Bibliometric Analysis of Misconseptions in Physics Learning in Indonesia: Research Ternds in 2018-2022

H T Putra[1*], N Suprapto[1], M Habibbulloh[1], H N Hidaayatullaah[2]
[1]Physics Education, Universitas Negeri Surabaya, Indonesia
[2]Science Education, Universitas Negeri Surabaya, Indonesia
*Email : handikatusuka.20030@mhs.unesa.ac.id

Abstract. This study aims to determine the trend of the misconceptions of physics learning in Indonesia using bibliometrics. The research method used is bibliometric analysis in this case using Scopus-based metadata in the data retrieval process and using VOSviewer software in the data processing process. This research aims to analyze the misconceptions of physics learning in Indonesia so as to minimize similar events in the future and physics learning can be absorbed optimally. Indonesia, which was conducted in 2018 and above, does not have as many relationships as the United States because it is close to the current year. Based on bibliometric analysis, it can be concluded that there are still many words that are not prominent including physics, learning, science, and physics education, but still have a relationship with the main keyword, namely misconceptions. This can be an opportunity to conduct research using other keywords to have a strong relationship in the coming year. Using VOSviewer software makes processed metadata produce interactive visuals because it can describe objects that stand out from other objects. So that misconceptions about physics can be minimized and can build enthusiasm in learning physics.

1. Introduction

Physics is a branch of natural science which includes facts, principles, laws, postulates, theories, and scientific methodology. Physics is a subject in the science family that is very closely related to everyday life[1]. Physics is one of the main obstacles faced by high school students master the concepts of physics [2]. When studying physics, it is necessary not only to master the mathematical aspects, but also to understand the whole essence of physics. One of the factors for the low achievement of students in physics at school is the lack of understanding of the concept[3].[4] defines a concept as an idea, design, or understanding derived from concrete events, mental images of objects or processes, or things that cannot be explained in words. The initial concept that students bring is often not conform or conflict with the concept accepted by experts. The initial concept not in accordance with the scientific concept is said misconception or wrong concept [5].

Errors in understanding concepts are often found in physics learning. Students' initial concepts are often not in accordance with scientific concepts that have been agreed upon by experts, circumstances where students experience errors in understanding this concept are called misconceptions [6]. Misconception is one of the causes of difficulties in learning physics. Misconception is an idea or wrong view of a concept that is owned by someone where the concept is different from the concept that has been agreed upon and considered correct by experts. In addition, misconceptions occur because of mistakes made by someone in building conceptions based on information from the surrounding physical environment or accepted theories. Misconceptions generally involve misunderstanding the relationship between concepts.[3]. Misconceptions exist in all fields of science including physics [7].

The achievement of competence through the teaching and learning process in the classroom often experiences obstacles caused by many factors, for example the learning environment[8]and student errors in understanding the concepts being taught. Students' wrong understanding of concepts is not only caused by the learning process in class, but also because of the initial concepts (preconceptions) that students bring to class. Misconceptions can also be interpreted as conceptual errors that are understood by students, this happens because students do not understand what is being learned. This can disrupt the

student learning process for the next stage. Usually misconceptions occur among novice students which result in decreased learning outcomes[9].

Students' understanding of a concept that starts with a wrong concept will certainly be different from the scientific understanding possessed by experts or scientists in that field, so that it can only be accepted in certain cases, but does not apply to other cases and cannot be generalized.[10]. In the learning process, there will be differences between students' conceptions and scientific conceptions. The majority of Physics learning in schools today still not focusing on understanding the concept in full. Students who have different concepts with scientific concepts are still widely found [11]. Conceptions or interpretations of concepts that are not in accordance with the scientific understanding or understanding of experts in that field are called wrong concepts or misconceptions [12]. The problem of misconceptions in various fields of science, especially physics, has long been expressed by many researchers from various places, where the field of physics is a branch of natural science that discusses phenomena in everyday life [13].

Research that is relevant to misconceptions in physics learning in Indonesia continues to grow and has been in the past few years. Based on this, researchers need to conduct a bibliometric analysis which aims to uncover trends in misconceptions about physics learning that can be integrated into physics learning using the Google Scholar metadata database in the 2019-2022 range. The purpose of this research is to provide a bibliometric literature review to find recommendations for future trends regarding misconceptions in physics learning.

The formulation of the problems related to this research are:

a. What are the trends in research topics related to misconceptions?
b. What are the author's most used keywords in research topics related to misconceptions?
c. What is the contribution of Indonesian researchers regarding misconceptions in physics learning?
d. What are the opportunities for future research on the topic of misconceptions in physics learning?

2. Methods

The research method used is library research with a descriptive analysis method using a bibliometric approach. The method used in this study is bibliometric analysis which can assist researchers in studying the contents of the bibliography, citation analysis of each article taken from the Google Scholar metadata database on various publications related to academic content.

Article metadata was obtained from Scopus and Google Scholar database searches, with keyword criteria adjusted to the research focus. Furthermore, the Google Scholar database obtained 18,600 articles for 2018-2022 with the keyword 'Misconception'. Meanwhile, the Scopus database obtained 6 Scopus indexed articles for 2018-2022 with the keyword 'Misconception'. Specifically for metadata from Google Scholar, only the Top 50 papers were randomly selected but still based on the suitability of titles and keywords which were analyzed manually. All metadata obtained is stored in csv (comma separated values) and ris (research information system) formats. The preparation of preliminary data statistics can be done especially on data from the Scopus database, namely by grouping data through Microsoft Excel based on source, top author, country, institution, and top citation for .csv data format. Furthermore, metadata mapping for format.ris is performed with the VOSviewer application. This application can produce output that provides three map visualizations: network, overlay, and density, both based on keywords and authors. VOSviewer can work efficiently with large data sets and offers a variety of attractive and visually appealing analyzes through its comprehensive mapping visualization feature. Figure 1 is the flow of data collection and processing for bibliometric analysis both based on keywords and author. VOSviewer can work efficiently with large data sets and offers a variety of attractive and visually appealing analyzes through its comprehensive mapping visualization feature. Figure 1 is the flow of data collection and processing for bibliometric analysis both based on keywords and author. VOSviewer can work efficiently with large data sets and offers a variety of attractive and visually appealing analyzes through its comprehensive mapping visualization feature. Figure 1 is the flow of data collection and processing for bibliometric analysis

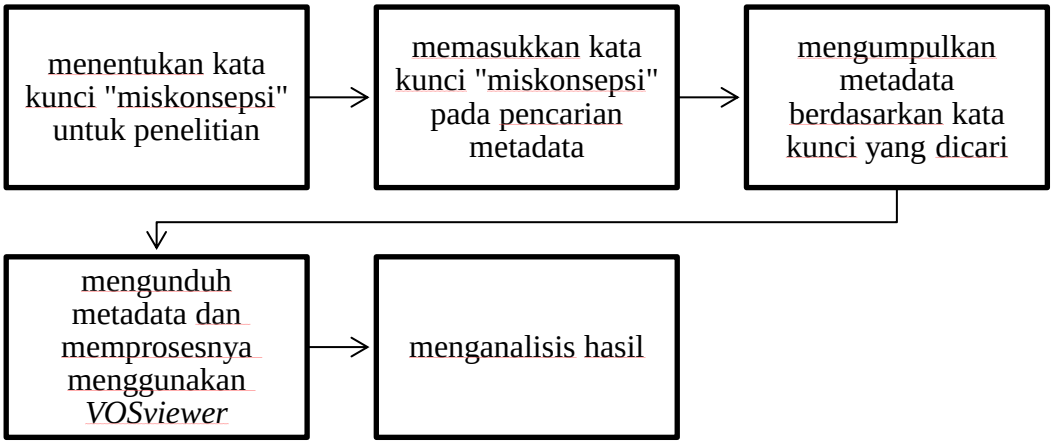

Figure 1. Research Methods

3. Results and Discussion

Co-authorship analysis

Co-authorship analysis used to explore the relationship between topics in the field of research that focuses on publication documents, the analysis carried out in research is based on the title of the publication. By setting the minimum number of occurrences of terms where there are at least several related topics that stand out in this research:

1. Based on *author* 3 domestic authors occupy the top positions, namely Samsudin A. with 22 documents and 143 citations and a link strength of 44, followed by Kaniawati I. with 10 documents and 104 citations and a link strength of 26, with 15 documents and 121 citations and a link strength of 25.

Table 1. Co-Authorship Author

Author	Documents	Citations	Total link strength
Samsudin A.	22	143	44
Kaniawati I.	10	104	26
Suhandi I.	15	121	25
Arora A.	5	8	20
Erberber E.	5	8	20
Mai T.	5	8	20
Neidorf T.	5	8	20
Tsokodayi Y.	5	8	20
Suhendi E.	6	35	18
Suyana I.	5	36	16

Here is a visual of *co-authorship* based on *author*

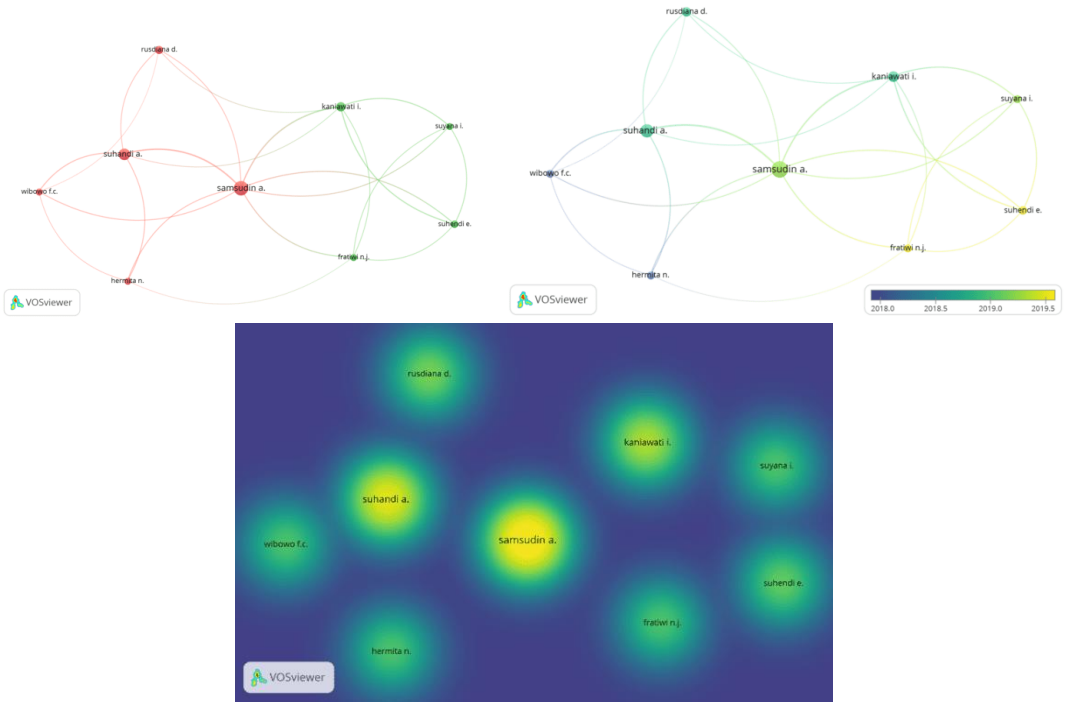

Figure 2. Co-Authorship Author

2. Based on countries the United States is the top country, followed by Germany and the United Kingdom, while Indonesia occupies the 14th position with 165 documents and 663 citations and the strength of links is 13.

Table 2. Co-Authorship Country

Country	Documents	Citations	Total link strength
United States	361	14627	67
Germany	54	2696	47
United Kingdom	69	1408	31
spain	27	498	24
Australia	32	725	19
….	….	….	….
Indonesia	165	663	13

Here is a visual of *co-authorship based on countries*

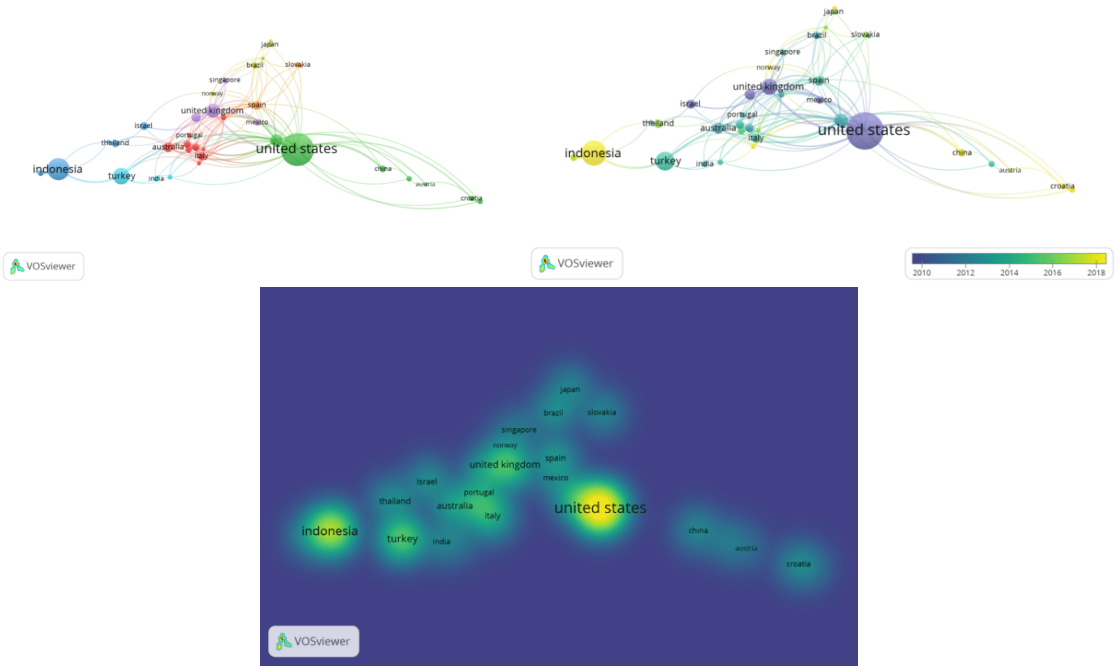

Figure 3. Co-Authorship Countries

It appears that the United States has relations from various sides which are dominated by countries with different colors where research conducted by the United States was in 2010 and below.

Co-occurrence analysis

Co-occurrence analysis used to explore the relationship between topics in the field of research that focuses on publication documents, the analysis carried out in research is based on the title of the publication. By setting the minimum number of occurrences of terms where there are at least several related topics that stand out in this research:

1. Based on *all keywords* the top keywords obtained are students, physics, misconceptions, education, teaching, engineering education, problem solving, student misconceptions, conceptual change, physics learning, human.

Table 3. Co-Occurrence Of All Keywords

Keyword	Occurrences	Total link strength
students	239	1106
physics	137	482
teach	80	426
education	70	392
misconceptions	116	337

Here is a visual of *co-occurrence* based on *all keywords*

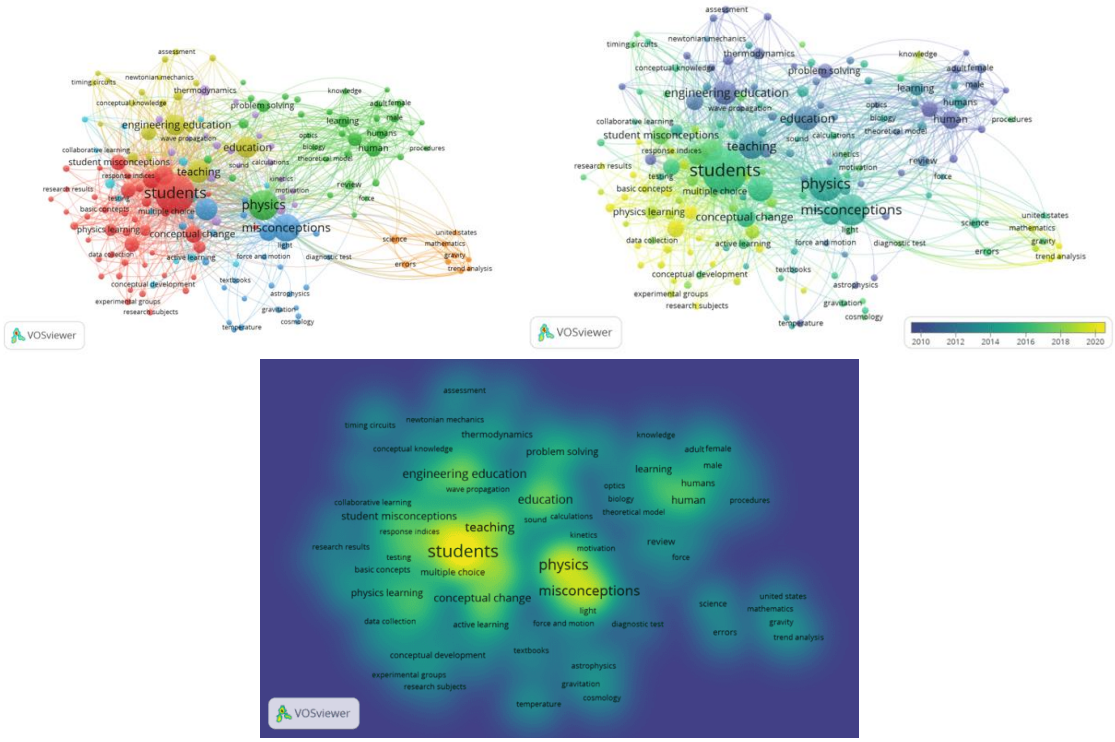

Figure 4. Co-Occurrence Of All Keywords

Based on the picture above, it shows that the brighter the color display, the more people who do research. Conversely, the darker the color displayed, the fewer people who do research related to misconceptions in physics.

2. Based on *author keywords* obtained the top keywords misconceptions, physics, physics education, conceptual understanding, science, physics education research, conceptual development.

Table 4. Co-Occurrence Author Keywords

Keyword	Occurrences	Total link strength
misconceptions	116	137
physics	40	74
science	12	48
misconceptions	46	47
physics education	45	47

Below is a visual of the co-occurrence based *author keywords*

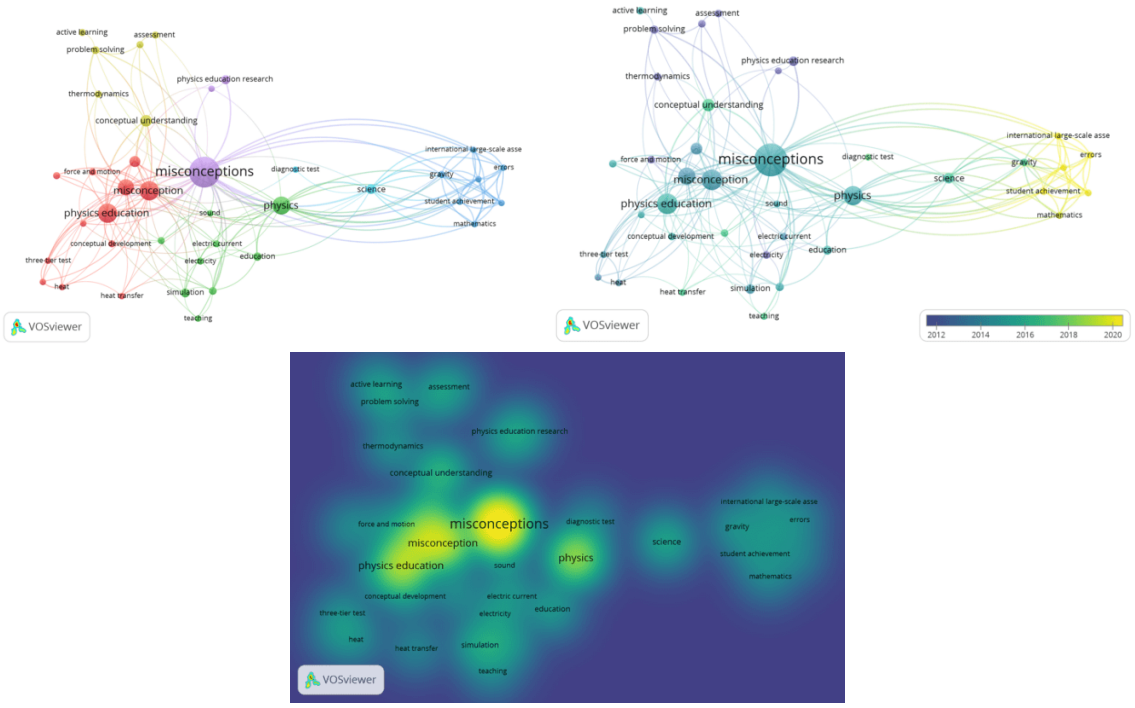

Figure 5. Co-Occurrence Author Keywords

Based on the picture above, it shows that the brighter the color display, the more people who do research. Conversely, the darker the color displayed, the fewer people who do research related to misconceptions in physics. The resulting visual refers to the topic more because it adjusts the author keyword, namely 2 identical words, there are misconceptions and misconceptions in the top positions, followed by 2 identical words, there is physics education and physics.

3. Based on*index keywords* the top keywords obtained are students, physics, teaching, education, conceptual understanding, engineering education, education computing, human.

Table 5. Co-Occurrrence Index Keywords

Keyword	Occurrences	Total link strength
students	239	1032
teach	75	378
physics	107	359
education	64	344
....	….	….
students misconceptions	37	199

Below is a visual of the co-occurrence based*index keywords*

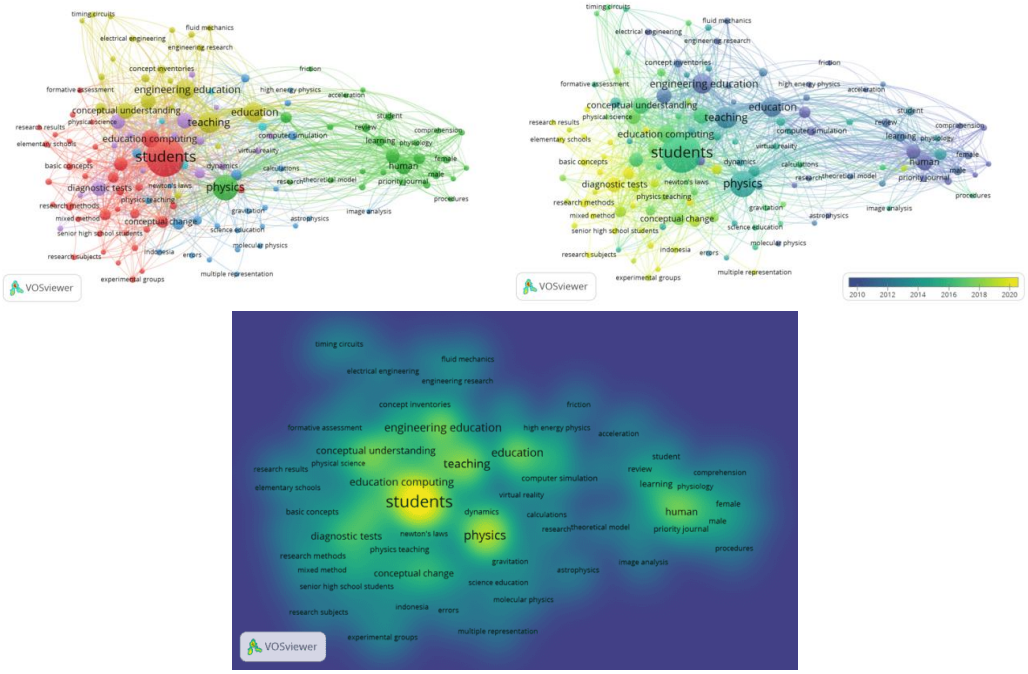

Figure 6. Co-Occurrence Index Keywords

Based on the picture above, it shows that the brighter the color display, the more people who do research. Conversely, the darker the color displayed, the fewer people who do research related to misconceptions in physics. What's interesting is that Indonesia is included in the keyword index which has a relationship with students, physics, diagnostic tests, conceptual understanding, education computing, high school students.

Citation Analysis

Citation analysis used for checking the impact and quality assumptions of an article, author or institution based on the number of works and/or authors that have been cited by others. By setting the minimum number of occurrences of terms where there are at least several related topics that stand out in this research:

1. Based on the author, Samsudin A. obtained 22 documents and 143 citations, the most among other authors.

Table 6. Citation Analysis Author

Author	Documents	Citations	Total link strength
Samsudin A.	22	143	91
Kaniawati I.	10	104	82
Suhandi I.	15	121	58
Suhendi E.	6	35	53
Rusdiana D.	7	92	46
Eshach H.	6	34	43

The following is a visual of the citation analysis by author.

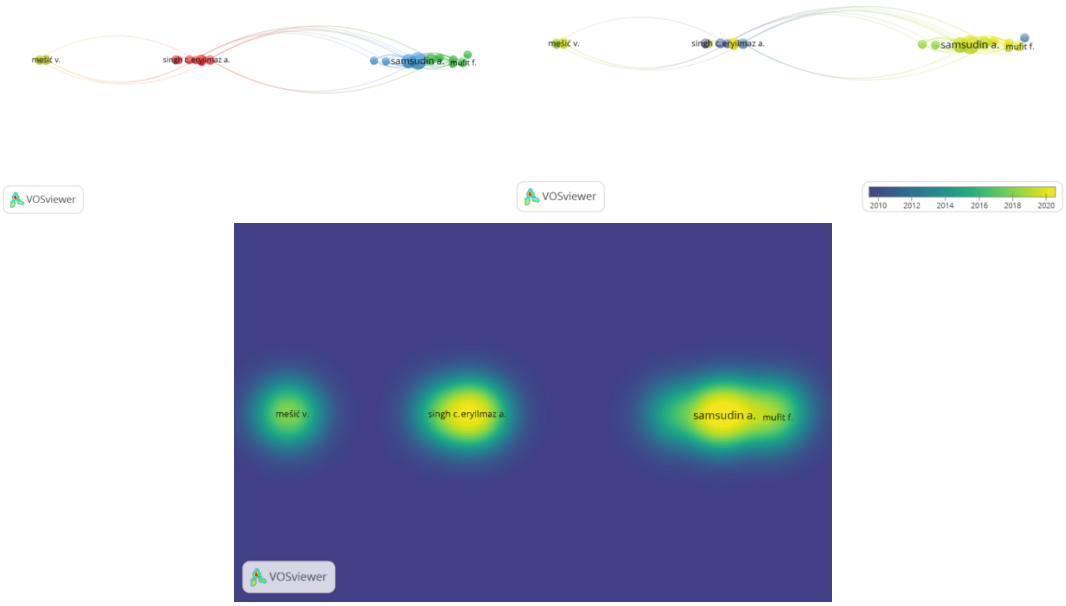

Figure 7. Citation Author

Based on the picture above, it shows that the brighter the color display, the more often the author conducts research. On the other hand, the darker the color displayed, the fewer authors who conduct research related to misconceptions in physics.

2. Based on *countries* the United States became the top country, while Indonesia followed in second place.

Table 7. Citation Analysis Countries

Country	Documents	Citations	Total link strength
United States	361	14627	367
turkey	54	2696	221
Indonesia	165	663	191
Germany	54	2656	83
United Kingdom	69	1408	74
….	….	….	….

The following is a visual of the citation analysis by country.

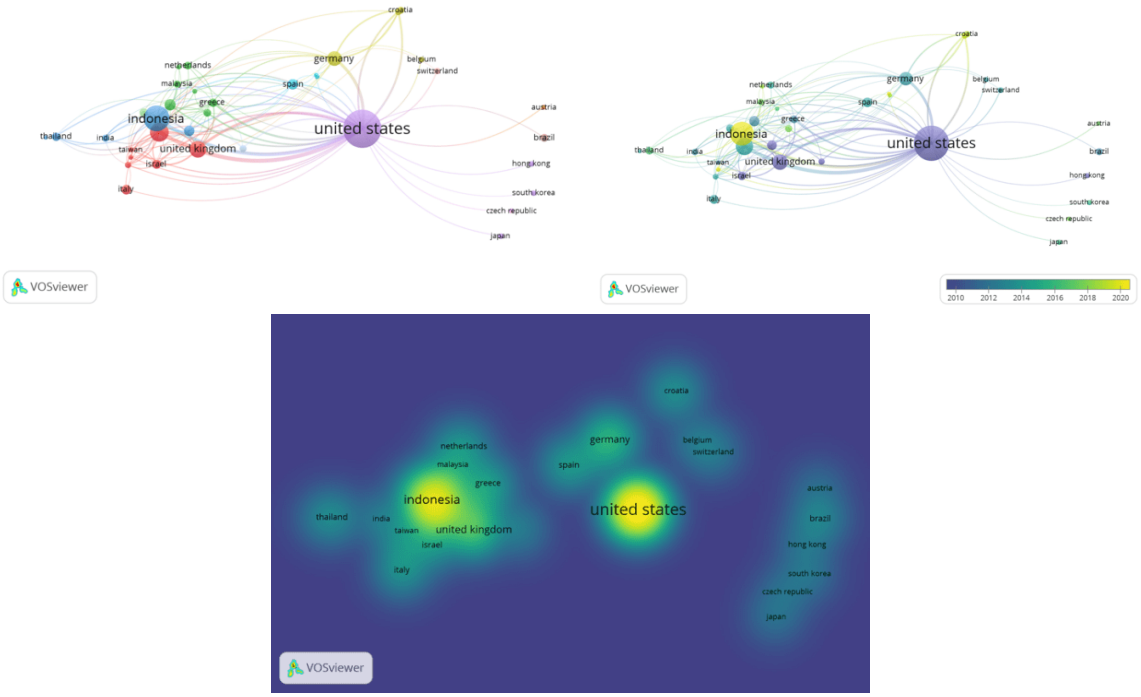

Figure 8. Citation Countries

It appears that the United States and Indonesia are the top countries among other countries, but Indonesia is surrounded by countries that are almost close together while the United States is surrounded by countries that are far apart. This happens because the United States of America has relations from various sides, including countries that have relations with Indonesia.

Bibliographic Coupling Analysis

*Bibliographic coupling*occurs when two works reference a third work that is common in their bibliographies. This is an indication that it is possible that the two works treat related subject matter.

1. Based on the author, Samsudin A. obtained 22 documents and 143 citations and a link strength of 2334, the highest among other authors.

Table 8. Bibliographic Coupling Author

Author	Documents	Citations	Total link strength
Samsudin A.	22	143	2334
Kaniawati I.	10	104	1609
Eshach H.	6	34	1552
…	…	…	…

Here is a visual of bibliographic couping based onauthor

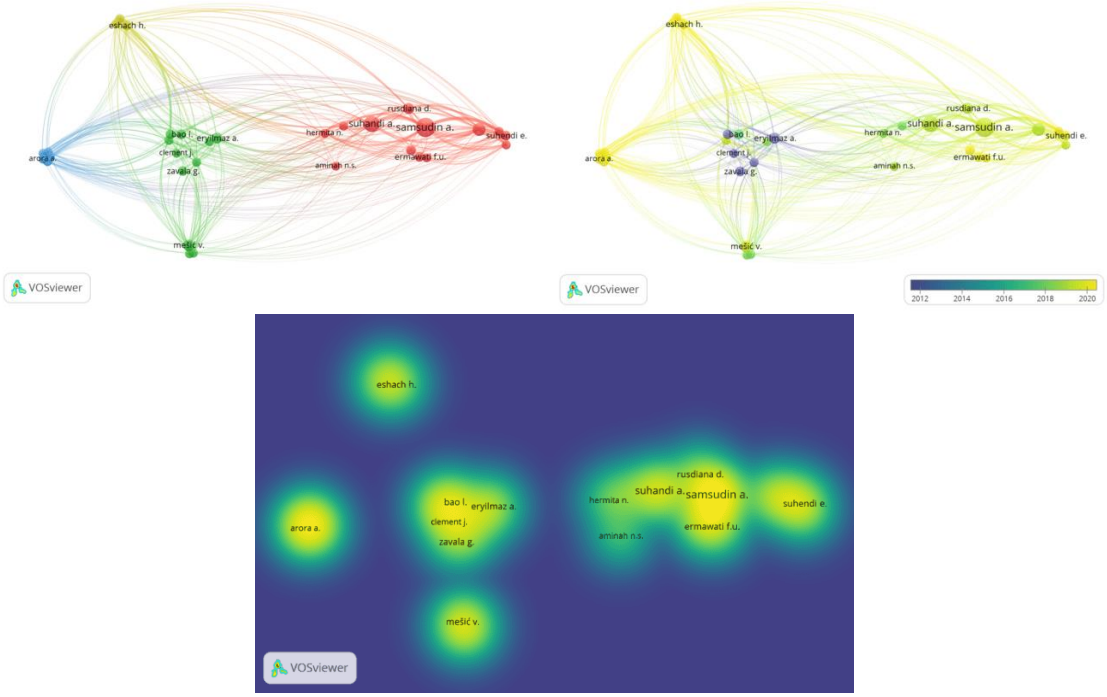

Figure 9. Bibliographic Coupling Autnor

Samsudin A., who occupies the red cluster based on network visualization, is surrounded by adjacent authors and has the most relationships among the others. The research being conducted is also close to 2018 according to the yellow color on the overlay visualization and surrounded by authors who have the same color

2. Based on *countries* the United States became the top country, followed by Turkey and the United Kingdom, while Indonesia followed in fourth place.

Table 9. Bibliographic Coupling Countries

Country	Documents	Citations	Total link strength
United States	361	14627	24662
turkey	90	1240	13400
United Kingdom	69	1408	7886
Indonesia	165	663	7249
Germany	54	2656	6740
….	….	….	….

Here is a visual of bibliographic coupling based on countries.

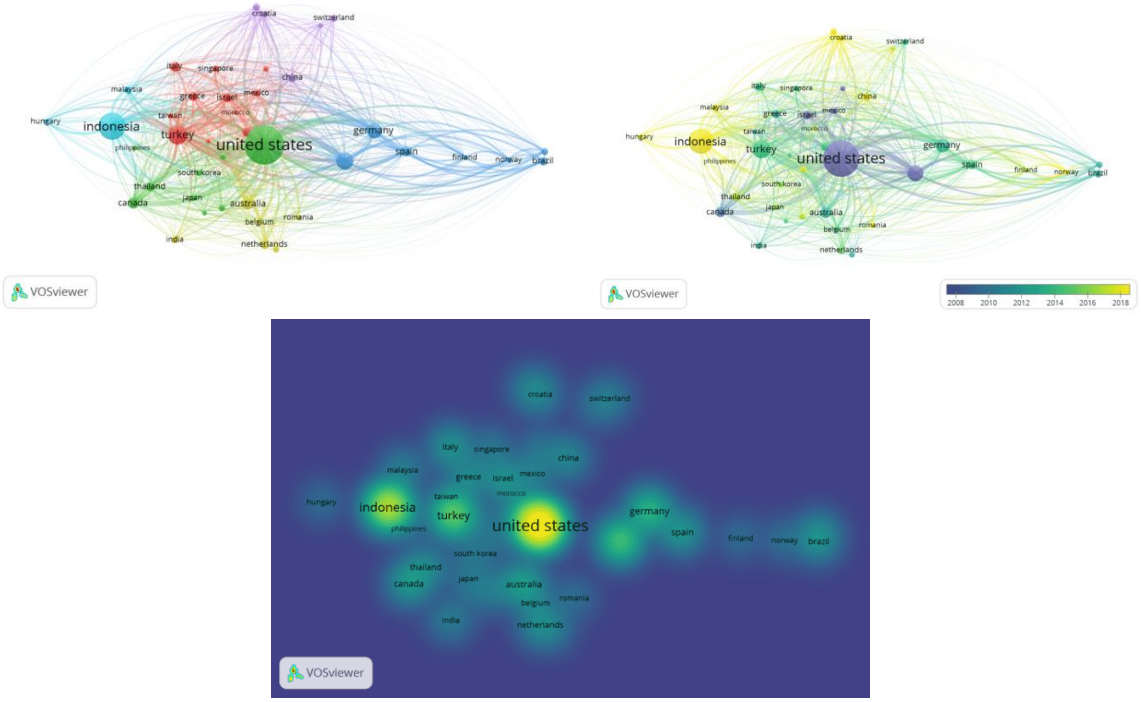

Figure 10. Bibliographic Coupling Countries

Even though Indonesia is not at the forefront, the research conducted is very close, namely in 2018 according to the yellow color on the overlay visualization and surrounded by countries that have the same color.

4. Conclusions

From the research that has been done, it is known that metadata analysis using VOSviewer software produces interactive visuals because it can describe objects that stand out from other objects. From the results presented, there is a misconception that learning physics is dominated by western countries, but Indonesia also has a big contribution because it occupies position 2 in citation analysis based on countries and position 4 in bibliographic coupling analysis based on countries. Indonesia, which conducted research in 2018 and above, does not have as many relations as the United States because it is approaching the current year. Authors from Indonesia also have a big role because they stand out from other authors, besides that they also have strong relationships between clusters. What's interesting is that the word Indonesia is included in the keyword index which has a relationship with students, physics, diagnostic tests, conceptual understanding, education computing, high school students. Even though Indonesia is not at the forefront, the research conducted is very close to the current year and is surrounded by countries that have the same color. This is a strong capital for Indonesia to raise the issue of misconceptions related to learning physics so that it can be minimized in the future.

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