Bibliometric Analys Related to Problem Solving Ability in Physics Learning in The Range of 2018 - 2023

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Abstract. The existence of several abstract concepts contained in physics learning causes low student skills in solving problems (Problem Solving). This study aims to examine the number of journal publications, researcher productivity, research trends or topics that are often researched regarding problem solving or problem solving during 2018-2023, top publishers, top articles that are widely cited from the Scopus database through bibliometric analysis using VOSviewer software with the keyword "Problem Solving in Physics Learning". Based on bibliometric analysis, the results obtained based on the metadata obtained show an unstable writing trend from 2018 to 2023. A lot of research was studied related to problem solving in 2022. This study shows that the Division of Applied Mathematics from Brown University, United States is the top publisher. Meanwhile, the top article that is widely cited is an article with the title Physics-informed neural networks: A deep learning framework for solving forward and inverse problems involving nonlinear partial differential equations with the author's name Raissi and the number of citation as many as 2902. In the visualization of the relationship, the keyword problem solving displays most of the clusters in red, as well as in the density visualization display with the keyword problem solving showing clusters with lighter colors. Then the researcher who has the top research productivity is Karniadakis g. e. In density visualization with country variations dominated by Indonesia, the United States, and China, indicated by the lighter cluster color than other countries.

1. Introduction

Physics is a scientific discipline that studies natural phenomena and explains how these phenomena occur. Physics is a subject that does not only contain theories and formulas to be memorized, but physics requires understanding and understanding of concepts that are focused on the process of forming knowledge through a discovery, presenting data. Physics is one part of science that focuses on the study of natural materials or events and interactions that occur between nature and humans. The subject matter of the study on this matter causes the existence of physics concepts that are real and abstract. The existence of several abstract concepts contained in physics learning which causes students to have difficulty in understanding a physics material learning physics in students lacking in learning physics which causes low student problem solving skills. In physics learning, students generally tend to be passive, and the ability to solve problems in students is still relatively low, thus making students less develop their thinking skills. Physics learning should be more aimed at the active role of students in the teaching and learning process and the teacher only as a learning facilitator. This means there must be a shift in the way of learning physics, from the original teacher sets what will be learned (teacher centered) to how to provide and enrich the experience of students (student centered). Physics learning that occurs so far is still teacher centered and not yet oriented to student centered. Teachers do not provide opportunities for students to actively participate in expressing opinions, as a result students become passive and less motivated to learn physics so that some students consider physics lessons as difficult and boring lessons.

Thinking skills will be directly related to students' skills in problem solving. The lack of problem solving skills includes a weak understanding of the principles and rules of physics, deficiencies in understanding the problem, and insufficient motivation from students. In working on physics problems given by teachers, students more often use mathematical equations without doing analytics, guessing the formulas used and memorizing examples of problems that have been done to work on other problems. Students still often use plug and chug and memory-based approaches in solving physics

problems. In fact, one of the goals of physics learning is to create humans who can solve complex problems by applying their knowledge and understanding to everyday situations.

High-level intellectual skills can be developed through problem solving. Problem Solving or problem solving, according to the term is the process of solving a problem or event, an effort to choose one of several alternatives or options that are close to the truth of a particular goal. There are 4 factors that influence the process in problem solving, namely motivation, wrong beliefs and attitudes, habits and emotions. The problem solving steps proposed by Gray that are used are 6 steps: 1). Understand the problem; 2). Collect information or data; 3). Formulate or possible problem solving; 4). Evaluate the hypothesis. 5). If the hypothesis cannot be successful, it is necessary to return to the literature investigation. But if the experiment is successful, then it can be continued to the next step; 6). Making experiments; 7). Conclusion [1]. Problem solving is a basic skill that must be mastered by students. According to [2] that problem solving is a series of learning activities that focus on solving problems scientifically. The strategies contained in problem solving are based on many problems that require real investigation of real problems. There is no student involvement to play an active role in learning activities which results in students having difficulty solving problems. This has an impact on students because of the lack of student understanding of the material provided which indicates that students have weak problem solving skills. Indicators of problem solving ability that will be used in the study refer to the opinion of [3].

The ability of students to solve problems (problem solving) in the implementation of learning is very necessary. The implementation of learning through problem solving in schools can help students learn key concepts and principles, and apply them in solving problems they face in the implementation of learning. Problem solving is a learning model based on training students' ability to solve a problem or problem. The problem or problem may come from the teacher, from a certain phenomenon, or problems encountered in everyday life by students. The problem is posed after students are given knowledge related to the problem and problem solving techniques that must be done. In problem solving, students think and reason to apply previously acquired knowledge to solve new problems that have never been encountered before. There are several things that need to be considered in learning problem solving, namely: (1) determining the problem to be presented is adjusted to the material, (2) the problem presented must be able to encourage students to think from different points of view, (3) the problem must be adjusted to the level of student ability, (4) the problem must be clear, and (5) the problem is associated with the real world and is quite interesting to students.

Characteristics of learners who have good problem solving skills, including focusing on finding the right solution, having an open mind by accepting new knowledge, looking for opportunities in problems, knowing the difference between complex and simple thinking, identifying specific problems, making fair solutions without harming others, exploring options by finding new and logical ways without creating new problems [4, 5]. Problem solving is a complete process for students in physics learning, because the problems in physics learning are related to the context of everyday life [6]. Learners who can solve problems will have meaningful experiences and be embedded in memory, which makes students active in teaching and learning activities [7]. This fact shows that problem solving skills are one of the important skills that must be developed in physics learning [8]. The government has established various learning models and methods that can train students' problem solving skills [9]. The learning model must be based on problems that require authentic investigation, namely investigations that require real resolution of a problem using a learning approach that trains students to actively learn, so that they can formulate and solve problems based on the information that has been provided [4,7]. As well as learning methods that can increase students' attention to physics phenomena, it will facilitate understanding of physics material [9].

Based on these problems, this study was conducted with the aim of examining the development trend of scientific publications which include the number of journal publications, researcher productivity, top articles that are widely cited, relationships between research topics, research trends, and topics that are often researched regarding problem solving or problem solving during 2018-2023 from the Scopus data base through bibliometric analysis with the keyword "Problem Solving in Physics Learning". This

research is expected to provide information about the development of research methods on problem solving skills in the range of 2018-2023 so that it can be used as a further research study on the relationship between students' problem solving skills and physics learning.

2. Methods

This type of research is bibliometric analysis research. Bibliometrics is a quantitative evaluation of the publication patterns of all micro and macro communications along with their authorship using mathematical and statistical calculations. Bibliometrics is a quantitative evaluation of the publication patterns of all forms of communication both micro and macro along with their authorship using mathematical and statistical calculations (Suyono, 2021). This bibliometric analysis is based on research that describes the development of literature, such as the number of publications, articles, research approaches, and author productivity in the period 2018 to 2023. Bibliometric analysis uses VOSviewer software that applies Co-Occurrence calculations, and Microsoft Excel processing. Co-Occurrence analysis reveals research topics statistically, provided that the more frequent the pair between two keywords, the closer the relationship between the keywords, and also analyzes Co-authors to determine author productivity. Research data was obtained from metadata from Scopus with the keyword Problem Solving in Physics Learning.

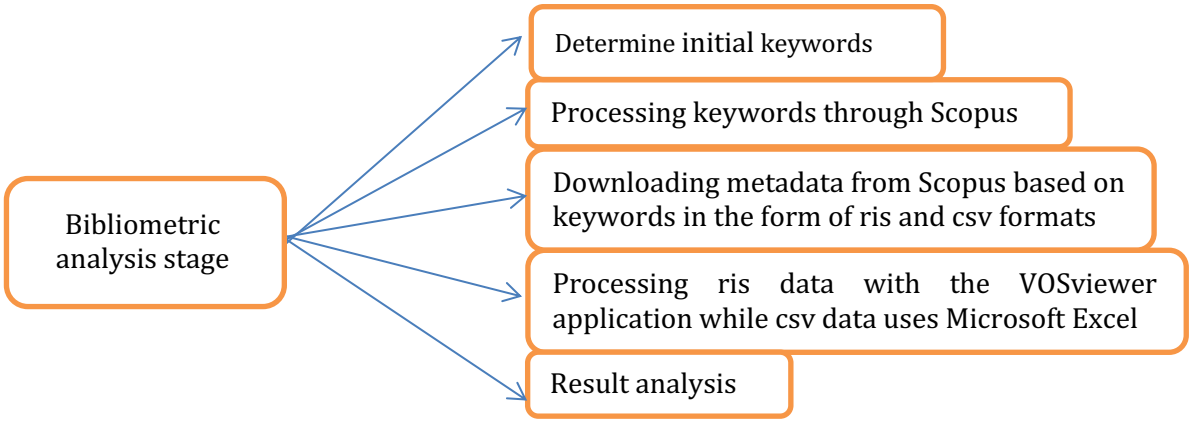

Figure 1. Research steps with bibliometric analysis

3. Results and Discussion

The search was conducted through Scopus metadata in May 2023 in the range of 2018-2023. The metadata was processed through VOSviewers which shows the writing trends of researchers in 2018-2023. Research based on metadata from Scopus produced 2,106 documents throughout the year. For metadata in the 2018-2023 range, there were 1,211 documents. The results of metadata through VOSviewer are represented in the graph in Figure 2, where the graph shows the number of publications in the last 6 years, namely 2018 to 2023. The metadata results obtained show an unstable writing trend from year to year as shown in Figure 2 below.

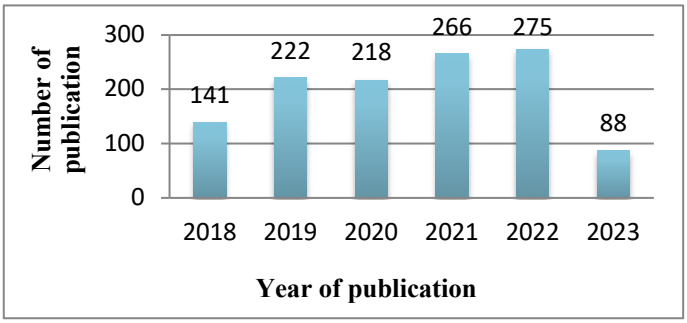

Figure 2. Graph of the number of article publications in 2018-2023

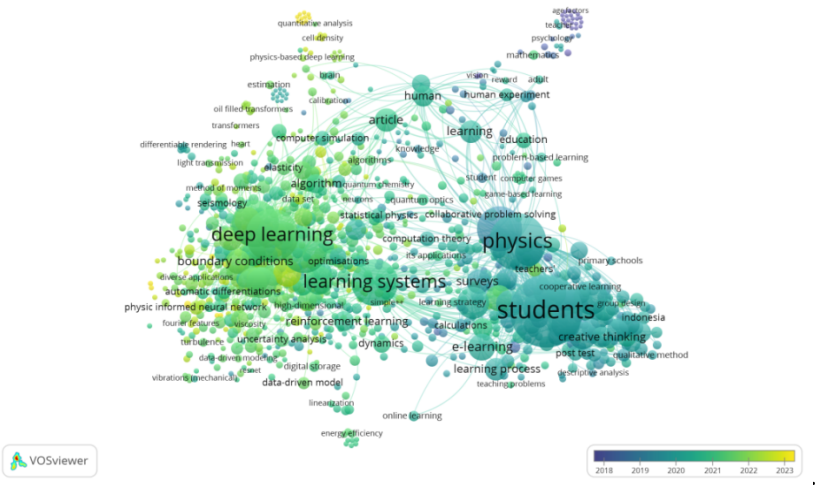

Figure 3. Visualization of overlay

In 2018 there were 140 articles published, while in 2019 it increased to 222 articles. In 2020 it decreased to 218 articles and in 2021 it increased again to 266 articles. The peak of the highest writing trend was in 2022, reaching 275 articles and in 2023 until May, 88 articles were published. Likewise in Figure 3, the overlay visualization shows that researchers studied a lot of research related to problem solving in 2022 with a light green cluster. Studies on problem solving are least in 2023 with yellow clusters.

The metadata analysis with VOSviewer regarding top publishers related to problem solving keywords is shown in Figure 5 below.

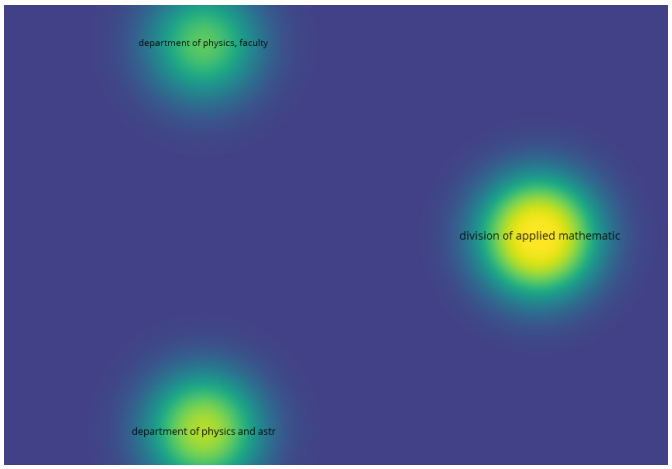

Figure 4. Top publisher densities visualization display

Based on metadata analysis through VOSviewer software displayed in Figure 4, there are 3 clusters. Where of the 3 clusters the most in publishing articles is in cluster 1, namely from the division of applied mathematics from Brown University, United States with 13 published documents. The visualization of the top publisher density as shown in Figure 5, where the division of applied mathematics shows the brightest color indicating the top publisher.

The top citation or top citations used from the topic of problem solving from 2018 to 2023 are shown in the following visualization of Figure 5.

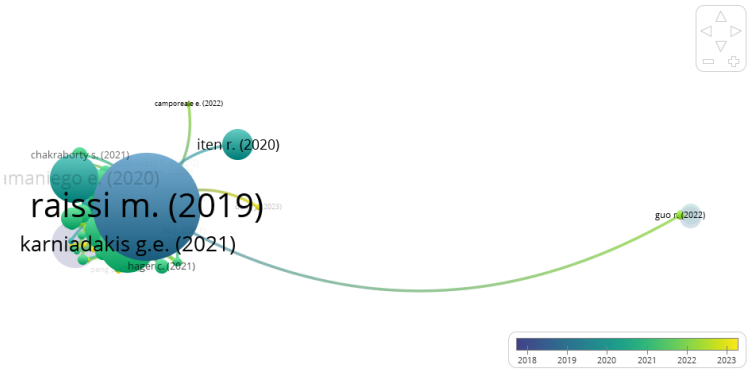

Figure 5. Visualization display of top citation overlay

Figure 6. Visualization display of top citation density

Based on metadata analysis through VOSviewer software displayed in Figure 5, there are 76 clusters which show the results of citation searches on article publications with the keyword problem solving in physics learning. The visualization shows that citations between documents that are often used are in cluster 12 with the author named Raissi with the title Physics-informed neural networks: A deep learning framework for solving forward and inverse problems involving nonlinear partial differential equations, the number of citations is 2902. The visualization of the density displayed is as in Figure 6 where the top citations are shown by the lightest colored cluster.

In this study, an analysis was also carried out with keywords related to problem solving as shown in Figure 7.

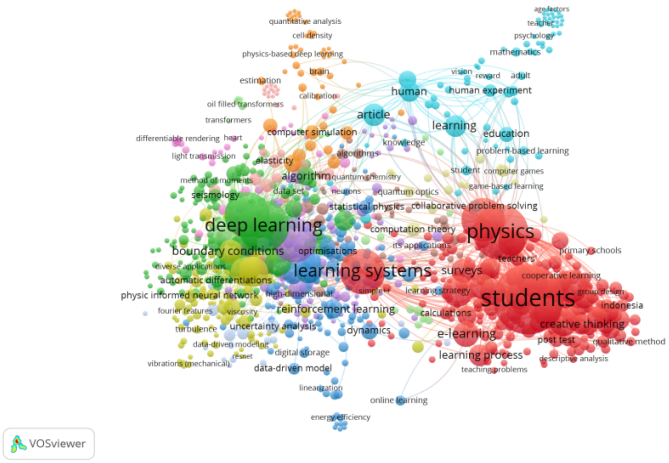

Figure 7. Network visualization display

Based on metadata analysis through VOSviewer software displayed in Figure 7 shows the search results with the keyword problem solving in physics learning. In the visualization there are 13 clusters by displaying most of the red clusters or cluster 1 as many as 203 items, green clusters or cluster 2 as many as 158 items, red clusters or cluster 3 as many as 116 items, yellow clusters or cluster 4 as many as 100 items. Based on the search with the keyword problem solving in physics learning contained in several articles, it is shown with the keyword problem solving in the red cluster or cluster 1 in Figure 7. The keyword problem solving is connected to the physics keyword and connected to the green, blue, yellow, and purple clusters as shown in Figure 8 below.

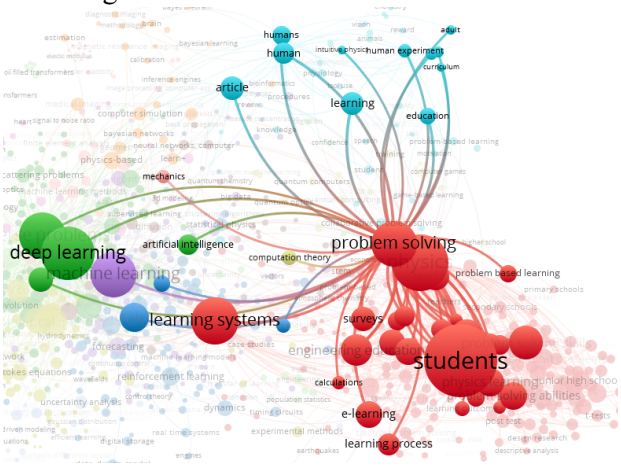

Figure 8. Visualization of keyword relationships in VOSviewer

Based on metadata analysis through VOSviewer shown in Figure 8. Research on the topic of problem solving, namely on related keywords, shows a light color, this means that discussion on light-colored topics is a lot of research. In Figure 9 there are also topics in dark colored areas, this indicates research that is still rare to study.

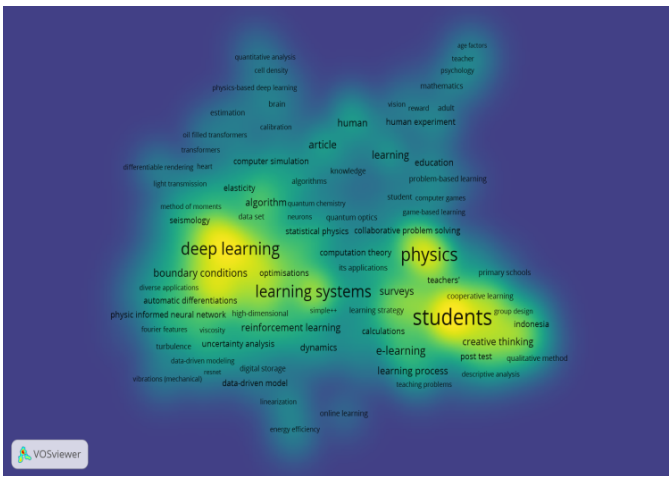

Figure 9. Visualization of density on the topic of problem solving ability

Figure 10 shows the authors or researchers and the research clusters conducted and shows the research productivity on the topic of problem solving in physics learning. Blue clusters show researchers who have the top research productivity.

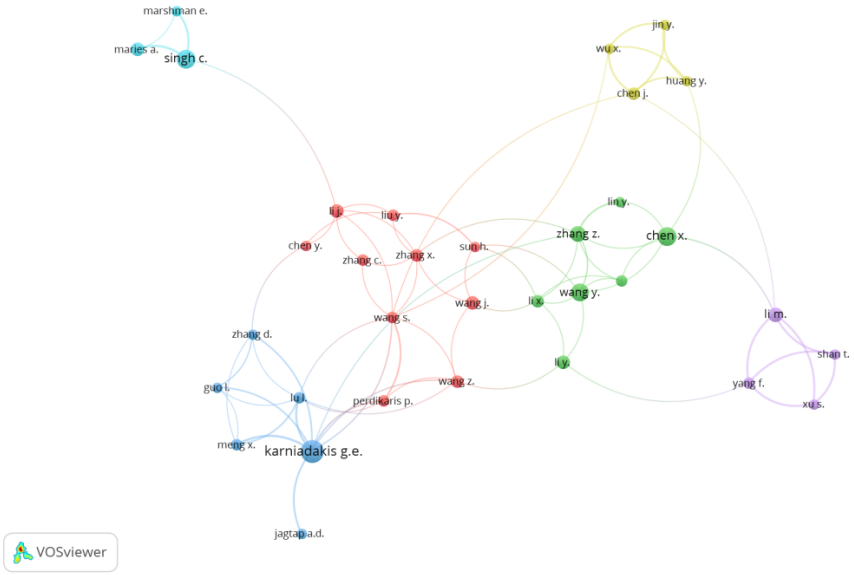

Figure 10. Researcher's visualization on the topic of problem solving in physics learning

Based on Figure 11, research on problem solving is dominated by researchers from Indonesia with 305 documents, the United States with 305 documents, China with 305 documents. This is indicated by the light color of the cluster.

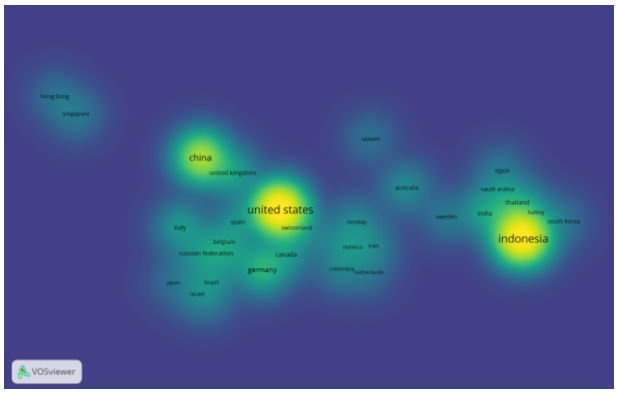

Figure 11. Visualization of publication density with country variations

4. Conclusions

Based on bibliometric analysis through mapping results with VOSviewer software, several conclusions are obtained, namely the results of the metadata obtained show an unstable writing trend from 2018 to 2023. Meanwhile, the organization or publisher that publishes many articles is in cluster 1, namely from the division of applied mathematics from Brown University, United States with 13 published documents. The visualization shows that the citations between documents that are often used are in cluster 12 with the author named Raissi with the title Physics-informed neural networks: A deep learning framework for solving forward and inverse problems involving nonlinear partial differential equations the number of citations is 2902. Related to problem solving in physic learning, researchers have studied a lot of research related to problem solving in 2022 with light green clusters. In the visualization of the problem solving keyword relationship displays most of the red clusters or cluster 1 as many as 203 items, as well as in the visualization display of the problem solving keyword density showing clusters with lighter colors. Then in the Cho-authorship analysis, it can be seen that the blue cluster shows researchers who have the top research productivity with the author's name is Karniadakis g. e. in the visualization of

density with country variations dominated by Indonesia, the United States, and China as shown by the cluster color that is brighter than other countries. Based on the results of the analysis that has been carried out, there are still several topics or research that are still little researched. This can be a reference by researchers to study topics or research that are still a little to be studied or researched further.

References

[1] Maulidya 2018 *J. Pendidik. Bhs. Sastra Arab* **4**.
[2] Malau, Natalia Y F, Sutarno, and Medriati R 2021 *J. Ilm. Pendidik. Sains* **2** 31.
[3] Sujarwanto E, Hidayat A, and Wartono W 2014 *J. Pendidik. IPA Indones.* **3** 65.
[4] Abdulfattah A and Supahar 2019 *J. Educ. Gifted Young Sci.* **7** 1037.
[5] Nusaila, Siti, and Farida 2015 *Int. J. Bus. Soc. Sci.* **6** 94.
[6] Amanah P D, Harjono A, and Gunada I W 2017 *J. Pendidik. Fis. Teknol.* **3**.
[7] Destalia L, Suratno, and Aprilya. S H 2014 *Saintifika* **3** 213.
[8] Supeno, Subiki, and Rohma L W 2018 J. Ilm. Pendidik. Fis. Al-BiRuNi **7** 59.
[9] Ratnaningdyah D 2017 *J. Ilmu Pendidik. Fis.* **2** 1.
[10] Suyono 2021 *Analisis Bibliometrika Artikel Jipi (Jurnal Ilmu Perpustakaan Dan Informasi) Tahun (2016-2020)* (Skripsi: Universitas Islam Negeri Sumatera Utara Medan).