Indonesian Journal of Applied Mathematics and Statistics (IdJAMS)

Volume 1 Issue 1 June, 2024, pp. 27-38
https://idjams.com/index.php/jms/index

Trends, Contributions and Prospects: Bibliometric Analysis of ANOVA Research in 2022-2023

Utis Sutrisno[1], Yulia Wulandari[2], Usep[3], Samsul Arifin[4,*], Roni[5], Monica Mayeni Manurung[6], Muhamad Faisal[7]

[1,2,3]Master's Program of Basic Education, Universitas Muhammadiyah Jakarta, Ciputat, South Tangerang, 15419, Indonesia
[4,5,6,7]Study Program of Data Science, Faculty of Engineering and Design, Institut Teknologi Sains Bandung, 17530, Indonesia
**Corresponding author: samsul.arifin@itsb.ac.id*

Copyright: ©2024 by the authors. Submitted for possible open access publication under the terms and conditions of the Creative Commons Attribution-ShareAlike 4.0 International License-(CC-BY-SA) (https://creativecommons.org/licenses/by-sa/4.0/)

Article Info

Article history:
Received: June 2024
Revised: August 2024
Accepted: August 2024
Available online: *August 2024*

Abstract

This study aims to analyze the development and contribution of research on the topic of ANOVA (Analysis of Variance) using the bibliometric analysis method. ANOVA is a statistical method used to compare the means of three or more groups. Through bibliometric analysis, we explore articles published in journals related to ANOVA within a certain time span, namely 2022-2023. The method of bibliometric analysis involves collecting bibliographic data from relevant sources and analyzing characteristics such as frequency of publication, notable authors, and most frequently cited journals. This study uses a bibliometric analysis method that retrieves 1,911 metadata from Scopus. The results of the bibliometric analysis revealed an increase in the number of publications about ANOVA during the time span studied, namely 2022-2023. These findings indicate that ANOVA remains a relevant and interesting topic for researchers in various disciplines. In addition, there is a wide variety of research topics related to ANOVA, including the use of ANOVA in various contexts, such as laboratory experiments, clinical research, and analysis of survey data. By analyzing the contribution of research on the topic of ANOVA, this study provides valuable insights for us. Moreover, the researcher also discussed prospects for future research on this topic, including the development of new analytical methods and the wider application of ANOVA in various scientific and practical contexts.

Keywords: Bibliometric Analysis; Methods of Analysis; ANOVA Research Prospects

I. Introduction

Statistical research is an important field of science used to understand and quantitatively analyze data. One of the statistical methods often used in data analysis is ANOVA (Analysis of Variance), which is used to compare the averages of three or more groups. ANOVA has become a very useful tool in many fields, including the social sciences, medicine, economics, and natural sciences. Anava or Anova is a synonym for analysis of variance, so many people call it ANOVA. ANOVA is part of the statistical analysis method which is classified as a comparative analysis of more than two averages. Analysis of variance (ANOVA), also known as Analysis of Variability, is a statistical technique used to detect differences in the means between groups or observed populations. ANOVA is widely utilized to analyze research data from various fields, whether obtained through experiments or surveys. This analysis is

classified as a parametric analysis, requiring the fulfillment of the assumption of normality for the data. Furthermore, the observed response variable must be quantitative and measured on an interval or ratio scale [1] [2].

ANOVA can be understood as an extension of the *t*-test, allowing its application beyond testing the difference between two population means. It enables the testing of differences among three or more population means simultaneously. ANOVA is employed to examine the variations between multiple population means by comparing their variances. Types of ANOVA can be categorized based on the number and nature of independent variables. Some commonly known types of ANOVA include a) Simple ANOVA or One Way ANOVA: ANOVA that has only one independent variable or factor. This type of ANOVA is used to test the average difference between groups or treatments. b) Two Way ANOVA: ANOVA which has two independent variables or factors. This type of ANOVA is used to examine the interaction between two factors and the effect of each factor on the dependent variable. c) Three Way ANOVA: ANOVA which has three independent variables or factors. This type of ANOVA is used to examine the interaction that is used between three factors and the effect of each factor on the dependent variable. e) MANOVA (Multivariate ANOVA): ANOVA used to test the average difference between groups or treatments on two or more dependent variables. f) ANCOVA (Analysis of Covariance): ANOVA is used to control or adjust for the effect of other independent variables on the dependent variable [3] [4].

ANOVA can also be utilized to test research hypotheses, assess mean differences between groups, and address various problems across different fields. In the last few decades, numerous studies have employed the ANOVA method to address diverse research questions. These developments underscore the significance of this method in assessing differences between groups and comprehending the factors that contribute to data variability. Therefore, this study aims to conduct a systematic bibliometric analysis of research utilizing the ANOVA method. Through this analysis, the author will examine research trends associated with ANOVA, the contributions of prominent researchers, and the most frequently investigated research topics. By undertaking this bibliometric analysis, the authors intend to present a comprehensive overview of the development of ANOVA research in recent years, specifically 2022-2023 [5] [6].

Bibliometric analysis is a quantitative method for analyzing scientific literature with the aim of identifying publication patterns, research influence, and relationships between scientists or fields of study. This method involves measuring and analyzing bibliometric data such as the number of publications, citations, collaboration between authors, and distribution of topics in the literature. By using tools and techniques such as co-citation analysis, co-authorship analysis, and citation analysis, bibliometric analysis helps evaluate scientific developments, identify research trends, and uncover underlying relationships in scientific data. VOSviewer, one of the software that is often used in bibliometric analysis, allows the visualization of complex networks built from bibliometric data, such as networks of authors, keywords, and journals, making it easier to understand and interpret the data. This analysis has become increasingly important in today's information age, where the number of scientific publications continues to increase, and researchers need effective ways to filter and analyze available information [7] [8].

This study involves collecting bibliographic data from pertinent sources, specifically from the Scopus database, by retrieving 1,911 metadata entries from the 2022-2023 timeframe. The author will employ relevant keywords to identify articles related to ANOVA. Once the data is collected, the authors will analyze various publication characteristics, including the number of publications per year, notable authors, institutional affiliations, and the most frequently cited journals. The results of this study are anticipated to enhance our understanding of the contribution of ANOVA research in diverse scientific fields. Furthermore, the findings may offer valuable insights for researchers interested in utilizing these statistical methods. We also discuss potential avenues for future research on this topic, encompassing the development of novel analytical methods and the broader application of ANOVA in various scientific and practical contexts. As such, this research has a clear aim of making a substantial

contribution to the understanding of research utilizing the ANOVA method and providing guidance for future research in this field [7] [9].

II. Method

VOSviewer is software designed to build and visualize bibliometric networks. This application is useful for analyzing relationships in scientific literature based on bibliometric data such as co-authorship, co-occurrence, citation, bibliographic coupling, and co-citation [10] [11]. Here are some of the main features and how VOSviewer works:

a) Input Data:
VOSviewer can process bibliometric data from various sources such as Web of Science, Scopus, PubMed, and other bibliometric databases. This data usually includes information about publications, authors, journals, citations, and keywords.

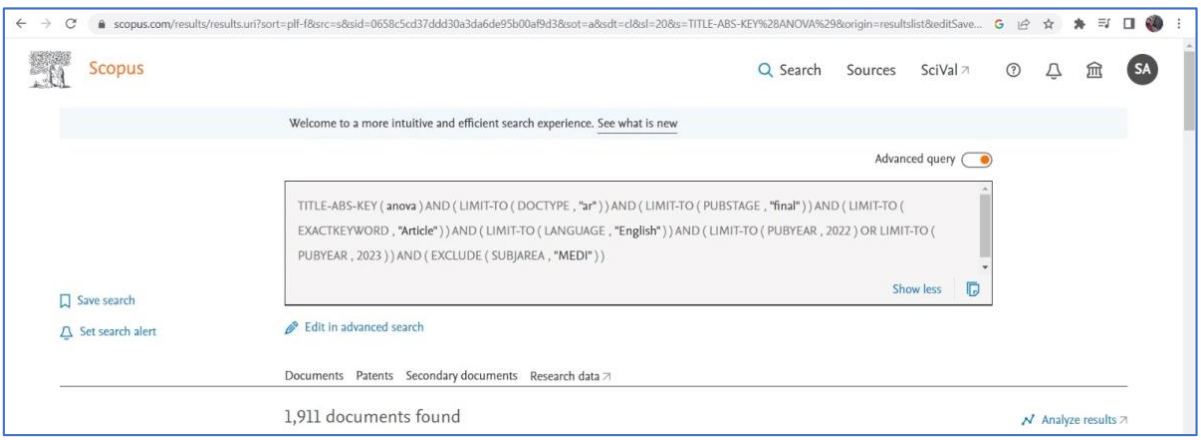
b) Building a Network:
Based on input data, VOSviewer builds a network consisting of nodes and edges. Nodes can represent authors, publications, or keywords, while edges represent relationships or links between nodes, such as co-authorship or co-occurrence.

c) Network Visualization:
VOSviewer provides various visualization tools to display networks. Networks can be visualized in the form of a graph where nodes are close together if they have a strong relationship, and the color and size of the nodes can be adjusted to highlight certain information.

d) Cluster Analysis:
VOSviewer can perform cluster analysis to identify groups of nodes that are closely related. Each cluster can be colored differently for easier identification.

e) Data Analysis and Export:
VOSviewer allows users to analyze networks with various metrics and also supports export of visualizations and data in various formats for further use.

The research method employed in this study is bibliometric analysis, which aims to provide a comprehensive overview of the relationship among various scientific publications and identify research trends within a specific research field. For this study, bibliometric analysis is conducted using data obtained from Scopus, with a total of 1,911 scientific work metadata from the years 2022-2023. Scopus was selected as the data source due to its worldwide recognition and accreditation as a reputable journal indexing platform [12] [13]. The research process, as outlined by Nandiyanto (2022), consists of the following steps: (1) collecting metadata from Scopus, (2) downloading the data in CSV format, (3) processing the data using VOSViewers, and (4) analyzing the results of the data processing [14] [15]. The data search settings in Scopus web can be observed in the title key and the accompanying Figure 1 shown below:



Indonesian Journal of Applied Mathematics and Statistics (IdJAMS)

Volume 1 Issue 1 June, 2024, pp. 27-38
https://idjams.com/index.php/jms/index

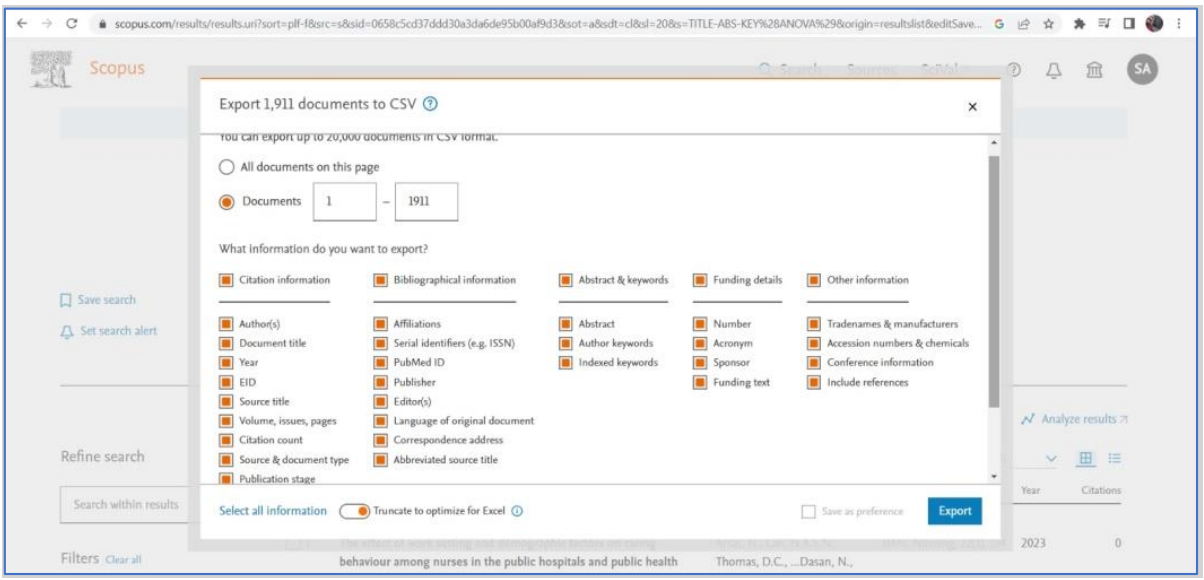


Figure. 1 Settings for metadata search and downloading on Scopus web

The use of keywords in the metadata search process used is "ANOVA", after searching the data it will be displayed as shown in Figure 1 then do the data sorting by making settings as follow [16] [17]. *TITLE-ABS-KEY (anova) AND (LIMIT-TO (DOCTYPE , "ar")) AND (LIMIT-TO (PUBSTAGE , "final")) AND (LIMIT-TO (EXACTKEYWORD , "Article")) AND (LIMIT-TO (LANGUAGE , "English")) AND (LIMIT-TO (PUBYEAR , 2022) OR LIMIT-TO (PUBYEAR , 2023)) AND (EXCLUDE (SUBJAREA , "MEDI"))*

After conducting the search and sorting the metadata until the number of retrieved data entries falls below the data limit of 2000, the data is downloaded in CSV format, as illustrated in Figure 2 below [18] [19].

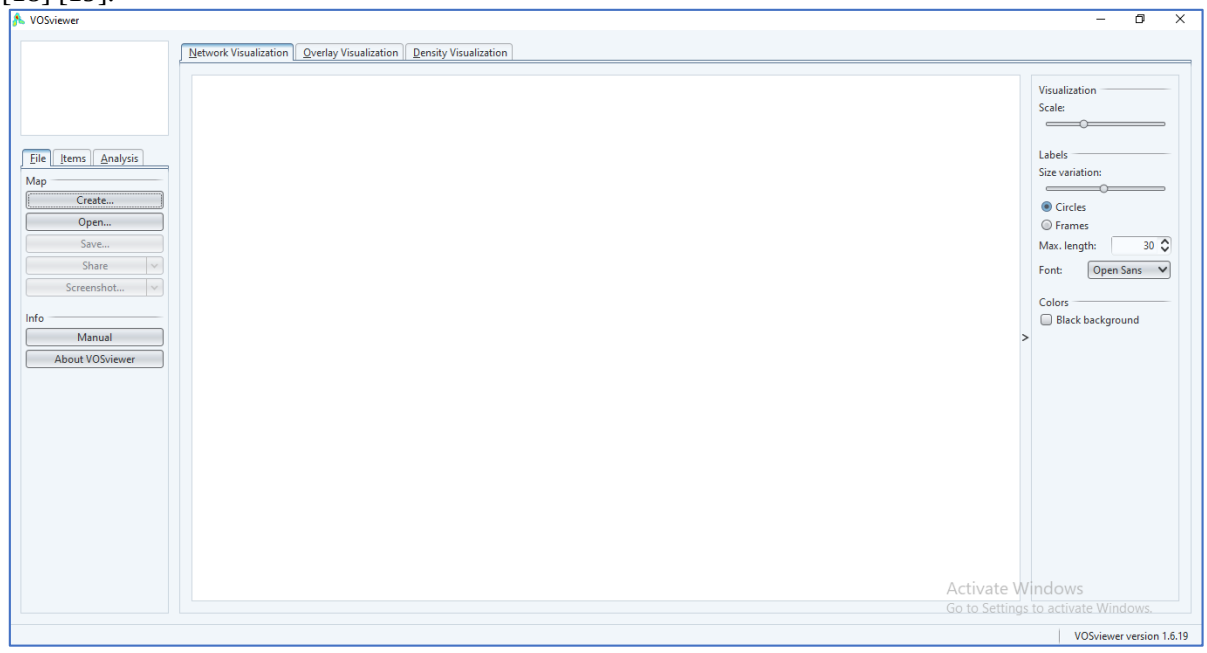


Figure 2. Initial view of VOSViewers

The acquired metadata is subsequently loaded and processed within the VOSViewers application, as depicted in Figure 3. Data analysis is conducted by inputting the previously downloaded Scopus metadata source and performing the necessary operations [20] [21]. The advantages of bibliometric analysis using VOSviewer are as follows.

a) Interactive visualization:
VOSviewer allows creating interactive network maps based on bibliometric data. This allows users to better explore and understand the relationship between authors, journals, and keywords.
b) Multidimensional mapping capabilities:
VOSviewer can map multiple dimensions of bibliometric data, such as author, journal, and keywords. This allows the user to see complex patterns and relationships between these elements.
c) In-depth statistical analysis:
VOSviewer is equipped with various statistical techniques that can be used to analyze bibliometric data. Users can perform statistical analysis such as co-cluster analysis and ranking analysis to gain deeper insights into the data.
d) Ease of use:
VOSviewer has an intuitive and easy-to-use interface. Users can easily import bibliometric data and set visualization parameters according to their needs [22] [23].

Disadvantages of bibliometric analysis using VOSviewer are as follows.

a) Limitations in accessing data:
VOSviewer relies on bibliometric data available in the database used. If the required data are not available or incomplete, bibliometric analysis using VOSviewer may not provide accurate or representative results.
b) Limitations in interpretation:
While VOSviewer can help visualize and analyze bibliometric data, interpretation of results still requires a deep understanding of the research context and other methods of analysis. Bibliometric analysis provides only an overview and cannot replace a more in-depth qualitative analysis.
c) Limitations in the selection of bibliometric elements:
VOSviewer allows mapping based on specific bibliometric elements, such as author, journal, and keywords. However, there are other elements that may also be relevant in a bibliometric analysis, such as the author's institution or country of origin. VOSviewer may not be able to map these elements with the same detail.

Dependence on the quality of the bibliometric data: Bibliometric analysis using VOSviewer is highly dependent on the quality of the bibliometric data used. If the bibliometric data has errors or inaccuracies, the analysis results may be inaccurate or biased. Although VOSviewer has advantages and disadvantages, its wise use in conjunction with other research methods can provide valuable insights into research trends, contributions, and prospects in bibliometric analysis [24] [25].

III. Results and Discussion

The search results reveal a total of 1,911 scientific journal articles published on the topic of ANOVA during the period of 2022-2023. Among these, 1,410 articles were published in 2022, while 501 articles were published in 2023. Initially, a bibliometric analysis is conducted based on authorship by selecting co-authorship analysis. The document boundary for each author is set to a minimum of 1, and a minimum citation of 1 is applied, resulting in 846 matches out of 1,920 authors. Among the authors, four individuals published the highest number of documents, each contributing two documents, while the remaining authors had only one document each. In terms of author citation counts, there are 23 authors with citations ranging from 10 to 39, and based on link strength, only 14 authors were connected [26]. The results are presented in the following Figure 3.

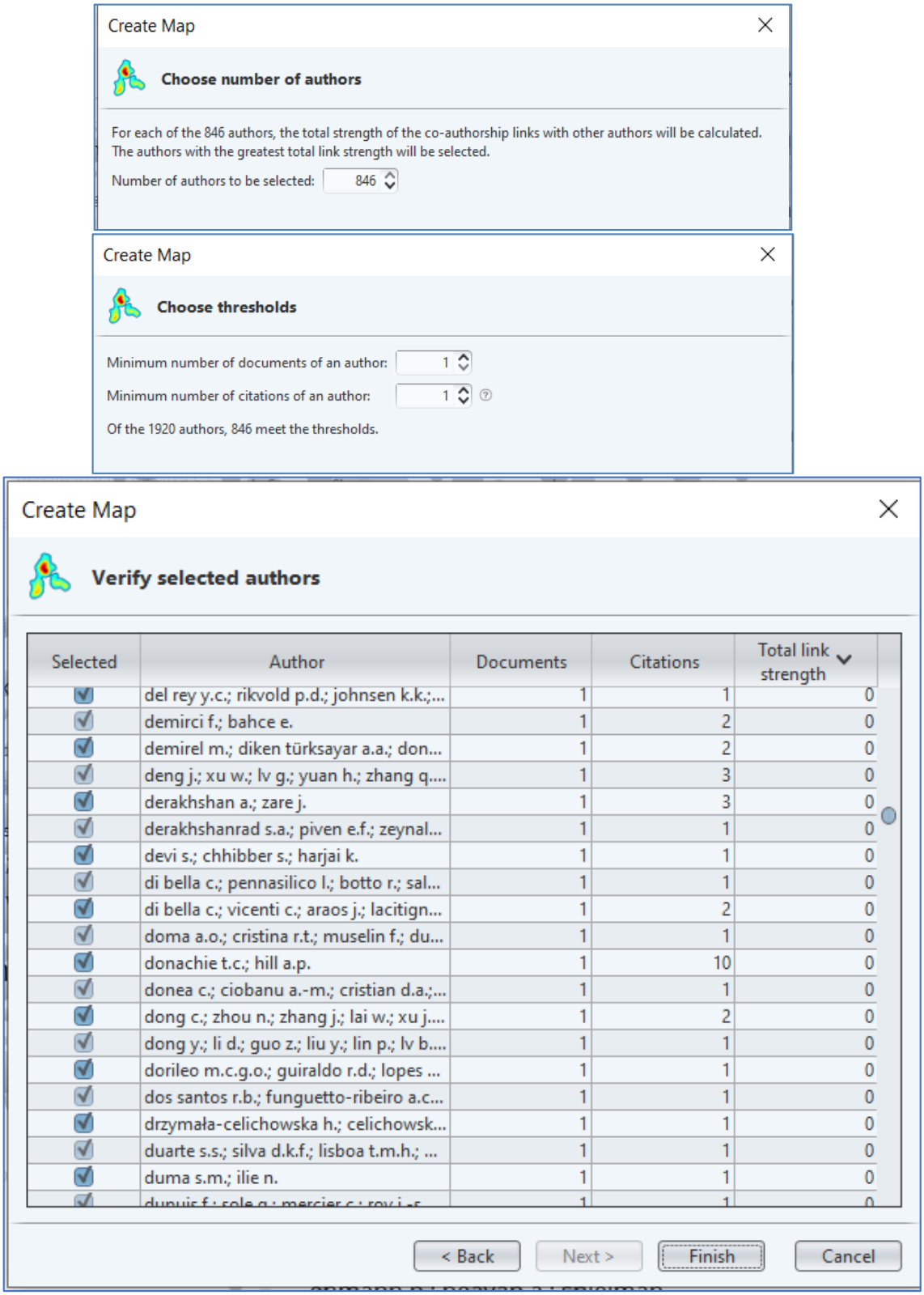


Figure 3. Setting options, by document, citation, and total link strength link on Vosviewer

Based on the results of this analysis, it can be observed that a significant number of authors originate from the United States, India, and China. Furthermore, many authors are affiliated with prominent higher education institutions such as Universidade de São Paulo, Universidade Estadual Paulista "Júlio de Mesquita Filho," and Tehran University of Medical Sciences. This analysis provides an overview of the quantity and distribution of contributors to the advancement of ANOVA research [27]. The visualization results based on the authors are presented in Figure 4 below.

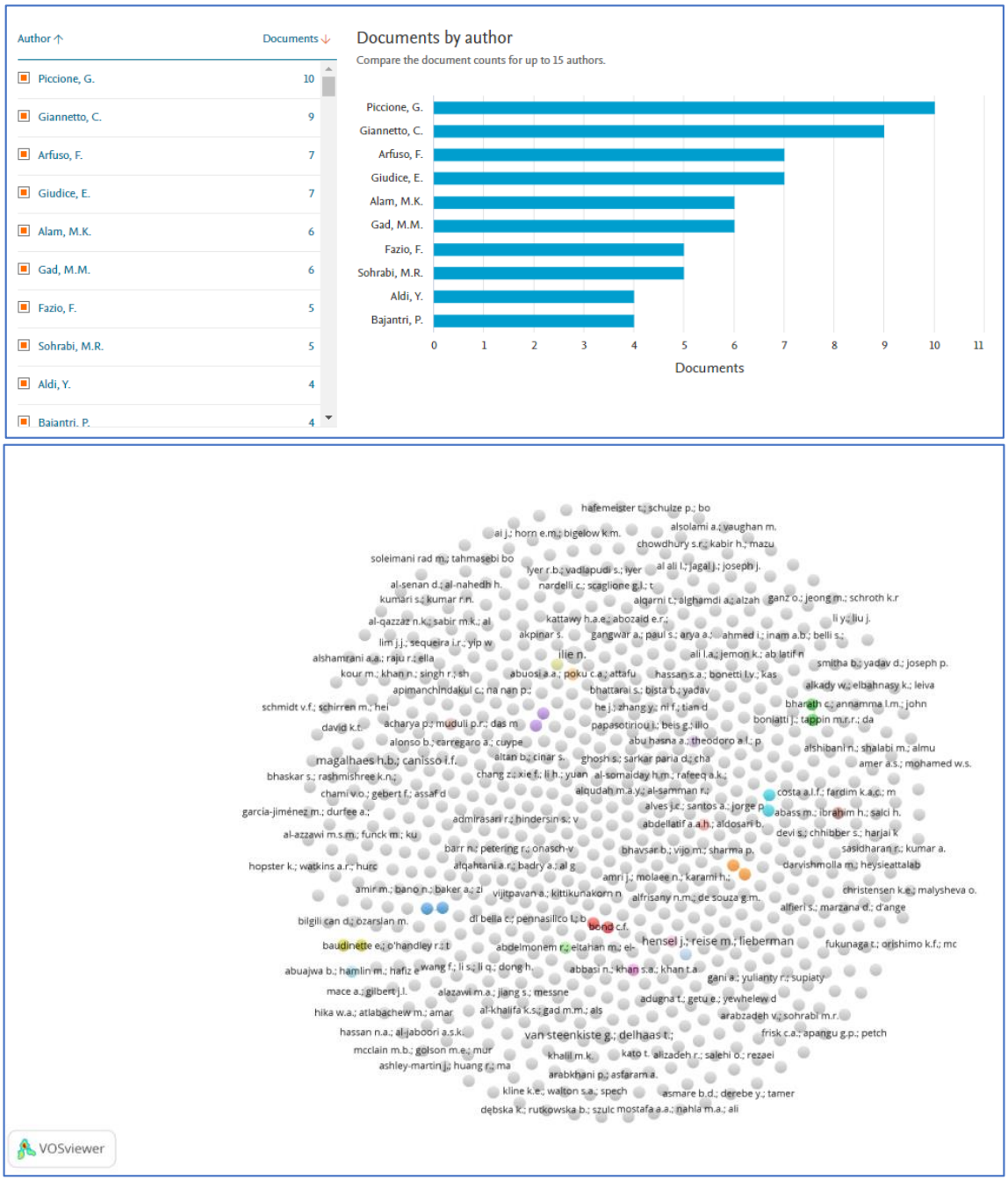


Figure 4. Visualization by the author on VOSViewer and Web Scopus

Figure 4 illustrates a network visualization generated by VOSViewer, depicting the relationships and co-authorship patterns among researchers who have contributed to ANOVA research during the period 2022-2023. This figure provides a visual representation of the collaborative efforts and interconnections among authors based on their publications and citation linkages. In this network: (a) Nodes represent individual authors. The size of each node indicates the number of publications by that author, with larger nodes signifying more prolific authors. (b) Edges (Lines) connecting nodes indicate co-authorship links, demonstrating collaborative work between authors. Thicker lines suggest stronger collaboration or a higher number of co-authored papers. (c) Colors may be used to cluster authors into groups based on their collaboration patterns, highlighting distinct communities or research groups within the broader ANOVA research network.

Figure 4 helps in identifying key researchers and their collaborative networks, highlighting the prominent contributors to the field of ANOVA. This visualization aids in understanding the collaborative dynamics and the influence of various researchers within the academic community. This network visualization, generated from bibliometric data sourced from Scopus, is crucial for comprehending the collaborative landscape and identifying potential research partnerships and influential authors in the field of ANOVA. Secondly, when analyzing by country, the top five countries with the highest number of authors out of 1,920 authors are the United States (310 documents), India (232 documents), China (215 documents), Brazil (162 documents), and Iran (149 documents). This analysis offers a comprehensive overview of the primary regions where ANOVA research has been published. The details can be seen in Figure 5 below [28].

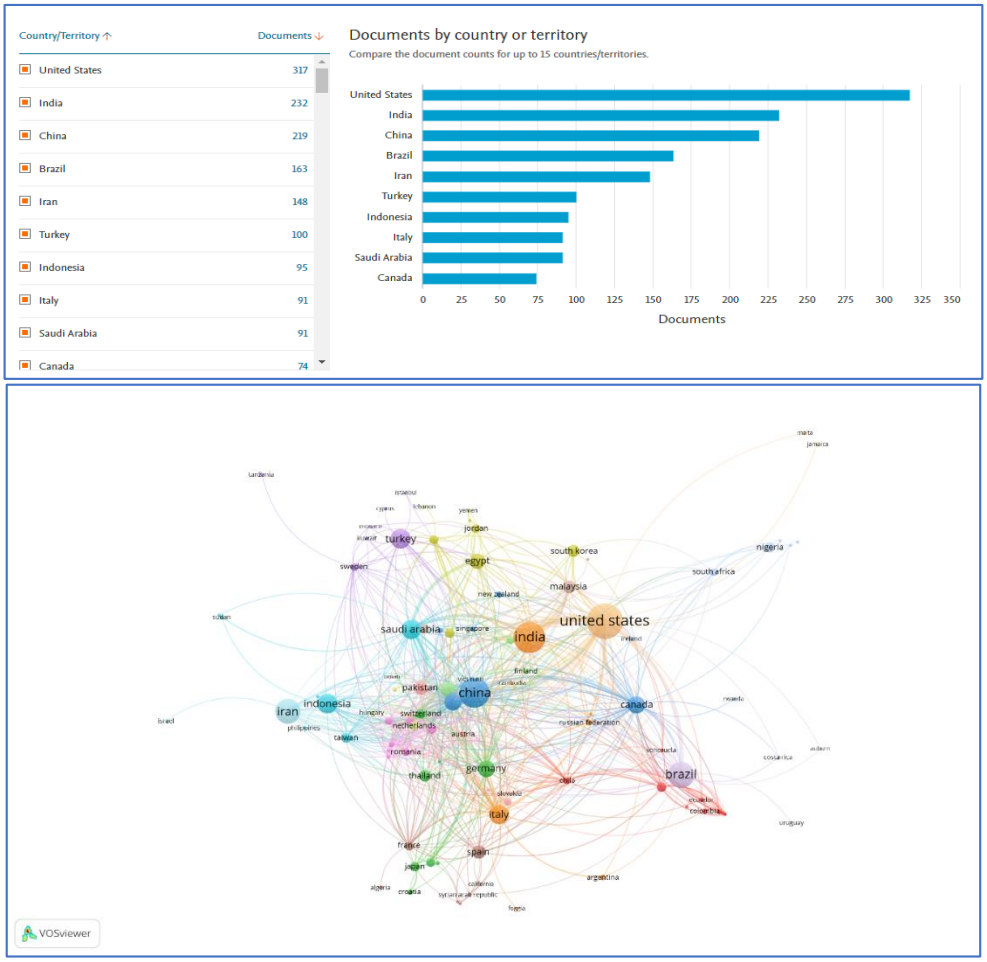


Figure 5. Visualization by author's country on VOSViewer and Web Scopus

Thirdly, the analysis based on co-occurrence involves displaying network visualization between keywords. ANOVA is extensively utilized across various scientific domains, leading to numerous connections between keywords. In ANOVA research, the most prevalent inter-keyword networks revolve around articles, controlled studies, human subjects, males, and females. All of this can be seen in more detail in Figure 6 below [29].

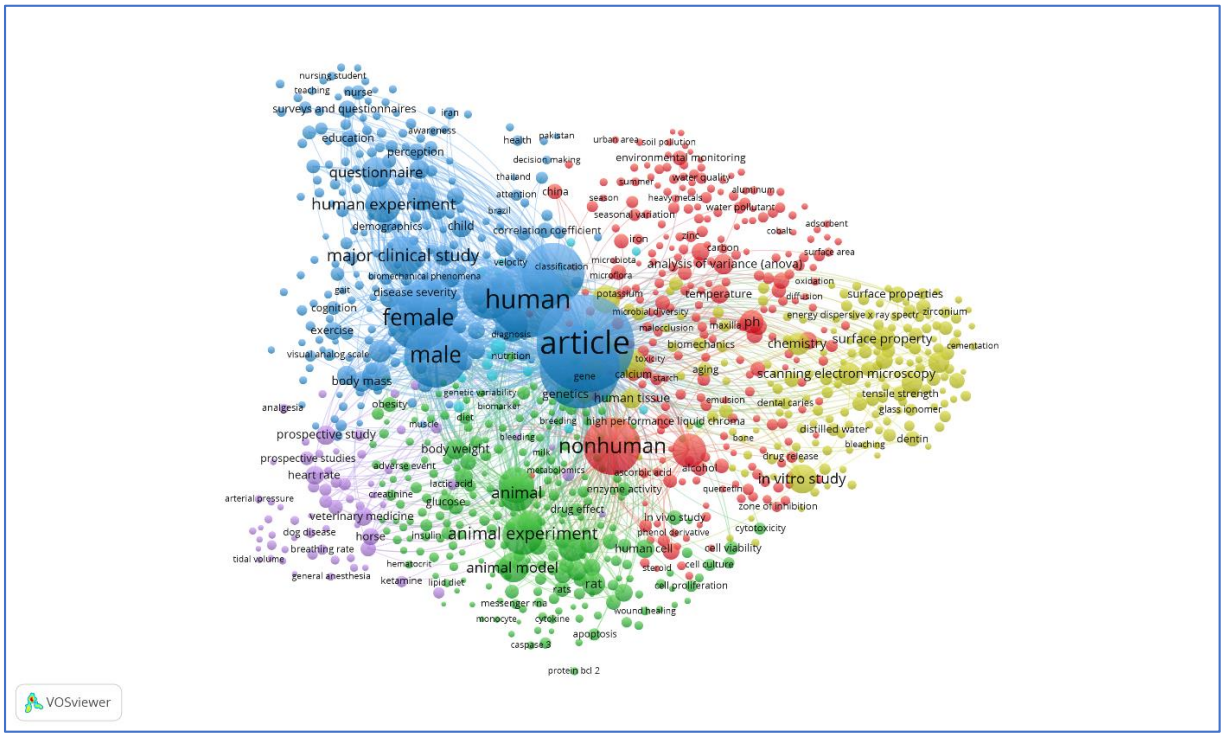


Figure 6. Visualization by author's keywords

In the conducted bibliometric analysis, several trends related to research employing the ANOVA method are identified by the authors. One notable trend is the increase in the number of ANOVA-related publications each year. For instance, in 2019, there were 11,298 documents on ANOVA, followed by 12,340 documents in 2020, and 13,536 documents in 2021. This demonstrates that ANOVA remains a relevant and captivating topic for researchers across various disciplines. This trend may reflect the growing recognition of the importance of understanding variations and differences between groups in data analysis. ANOVA is increasingly being applied in diverse fields such as social sciences, economics, medicine, and others. Its usage is expanding due to the increasing complexity of data and the necessity to compare more than two groups. ANOVA is frequently utilized in the analysis of experimental and survey data, particularly in studies involving multiple variables. Research utilizing the ANOVA method has made significant contributions to our comprehension of differences and variations between groups in data. This method enables researchers to test hypotheses regarding mean differences between groups and identify factors influencing data variability [30] [31].

In various fields, research employing ANOVA has provided valuable insights into the effects of specific variables, validated interventions or treatments, and laid the groundwork for informed decision-making. ANOVA assists researchers in detecting significant differences between groups or treatments, enabling improved decision-making processes. Furthermore, research utilizing the ANOVA method contributes to the development of additional statistical methods. The prospects for future research in the field of ANOVA are vast and promising. With advancements in technology and the development of statistical analysis methods, there are several areas that offer exciting opportunities for ANOVA

research. Firstly, the application of ANOVA in the context of Big Data and multilevel data analysis is gaining increasing relevance. With the availability of large and complex datasets, the ANOVA method can be employed to analyze differences between groups on a broader scale and tackle the challenges associated with complex data analysis. Secondly, integrating ANOVA with other analytical methods such as regression analysis, path analysis, or cluster analysis can provide a more comprehensive understanding of the relationships among interconnected variables. This integrated approach can enhance insights into complex phenomena. Thirdly, the development of more sophisticated statistical inference techniques and nonparametric approaches can improve the reliability and power of ANOVA analysis. These advancements can enhance the accuracy and validity of results derived from ANOVA. Lastly, exploring the application of ANOVA in research focusing on interaction effects and moderating effects holds promise. Understanding how variables interact and how their effects may vary under different conditions can provide deeper insights into the phenomena being studied. Overall, the prospects for future research in the field of ANOVA are highly promising. Continued research in this area will expand our understanding of the method and its application in various scientific and practical contexts. In conclusion, ANOVA is being increasingly utilized across diverse scientific fields, making a significant contribution to the advancement of statistics and research. ANOVA retains promising prospects for the future and can serve as a valuable tool in addressing various challenges in multiple disciplines [32] [33].

Even though this manuscript contains minimal mathematical concepts, this research provides significant contributions in the field of bibliometric analysis and network visualization techniques. Using VOSviewer to analyze bibliometric data and identify research trends provides valuable and relevant insights for the scientific community. In addition, this manuscript is well structured and interactive, making it suitable for publication online. The author has succeeded in presenting the data and analysis results in a way that is easy to understand, even though the mathematical elements have not been fully explored. Thus, this article still has high academic value and can be useful for readers and other researchers [34] [35].

IV. Conclusion

Based on the bibliometric analysis that has been carried out, several main findings were found regarding the ANOVA research in 2022-2023. These findings include: The countries that conducted the most ANOVA research were the United States, India, and China. The most discussed ANOVA subject areas are biochemistry, genetics and molecular biology; pharmacology, toxicology and pharmaceutics; and veterinary. These findings have important implications and significance for future ANOVA research. First, the increase in the number of publications indicates that ANOVA research is gaining increasing interest among researchers. This may open opportunities for further research in the future. Second, countries that have conducted the most ANOVA research can become a reference for other countries to improve research in this field. Third, the journals that publish the most ANOVA research can be a reference for researchers to choose the right journal to publish their research results. Fourth, the most widely discussed ANOVA research topics can be a reference for researchers to determine relevant research topics in the future. Based on these findings, there are several recommendations for future ANOVA research. First, researchers can conduct further research to develop better ANOVA analysis methods. Second, researchers can conduct research to apply the ANOVA analysis method to fields that have not been widely researched. Third, researchers can conduct research to compare the ANOVA analysis method with other analytical methods. Thus, this bibliometric analysis provides an overview of the trends, contributions, and prospects for ANOVA research in 2022-2023. These findings can be a reference for researchers to conduct further research in the future. In addition, bibliometric analysis can also be a useful tool for researchers to map future research trends.

Acknowledgment

The authors would like to express their sincere gratitude to the anonymous reviewers for their valuable time, insightful comments, and constructive suggestions. Their expertise and dedication have significantly improved the quality of this paper. Their feedback has been instrumental in shaping the final version of this manuscript. This study is supported and funded by Lembaga Penelitian dan Pengabdian kepada Masyarakat (LPPM), Institut Teknologi Sains Bandung.

References

[1] I. Thoifah, *Statistika pendidikan dan Metode Penelitian Kuantitatif*. Malang: Madani, 2015.
[2] J. N. Rouder, M. Schnuerch, J. M. Haaf, and R. D. Morey, "Principles of model specification in ANOVA designs," *Comput. Brain Behav.*, vol. 6, no. 1, pp. 50–63, 2023.
[3] M. J. Blanca Mena, J. Arnau Gras, F. J. García de Castro, R. Alarcón Postigo, and R. Bono Cabré, "Non-normal data in repeated measures ANOVA: impact on type I error and power," *Psicothema*, 2023.
[4] A. Chatzi and O. Doody, "The one-way ANOVA test explained," *Nurse Res.*, vol. 31, no. 2, 2023.
[5] G. Rozing, M. Duspara, B. Dudic, and B. Savkovic, "Research on the Effect of Load and Rotation Speed on Resistance to Combined Wear of Stainless Steels Using ANOVA Analysis," *Materials (Basel).*, vol. 16, no. 12, p. 4284, 2023.
[6] D. D. Shankar and A. S. Azhakath, "Random embedded calibrated statistical blind steganalysis using cross validated support vector machine and support vector machine with particle swarm optimization," *Sci. Rep.*, vol. 13, no. 1, 2023, doi: 10.1038/s41598-023-29453-8.
[7] N. Donthu, S. Kumar, D. Mukherjee, N. Pandey, and W. M. Lim, "How to conduct a bibliometric analysis: An overview and guidelines," *J. Bus. Res.*, vol. 133, pp. 285–296, 2021, doi: 10.1016/j.jbusres.2021.04.070.
[8] O. Ellegaard and J. A. Wallin, "The bibliometric analysis of scholarly production: How great is the impact?," *Scientometrics*, vol. 105, pp. 1809–1831, 2015.
[9] Sugiyono, *Statistika Untuk Penelitian*. Bandung: Alfabeta, 2014.
[10] N. Gupta and R. Chakravarty, "Deciphering the Status of Library and Information Science Research in BRICS Nations: A Research Visualization Approach," *J. Libr. Adm.*, vol. 62, no. 3, pp. 404–418, 2022, doi: 10.1080/01930826.2022.2043695.
[11] D. Wong, "VOSviewer," *Tech. Serv. Q.*, vol. 35, no. 2, pp. 219–220, Apr. 2018, doi: 10.1080/07317131.2018.1425352.
[12] R. Ball, *Handbook Bibliometrics*. in De Gruyter Reference. De Gruyter Saur, 2022. [Online]. Available: https://books.google.co.id/books?id=vJh5zwEACAAJ
[13] K. Setiawan, "Buku ajar metodologi penelitian (anova satu arah)," 2019, *Universitas Lampung*.
[14] J. I. Gorraiz, R. Repiso, N. De Bellis, and G. Deinzer, *Best Practices in Bibliometrics & Bibliometric Services*. in Frontiers Research Topics. Frontiers Media SA, 2022. [Online]. Available: https://books.google.co.id/books?id=qfBXEAAAQBAJ
[15] L. Bornmann, P. Atkinson, S. Delamont, A. Cernat, J. W. Sakshaug, and R. A. Williams, *Bibliometric Indicators*. in Measurement methods. SAGE Publications Limited, 2020. [Online]. Available: https://books.google.co.id/books?id=_m1ZzwEACAAJ
[16] S. Arifin and I. B. Muktyas, "Generate a system of linear equation through unimodular matrix using Python and Latex," in *AIP Conference Proceedings*, American Institute of Physics Inc., Apr. 2021. doi: 10.1063/5.0041651.
[17] Yanuar, K. I. Sukmawati, and S. Arifin, "Penerapan Model Student Teams Achievement Division Terhadap Kemampuan Pemahaman Konsep Matematika Siswa Kelas VIII," *J. Ilm. Pendidik. Mat. "Union", Pendidik. Mat. Univ. Sarjanawiyata Tamansiswa Yogyakarta*, vol. 7, no. 1, pp. 57–64, 2019.
[18] Sulistiawati, Y. S. Kusumah, J. A. Dahlan, D. Juandi, Suparman, and S. Arifin, "The trends of studies in technology-assisted inquiry-based learning: the perspective of bibliometric analysis," *J. Eng. Sci. Technol.*, vol. 1, no. Special Issue, pp. 69–80, 2023.
[19] B. Langenberg, M. Janczyk, V. Koob, R. Kliegl, and A. Mayer, "A tutorial on using the paired t test for power calculations in repeated measures ANOVA with interactions," *Behav. Res. Methods*, pp. 1–18, 2022.
[20] A. Academia, "Panduan Analisis Bibliometrik Dengan VOSviewer Dan Contohnya." Accessed: Jun. 02, 2023. [Online]. Available: https://ascarya.or.id/analisis-bibliometrik/
[21] N. Van Eck and L. Waltman, "Software survey: VOSviewer, a computer program for bibliometric mapping," *Scientometrics*, vol. 84, no. 2, pp. 523–538, 2010.
[22] N. J. van Eck and L. Waltman, *Vosviewer: A Computer Program for Bibliometric Mapping*. SSRN, 2010. [Online]. Available: https://books.google.co.id/books?id=kmDmzgEACAAJ
[23] A. Ahmi, *Bibliometric Analysis for Beginners: A starter guide to begin with a bibliometric study using Scopus dataset and tools such as Microsoft Excel, Harzing's Publish or Perish and VOSviewer software.* in Pre-print Edition. 2021. [Online]. Available: https://books.google.co.id/books?id=kZ9BEAAAQBAJ
[24] S. Arifin *et al.*, "Prospects and Possibilities for Future Research of Fuzzy C-Means (FCM)," *Int. J. Intell. Syst. Appl. Eng.*, vol. 11, no. 2, pp. 741–751, 2023.
[25] S. Arifin *et al.*, "Long Short-Term Memory (LSTM): Trends and Future Research Potential," *Int. J. Emerg. Technol. Adv. Eng.*, vol. 13, no. 5, pp. 24–35, 2023.

[26] M. Visser, N. J. Van Eck, and L. Waltman, "Large-scale comparison of bibliographic data sources: Scopus, Web of Science, Dimensions, Crossref, and Microsoft Academic," *Quant. Sci. Stud.*, vol. 2, no. 1, pp. 20–41, 2021.
[27] A. W. K. Yeung, "Comparison between Scopus, Web of Science, PubMed and publishers for mislabelled review papers," *Curr. Sci.*, vol. 116, no. 11, pp. 1909–1914, 2019.
[28] R. Pranckutė, "Web of Science (WoS) and Scopus: The titans of bibliographic information in today's academic world," *Publications*, vol. 9, no. 1, p. 12, 2021.
[29] P. J. Purnell, "The prevalence and impact of university affiliation discrepancies between four bibliographic databases—Scopus, Web of Science, Dimensions, and Microsoft Academic," *Quant. Sci. Stud.*, vol. 3, no. 1, pp. 99–121, 2022.
[30] M. B. de Melo, D. Daldegan-Bueno, M. G. Menezes Oliveira, and A. L. de Souza, "Beyond ANOVA and MANOVA for repeated measures: Advantages of generalized estimated equations and generalized linear mixed models and its use in neuroscience research," *Eur. J. Neurosci.*, vol. 56, no. 12, pp. 6089–6098, 2022.
[31] S. Sutrisno and D. Wulandari, "Multivariate analysis of variance (MANOVA) untuk memperkaya hasil penelitian pendidikan," *AKSIOMA J. Mat. Dan Pendidik. Mat.*, vol. 9, no. 1, pp. 37–53, 2018.
[32] D. van den Bergh, E.-J. Wagenmakers, and F. Aust, "Bayesian repeated-measures ANOVA: An updated methodology implemented in JASP," 2022.
[33] B. A. Thango, "Application of the Analysis of Variance (ANOVA) in the Interpretation of Power Transformer Faults," *Energies*, vol. 15, no. 19, p. 7224, 2022.
[34] S. Arifin, I. Bayu Muktyas, and K. Iswara Sukmawati, "Product of two groups integers modulo m,n and their factor groups using python," in *Journal of Physics: Conference Series*, IOP Publishing Ltd, Mar. 2021. doi: 10.1088/1742-6596/1778/1/012026.
[35] Adi, S. Arifin, and B. Rahman, "Penerapan Model Kooperatif Tipe Numbered Head Together Untuk Meningkatkan Kemampuan Komunikasi Matematis Siswa SMP," *IndoMath Indones. Math. Educ.*, vol. 2, no. 2, pp. 117–126, 2019.