1.

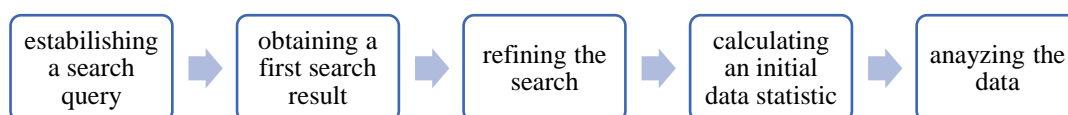


Figure 1. Five Stages in Bibliometric Analysis

The search for articles began in October 2021, with the keyword “higher order thinking skills”. This research uses Publish or Perish (PoP) software. PoP was chosen because it proved to be the most effective software in helping article metadata search (Baneyx, 2008). The search results focused specifically on articles published during 2012-2021. The search results are stored in Research Information Systems (RIS) format in PoP. The RIS-formatted data was then analyzed using VOSviewer software and other map visualizations that did not appear in Vosviewer were explored and analyzed manually.

3. RESULTS

3.1 Top Authors in Researching of Higher Order Thinking Skill

This study consisted of 1805 authors, 10 authors have the most documents, namely:

Table 1. Top Ten Authors in Researching of Higher Order Thinking Skill

Author	Number of Documents
Retnowati , H	11
Ichsan, IZ	9
Abdullah, AH	8
Setiawan,A	8
Suhandi, A	7
Sigit, DV	6
Nurkanto	6
Hwang, GJ	5
Miarsyah, M	5
Heong, Y.M	5

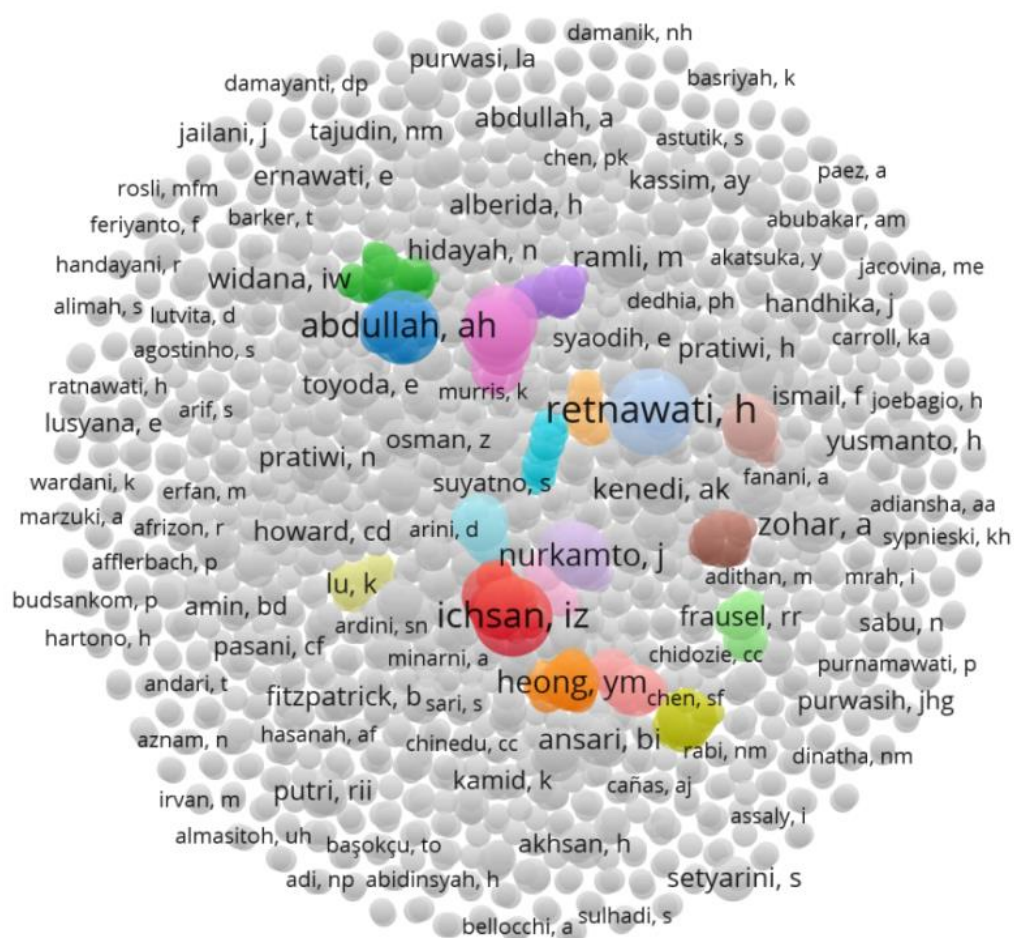


Figure 2. Network Visualization Author

Table 1 and Figure 2 show, it can be seen that Retnowati, H has the most documents, namely 11 documents, then followed by Ichzan, IZ with 9 documents, Abdullah AH., Setiawan, A., each having 8 documents, Suhandi, A With 7 documents, Sigit, DV., Nurkamto each had 6 documents, and Hwabg, GJ., Miarsyah, M., and Heong, YM each has 5 documents.

3.3 Number of Publications from 2012-2021

The development of higher order thinking skill article publications decreased from 2012 to 2013 and increased from 2014-2019, then from 2020-2021 it decreased again, and the highest publication was in 2019, namely 221 publications (22.12%), followed by in 2020, namely 206 publications (20.62%), and in 2021, namely 103 publications (10.31%)

Table 3. Publication of Higher Order Thinking Articles from 2012-2021

Year	Number of Documents	Percentage (%)
2012	33	3,30
2013	29	2,90
2014	46	4,60
2015	57	5,70
2016	65	6,50
2017	94	9,40
2018	145	14,51
2019	221	22,12
2020	206	20,62
2021	103	10,31
Total	999	100

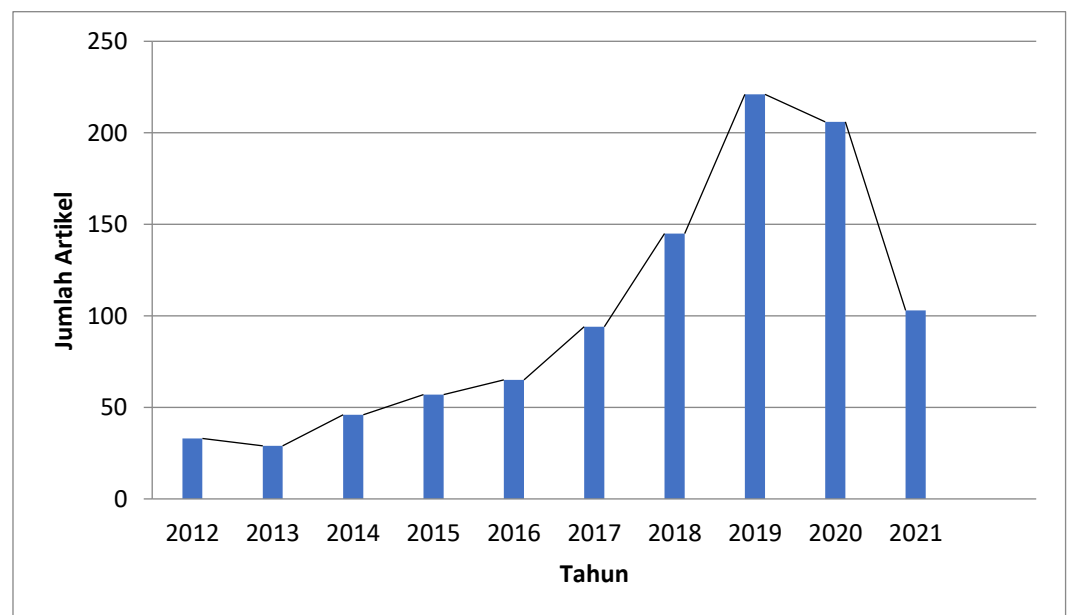


Figure 4. Publication of Higher Order Thinking Articles from 2012-2021

3.4 The Most Cited Articles

Table 4. Top Ten Most Cited Articles

Citation	Author	Title of Article
301	Jamie L. Jensen, Mark A. McDaniel, Steve M. Woodard	Teaching to the Test or Testing to Teach: Exams Requiring Higher Order Thinking Skills Encourage Greater Conceptual Understanding
266	Tan Shin Yen, Siti Hajar Halili	Effective Teaching of Higher Order Thinking (HOT) in Education
231	Merta Dhewa Kusuma, Undang Rosidin, Abdurrahman, dan Agus Suyatna	The Development of Higher Order Thinking Skill (Hots) Instrument Assessment in Physics Study
230	Jennifer Lyn, S Ramos, Bretel B Dolipas, Brenda B Villamor	Higher Order Thinking Skills and Academic Performance in Physics of College Students: A Regression Analysis
219	Tri Widododa, Sri Kadarwati	Higher Order Thinking Berbasis Pemecahan Masalah untuk Meningkatkan Hasil Belajar Berorientasi Pembentukan Karakter Siswa
216	Abdul Halim Abdullah, Nur Liyana Zainal, Abidin, Marlina Ali	Analysis Of Students' Errors In Solving Higher Order Thinking Skills (HOTS) Problems for The Topic Of Fraction
212	Robyn Collins	Skills For The 21st Century: Teaching Higher-Order Thinking
211	Madhuri, G. V, Kantamreddi, V. S.S.N, Prakash Goteti, L. N.S.	Promoting Higher Order Thinking Skills Using Inquiry-Based Learning
200	Ridwan Abdullah Sani	Pembelajaran Berbasis Hots Edisi Revisi: Higher Order Thinking Skills
189	I Wayan Widana	Modul Penyusunan Soal Higher Order Thinking Skill (HOTS)

3.5 Countries with the Highest Publications

The countries with the highest publications are Indonesia, the United States, and Malaysia. The top ten countries with the highest publications are presented in Table 5.

Table 5. Top Ten Countries with Highest Publication

Countries	Number of Documents
Indonesia	694
Amerika Serikat	69
Malaysia	53
Kanada	11
Afrika Selatan	9
Israel	9

China	8
Taiwan	7
Australia	7
Jepang	6

The above table shows that the country with the highest number of documents is occupied by Indonesia with a total of 694 documents, then the second position is occupied by the United States with a total of 69 documents and the third position is occupied by Malaysia with a total of 53 documents.

4. DISCUSSION

The term higher order thinking skill was first introduced by Benjamin S. Bloom in 1956 through the book "Taxonomy of Educational Objectives". The publication of higher order thinking skills articles throughout the year increased significantly over the past decade. Based on the Google Scholar data base, in 2012, the publication of the higher order thinking skills article found 33 documents, then in 2013 there was a decrease to 29 documents. From 2014 to 2021 the publication of higher order thinking skills articles increased significantly. It is also estimated that for the following year, the publication of higher order thinking skills will increase drastically. This is because has long been identified as one of the success factors of students (Lee & Choi, 2017). As a result, an increasing number of researchers are focusing on HOTS. Considering the country's productivity in the publication of HOTS articles, the data sources used is Google Scholar, Indonesia occupies the first position with a total of 694 documents. This is due to the fact that the number of HOTS students in Indonesia is still low, it was recorded that in 2015 Indonesia was ranked 64th out of 72 countries that participated in PISA and ranked 45th out of 48 countries that participated in TIMSS (Nugroho, 2018 :11). This is what causes research on HOTS to be carried out in Indonesia. The most prolific writers are Retnawati, H with 11 documents and Ichsan, Z. with 9 documents. The most cited articles are Teaching to Test or Test to Teach: Exams Requiring Higher Order Thinking Skills Encourage Greater Conceptual Understanding written by JL Jensen, MA McDaniel, SM Woodard, the article was 301 times cited. This article is widely cited, because the article provides reliable data on HOTS and the article provides a high order thinking instrument that can be used by researchers as a desire to carry out research on high order thinking skills. Because this study focuses on HOTS, the word HOTS comes frequently in HOTS studies

5. CONCLUSION

It is possible to draw a conclusion based on the findings and debate, that the most productive researcher is Retnowati, H with the publication of 11 documents , the word "thinking" is the most keyword frequently and for the visualization of the keyword network forming 8 clusters, the publication of Higher Order Thinking Skill articles was the most in 2019 as many as 221 documents and publications. The least Higher Order Thinking Skill articles occurred in 2013 as many as 29 documents, the most articles being Teaching to the Test or Testing to Teach: Exams Requiring Higher Order Thinking Skills Encouraging Greater Conceptual Understanding with the title written by JL Jensen, MA McDaniel, SM Woodard. The article was cited 301 times, the country with the highest publication was Indonesia with 694 documents.

6. LIMITATIONS AND RECOMMENDATIONS

This study provides information about the development of research publications on higher order thinking skills for readers, especially students and teachers, although the research results provide an overview of higher order thinking skills research. However, this research also has some limitations. First, this study has limited time in data analysis. Second, this research uses the Google Scholar database so that there are still articles that are not official and accredited.

Based on the research limitations, the authors suggest the future researchers should give maximum time in writing articles about higher order thinking skills, use variables other than those used by current researchers, and use data sources other than Google Scholar so that can provide more knowledge about higher order thinking skills for readers

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