Bibliometric Analysis Related to Mathematical Research through Database Dimensions

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Abstract. A bibliometric study of the publication of research results and mathematical thinking at this time is needed to see the development of progress and trends that are happening. The purpose of this study is to conduct bibliometric research in online scientific publications. The research method uses quantitative studies from electronic information sources through the Dimension database. Data obtained from 2015-2019 from research results published in leading international journals. Data is processed using the Vosviewer application to create predetermined formulas and produce visualizations. The results of this study have described the number of publications that have been made through international journals, the distribution of titles in international journals, the types of publications produced, and the level of productivity of authors from the name of the institution. The results of the research are then carried out an analysis related to the trends that occur related to education policy in Indonesia in the obligation and culture of writing in scientific publications.

1. Introduction
Bibliometrics was first defined by Alan Pritchard in the 1960s as the application of mathematical and statistical methods in one of the options for submitting article reviews about information search, literacy information, and cataloging and classification through a literature review of a publication. The study continues to grow so that the study is more complex than keywords, institutions, or abstracts can be presented in the form of scientific publications [1,2].

Information has an important role in all aspects of human life, because everyone needs information in carrying out various activities, for example lecturers, students, researchers, etc. for their educational, teaching or research needs. The library as a learning resource is demanded to be able to provide information that can support the fulfillment of the information source's needs. As the development of science and technology, resulting in information sources now available in various forms, more and more, diverse and abundant. This requires information managers to be able to selectively select information and provide collections that fit the needs of users by identifying their needs and the characteristics of the literature used in order to provide more effective and efficient sources of information [3]. One way that can be done to obtain a picture of the needs of users and sources of information that they use is to look at the frequency of use of documents or literature. Where the more frequently a document or literature is used by the user, the document becomes increasingly important for the user. In addition, each field of science has characteristics in using information sources, for example the type of document used by researchers in mathematics and its application with the type of literature used in statistics, education, or researchers on algebra, geometry, arithmetic, and trigonometry.
Library and information science (LIS) as the name suggests is a merger of librarianship and information science that occurred in the 1960s. LIS is a field of professional practice and scientific inquiry. As a field of practice, this includes the librarian profession as well as a number of other information professions, all of which assume mutual influence between information sources, people who interact with information, and technology used to facilitate the creation, communication, storage, or transformation of information sources.

In studying bibliometrics, there are several other terms such as scientometrics, informetrics, webometrics, netometrics, cybermetrics. From some of these terms there are differences that lie in the order of factors and boundaries of the object being measured. But the approach used is the same, namely the existence of certain algorithms used by each of them through mathematical science. Scientific communication of these terms which implies various fields of research that often adjust to the core of science that will be studied through a cross-scientific approach. The purpose of each area of research is to analyze, measure, and measure communication phenomena to establish an accurate formal representation of their behavior for explanatory, evaluative, and administrative purposes.

Library and information science (LIS) is a very broad scientific discipline, which uses a variety of strategies and research techniques that are constantly evolving. Libraries not only study the functions and roles of libraries through reading material in the community [4] [5], but related studies across fields of science are very likely to be studied intensively. The aim in this research is to provide the latest views on research issues in the field of mathematics. Through a bibliometric study of the publication of research results and mathematical thinking at this time it is necessary to see the development of progress and trends that are happening [6] from the Dimensions database. Dimensions is a free database that is accessed via https://app.dimensions.ai/ is a collection of research knowledge systems from several international and national journals. Developed by Digital Science in collaboration with more than 100 leading research organizations worldwide. Dimensions brings together information sources from grants, publications, citations, alternative metrics, clinical trials, patents and policy documents to present a platform that allows users to find and access information that most relevant more quickly, analyze broader and academic research results, and gather insights to inform future strategies.

2. Research Methods
In this study using quantitative studies [3,7,8] of electronic information sources through the Dimension database. Data obtained from 2015-2019 from research results published in national, international journals included in the Dimensions database. Data is processed using the Vosviewer application to create pre-determined formulas and produce visualizations [9]. The foundation of the library's scientific discipline, which began in the 1920s, aims to provide a theoretical foundation for the profession of librarianship. The US has developed in close relations with other fields of research, specifically computer science, communication studies, and cognitive science. LIS connections with professional practice such as studies by mathematical researchers [10].

On the one hand, and other fields of research on the other have influenced the orientation of research and the development of theoretical tools and theoretical perspectives. Research problems are very diverse, depending on the direction of research, local trends, etc. In this bibliometric research it deals with professional practice in LIS research trying to address important information problems, such as "information retrieval, quality and authenticity of information, policies for access, application of information systems and data mining security. This research is multidisciplinary in nature, and has been strongly influenced by research designs developed in social science, behavior, and management and in the study of exact sciences or pure sciences.

About the data: Exported on Jun 21, 2020. Criteria: Text - 'Mathematics' in title and abstract; Publication Year is 2015 or 2016 or 2017 or 2018 or 2019; Fields of Research is 0101 Pure Mathematics; Publication Type is Article or Proceeding. © 2019 Digital Science and Research Solutions Inc. All rights reserved. Unless otherwise agreed, redistribution / external use of this work is not permitted. Result: 3769 records.
3. Result and Discussion

The results of research through the Dimensions database describe the number of publications that have been made through international journals, the distribution of titles in international journals, the types of publications produced, and the level of productivity of authors from the name of the institution [11,12]. The results of the research are then carried out an analysis related to the trends that occur related to education policy in Indonesia in the obligation and culture of writing in scientific publications.

| Year | Number of Publications |
|------|------------------------|
| 2019 | 3.735                  |
| 2018 | 2.805                  |
| 2017 | 1.999                  |
| 2016 | 1.294                  |
| 2015 | 600                    |

Total number of publications 48,013. With details in the form of datasets 465, grants 13,369, Patens 238, Clinical Trials 79 and Policy Documents 147. This study limits the review of the last 5 years of data taken to see statistics for an increase in the number of publications in the Dimensions database (Table 1). From this data from year to year there is an increase in the average of 1000 the number of publications that enter the Dimensions database. The highest data is in 2019, there are 12,255 publications. There is no significant increase in the number of documents as in Table 2.

| Source Title                        | Total |
|-------------------------------------|-------|
| Closed                              | 25,782|
| All Open Access                     | 22,231|
| Gold                                | 17,184|
| Green, Accepted & Submitted         | 4,534 |
| Green, Published                    | 513   |

Database Dimensions grouping information sources of types of publications into 5 major groups, namely publications that are Close, All Open Access, Gold, Green, Accepted & Submitted, and Green, Published. From these 5 groups the sources of scientific publications that are Closed have the highest number as in table 2. there are 25,782 units. This publication requires access to paid access first, if someone will open the document. In such closed publications the writer, if the individual requires these papers, pays from 20-45 dollars per document. The price will certainly be expensive if in publishing a scientific publication, the author requires several publications that are used as a reference. At present, most writers who work in a higher education institution in Indonesia have subscribed to it through their institutions. In conducting scientific publications, sources of information that are open access are no less good than the results of the research contained in the document. So that a series of publications that can be downloaded free of charge becomes the first and foremost choice by a researcher. There are currently 22,231 copies of Dimensions in the Dimensions database, which ranks second as an option in opening the desired journal database in scientific publications. Another option that is possible through DOAJ (Directory of Open Access Journals) is a website that lists open access journals, managed by Infrastructure Services for Open Access (IS4OA).

| Fields of Research                  | Total |
|-------------------------------------|-------|
| Education                           | 19,400|
| Curriculum and Pedagogy             | 15,925|
From the data in Table 3, it is obtained that in grouping based on the study of material in the Dimensions database, most related to mathematics education, there are 19,400 documents. Ranked number 2 on Curriculum and Pedagogy there are 15,925 documents. While those who study about Pure Mathematics are only 6,759 or 34.8% of the first rank. In this grouping there are studies related to Information and Computing Sciences, there are 3,272 documents, if you look at the data separately from the Artificial Intelligence and Image Proc. What is interesting is that there are mathematical studies related to psychology, there are 5,393, which is a combination of Psychology and Cognitive Sciences and Pure Psychology.

The most sources of publications (Table 4) in the Dimensions database from arXiv - Preprint are 2,352 documents. Rank 2 only half is 1.491 from the Journal of Physics Conference Series. arXiv - Preprint is an electronic precast repository (commonly called electronic print) scientific papers in mathematics, physics, astronomy, computer science, quantitative biology, statistics, and quantitative finance, which can be accessed online https://arxiv.org/. Preprint server has actually been around since the 90s, Arxiv. Nowadays, there are various kinds of preprint servers that are suitable for the field and concentration of knowledge widely. In Indonesia, INArxiv is the only preprint server that already exists. During this time, researchers in Indonesia have used the Academia.edu and Researchgate pages - which are not actually servers from Indonesia - to publish preprint articles. Preprint publications have been widely recognized by the international academic community. Elsevier, for example, has acknowledged and given instructions on the use of media and preprint articles on its website. Whereas the second publication through the Journal of Physics: Conference Series is a peer-reviewed, open-access publication from IOP Publishing that provides readers with the latest developments in physics presented at international conferences. The publication has been indexed by Scopus, INSPIRE-HEP, MathSciNet, ISI Proceedings and several others.
In Table 5 shows there are 3 groups (author) that have an intense number of publications. There is a red color that is the core of the writer is Dr. Douglas H. Clements, Kennedy Endowed Chair in Early Childhood Learning and Director. He has actively made 9 papers with 4 (four) other writers, namely Julie Sarama, Drew H. Bailey, Greg J. Duncan, and Tyler W. Watts. One of his publications was titled Does Early Mathematics Intervention Change the Processes Underlying Children’s Learning? Published in the Journal of Research on Educational Effectiveness in volume 10 of 2017. These Papers have been used as a reference by 19 publications included in Google scholar. In looking at the mathematical research group, there are other groups that have clusters in blue and green. But the contact person is Douglas H. Clements.

Through VOSviewer, novel research can also be visualized. New topics were identified by the bright colors as seen from Fig 1. Graph, graph theory, mathematical modelling, fuzzy mathematics are among the new topics in the field.

| Author        | Document | Total Link Strength |
|---------------|----------|---------------------|
| Kehoe, Elaine | 13       | 0                   |
| Matalytski, Mikhail | 13   | 2                   |
| Patey, Ludovic | 13       | 12                  |
| Jackson, Allyn | 12       | 0                   |
| Wang, Sophia  | 10       | 0                   |
| Kopytko, Bohdan | 9       | 2                   |
| Toller, Owen  | 9        | 0                   |
| Leversha, Gerry | 8     | 0                   |
| Sanders, Sam  | 7        | 1                   |
| Hirst, Jeffry L. | 6     | 5                   |

**Fig 1. Overlay visualization**
From the data found the author from Indonesia has the highest number of publications, namely Heri Retnawati. The author is from the Faculty of Mathematics and Natural Sciences, Yogyakarta State University. There are 48 documents recorded in the range of studies conducted. At the moment through the verified https://scholar.google.co.id account at uny.ac.id, the relevant document has been cited 1168 times and has an H-index of 16. Papers owned are entitled "Why are the Mathematics National Examination Items Difficult and What Is Teachers' Strategy to Overcome It? " written in collaboration with Heri Retnawati, Badrun Kartowagiran, Janu Arlinwibowo, Eny Sulistyaningsih through International Journal of Instruction 10 (3), 257-276, July 2017 https://doi.org/10.12973/iji.2017.10317a has 22 total citations on Dimensions.

The relationship between the size of the national scientific activities of developed countries and the level of specialization by the field of science is examined using a bibliometric indicator of the number of papers and citations of publications [13–16]. A negative relationship between the amount of scientific activity and the level of scientific specialization has emerged, with Japan and to a lesser extent India, indicating a level of specialization that is higher than expected. Countries with established scientific traditions (such as the US, UK, Netherlands and Switzerland) have lower levels of specialization than expected, showing a more diverse range of research activities. However, over time, most countries have reduced their scientific specialization, a pattern that is different from recent research on the study of mathematics and is more applied in industry.

Indonesia still has to make great efforts in increasing the visibility of scientific publications and journals. Lecturers and researchers are encouraged to carry out research and scientific publications that are relevant to the needs of society, not just fulfilling the demands of promotion and career development. On the one hand, these scientific publications have an impact on the increasing need for accredited and indexed journals in indexers of international reputation. Scientific journals also continue to experience improvement, both with national accreditation and international reputation. SINTA is a portal that contains the measurement of science and technology performance. Includes the performance of researchers, writers, authors, journal performance, performance of science and technology institutions. The government's efforts through the awarding of the SINTA Awards which are given annually to the best researchers, research institutions and journals have become a form of attention in advancing publications in Indonesia.

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