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Integration of Ethnoscience Approach in Physics Learning Based on Laboratory Practice: A Systematic Literature Review

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Abstract. The development of physics learning methods that integrate ethnoscience approaches and laboratory practices has become a major focus in the application of educational innovation in this modern era. This study aims to determine the development map of the number of publications examining ethnoscience-based learning; knowing which scientific articles have the highest number of citations, and knowing the development map of scientific publications based on keywords and authors. Data collection was carried out based on the Google scholar database with the keywords *ethnoscience, physics learning, laboratory, practice*. Data collection was carried out using *Harzing's Publish or Perish (PoP)* software as metadata. Data analysis was carried out using Vosviewer software as a bibliometric analysis medium. Based on the results of the article search using *Harzing's Publish or Perish,* 410 publications published from 2016 to 2024 were obtained for further analysis. The results showed that keyword co-occurrence analysis using VOSViewer resulted in 31 terms grouped into 4 clusters. Network and density visualization shows several keywords that often appear, namely science, education and practice. In addition, the overlay visualization illustrates the latest terms that appear in 2022 are project, critical thinking skill, physics learning, medium, physics education, and science learning. Based on the results of overlay data mapping, it can be seen that research on the topic of ethnoscience-based physics learning is still relatively new, so it is very necessary to conduct research on this topic. Meanwhile, the publication that has the highest number of citations is (W. Sumarni, S. Kadarwati) which was cited 246 times.

Keywords: physics learning, ethnoscience, laboratory practice

1. Introduction

Natural Science (IPA) is a unity of several components, including: products, processes and scientific attitudes that have an attachment or relationship to human life and a broader object of study. Science education can be utilized as a means of supporting learning, an effort to pursue and hone oneself and study the nature around and further development in its application in life. The learning process leads todirect transfer of knowledge and experience, because science learning subjects include contextual learning, meaning that learning is related and close to real objects in life. [1]. Science is also one of the lessons that has the potential to develop the understanding and character of students seen from the characteristics of the material. One part of science that has the potential to support it is physics because it looks at the characteristics of physics which in addition to conceptual aspects also emphasizes practical aspects [2]. This aspect can train the character of cooperation (gotong royong) and creativity of students in achieving the goals they want [2,3]. In addition, physics is also a compulsory subject for every high school throughout Indonesia. Therefore, by looking at the potential above physics is deemed necessary to be used as a vehicle in improving the understanding and character of students.

Therefore, it is necessary to develop a learning based on ethnoscience approach. Ethnoscience is a science learning approach that implements local wisdom (regional culture) using certain cultural products [4]. Ethnoscience-based learning is characterized by several characteristics including presenting science-related cultural topics, reconstructing local science in the community into scientific science, developing understanding and deepening concepts, and using knowledge and skills through exploration activities using scientific approaches [5]. One of the exploration activities using a scientific approach is practicum. Practicum is one of the learning strategies that can attract students' interest in developing science concepts and applying the scientific method [6].

Practicum in physics learning will be more interesting and meaningful if the practicum material is related to the real life of students in other words students can directly experience what they learn, not just know it [7,8]. In order for the practicum in physics learning to be directed and the problem solving process to run effectively, students must be encouraged to interpret the information provided by the teacher, until the information can be accepted by common sense. So, the teacher's task in the local wisdom practicum is to help students to achieve their goals, namely the teacher only manages theclass as a team that works together to find something new for students, so that the teacher can encourage students to link the material taught with the real world situation of students. Learning by integrating local wisdom, competence is built in individuals through continuous interaction with objects, phenomena, experiences, and the environment of learners [9].

In physics learning, utilizing local culture is very important. This is based on the following statements. First, students' knowledge of physics in their cultural context is the prior knowledge they acquire during class and greatly helps them understand physics lessons. Second, students' understanding of physics in the context of their culture affects their understanding of their own culture [10]. This local culture is very influential on the formation of students' knowledge. If science practicum does not pay attention to students' culture, then the consequence is that students will reject or accept only some of the science concepts developed in the practicum [11]. Similar opinion was expressed by [12], which states that if the sub-culture of modern science taught is aligned with thesub-culture of students' daily lives, then science learning will be able to strengthen students' views of the universe, the result is *enculturation*. If enculturation occurs, then students' scientific thinking abouteveryday life will increase. Conversely, if the sub-culture of science taught is different or even contradictory to the sub-culture of students' daily lives, then science learning will separate students' views of the universe [10].

Ethnoscience-based physics learning is a potential solution to improve the quality of physics learning in Indonesia. The integration of local wisdom in laboratory practices can help students understand physics concepts more easily and contextually, increase students' interest and motivation towards physics, and strengthen cultural values and local wisdom. Based on the above problems, the purpose of writing this article is to conduct a bibliometric analysis with computational mapping of articles related to the use of ethnoscience-based physics learning indexed by Google Scholar using VOSviewer software. This review article will examine research on ethnoscience-based physics learning, discussing the benefits, practices, and research on ethnoscience-based physics learning. This article is expected to contribute to the development of physics learning that is more contextual and relevant to students.

2. Methods

This study uses the *Systematic Literature Review* (SLR) method which aims to identify trends and knowledge growth in the topics of numeracy literacy and mathematical critical thinking [13]. Systematic literature review (SLR) is a systematic research method for collecting, critically evaluating, integrating, and presenting findings from various research studies on a research question or topic of interest [14]. In SLR, the *Systematic Mapping Study* (SMS) method is the initial stage in carrying outa Systematic literature review. The *Systematic Mapping Study* method is more descriptive, further supported by the Systematic literature review method which is exploratory and exploitative, thus providing adequate transparency and replicability as a research method [15]. The *Systematic Literature Review* method with bibliometric analysis is used to map research trends related to literacy, reasoning, and critical thinking by comprehensively analyzing documents on the Google scholar database for the period 2016-2024.

Referring to the opinion of [16] there are five stages in bibliometric analysis research, namely: first determining keywords, second searching for article data, third filtering articles, fourth collecting and compiling data, fifth analyzing data. First, determining keywords, determining keywords is adjusted to the needs of searching for research topics, because this research analyzes related to Ethnoscience in Physics Laboratory Practice, the keywords are ethnoscience, physics learning, laboratory, practice. From the systematic literature review conducted, 410 articles indexed by Google Scholar were selected.

Table 1. Rules for searching systematic literature review ethnoscience in physics laboratory practice.

Criteria	Results
Object	Conduct a systematic literature review on ethnoscience in physics laboratory practice
Data source	Google scholar
Keywords.	ethnoscience, physics learning, laboratory, practice
Year of publication	2016-2024
Last time to search the database	March 4, 2024
Selected documents	804
Document filtered	410
Documents analyzed	The database information obtained was then analyzed with the help of Microsoft Excel, VOSviewer and Harzing's Publish or Perish

This article search uses the Google Scholar database by utilizing the *Publish or Perish* application. Figure 1 is a display of article data obtained from the *Publish or Perish* application.

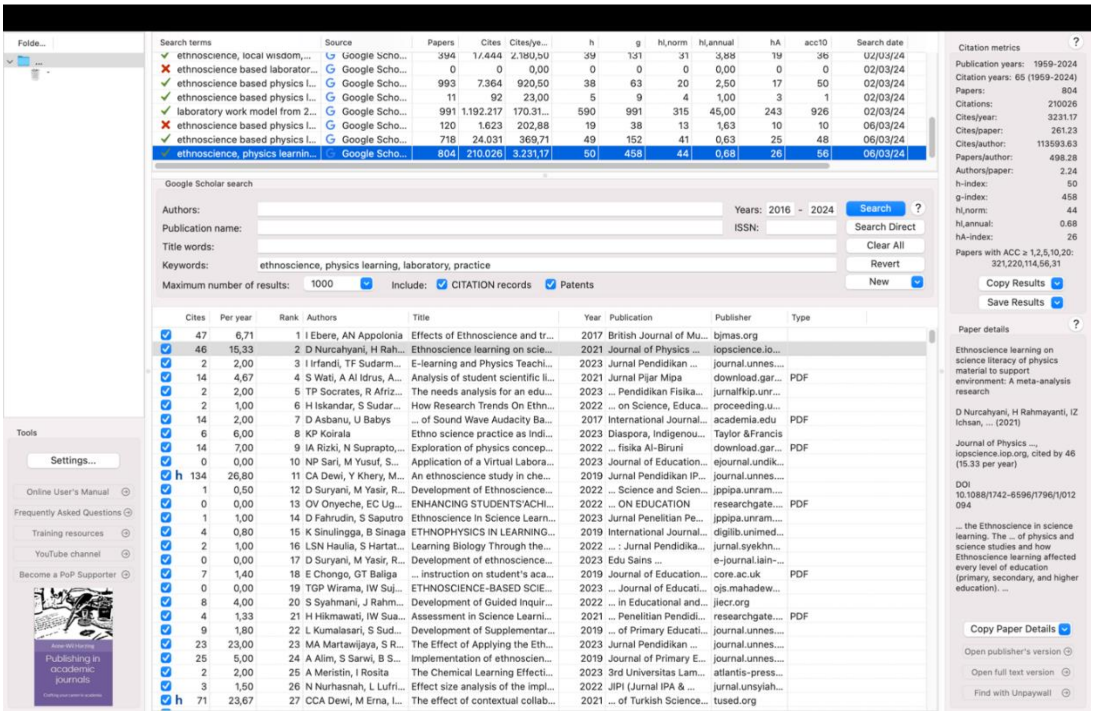

Figure 1. Search method through *Publish or Perish*
Source: *Publish or Perish* (2024).

In searching for articles, researchers limit the year of publication by selecting the range from 2016 to 2024, so that the results of the article search are obtained as many as 804 articles after going through the filtering process that is relevant to the topic of the article, 410 articles are obtained. After searching for articles, the next step is to save the file in RIS file format. After the data is obtained and stored in the form of a RIS file or Research Information Systems Citation File, the next step is to enter the file into the Vosviewer software with the aim of visualizing network patterns or relationships between bibliometrics into three categories, including network visualization, Overlay visualization, and density visualization. Network visualization aims to visualize whether or not the network or relationship between research terms is strong, Overlay visualization aims to visualize historical traces based on the year of publication of the research, while density visualization aims to display the densityor emphasis on research groups [17]. VOSviewer software is used as a bibliometric analysis tool to visualize networks in the form of authors, countries, journals, and keywords. [17]. This data is inputtedto be used for co-authorship and co-occurrence analysis to produce network maps of authors, countries, journals, and keywords. In addition, from the citation analysis, a network map of scientific journals was generated. VOSviewer software was used for bibliometric network construction and visualization. This software provides an overview of information from publications, such as the author, organization, country, and keywords [18].

3. Results and Discussion

Based on the article data on ethnoscience-based physics learning obtained, an analysis was carried out with the aim of considering several factors, especially the analysis of the most citations and relevant to the topic, analysis of research titles and abstracts, and analysis of *co-authorship.* VOSviewer software is used to map the co-occurrence of the author's keywords, and citation analysis.

3.1. Data acquisition from Harzing's Publish or Perish

Table 2. Most cited articles.

No.	Author	Title	Year	Publisher	Citation
1	W. Sumarni, S. Kadarwati	Ethno-Stem Project-Based Learning: Its Impact To Critical And Creative Thinking Skills	2020	Jurnal Pendidikan IPA Indonesia	246
2	A. Ramdani , A. W. Jufri, Gunawan, M. Fahrurrozi, M. Yustiqvar	Analysis Of Students' Critical Thinking Skills In Terms Of Gender Using Science Teaching Materials Based On The 5e Learning Cycle Integrated With Local Wisdom	2021	Jurnal Pendidikan IPA Indonesia	192
3	Citra Ayu Dewi, Maria Erna, Martini, Ikhfan Haris, I Nengah Kundera	The Effect of Contextual Collaborative Learning Based Ethnoscience to Increase Student's Scientific Literacy Ability	2021	Journal of Turkish Science Education	71
4	Shofwan Ridho, Sri Wardani, Sigit Saptono	Development of Local Wisdom Digital Books to Improve Critical Thinking Skills through Problem Based Learning	2021	Journal of Innovative Science Education	49
5	Ebere Ibe, Appolonia A. Nwosu	Effects Of Ethnoscience and Traditional Laboratory Practical On Science Process Skills Acquisition Of Secondary School Biology Students In Nigeria	2017	British Journal Of Multidisciplinary And Advanced Studies /	47
6	M. A. Martawijaya, S. Rahmadhanningsih , A. Swandi, M. Hasyim , E. H. Sujiono	The Effect Of Applying The Ethno-Stem-Project-Based Learning Model On Students' Higher-Order Thinking Skill And Misconception Of Physics Topics	2023	Jurnal Pendidikan IPA Indonesia	23

		Related To Lake Tempe, Indonesia			
7	Sakila Wati, Agil Al Idrus, and Abdul Syukur	Analysis Of Student Scientific Literacy: Study On Learning Using Ethnoscience Integrated Science Teaching Materials Based On Guided Inquiry	2021	J. Pijar MIPA	14
8	Dens E. S. I. Asbanu, Urny Babys	The Development of Sound Wave Audacity Base Learning Media Using Ethnoscience Approach of Amanuban Tribe to Improve Physics Teacher Candidates' Science Process Skill	2017	International Journal of Science and Research (IJSR)	14
9	Iqbal Ainur Rizki, Nadi Suprapto, Setyo Admoko	Exploration of physics concepts with traditional engklek (hopscotch) game: Is it potential in physics ethno-STEM learning?	2022	Jurnal ilmiah pendidikan fisika Al-Biruni	14
10	Saiful Prayogi, Sukainil Ahzan, Indriaturrahmi, Joni Rokhmat	Opportunities to Stimulate the Critical Thinking Performance of Preservice Science Teachers Through the Ethno-Inquiry Model in an E-Learning Platform	2022	International Journal of Learning, Teaching and Educational Research	13
11	Ni Nyoman Sri Putu Verawati, Ahmad Harjono, Wahyudi, Syifa'ul Gummah	Inquiry-Creative Learning Integrated with Ethnoscience: Efforts to Encourage Prospective Science Teachers' Critical Thinking in Indonesia	2022	International Journal of Learning, Teaching and Educational Research	9
12	Syahmani, Jahidah Rahmatilah, Atiek Winarti, Muhammad Kusasi, Rilia Iriani, Yogo Dwi Prasetyo	Development of Guided Inquiry Lesson Based on Ethnoscience E-Modules to Improve Students' Problem-solving Ability in Chemistry Class	2022	Journal of Innovation in Educational and Cultural Research	8
13	Derlina, Karya Sinulingga, Maryono, Sahyar, Bornok Sinaga	Ethnophysic In Learning Based On Java Culture To Improve Generic Skills Of Students' Science	2019	International Journal of Innovation, Creativity and Change (IJICC)	4
14	Luthfia Hanum, Muhammad Hasan, Andi Ulfa Tenri Pada,Hafnati Rahmatan, Ratu Fazlia Inda Rahmayani, Elisa, Yusrizal	Development of Learning Devices Based on Ethnoscience Project Based Learning to Improve Students' Critical Thinking Skills	2023	Jurnal Pendidikan Sains Indonesia (Indonesian Journal of Science Education)	4
15	I. Irfandi, T. F. Sudarma, F. Festiyed, Y. Yohandri, S. Diliarosta, D. Surahman, A. M. Siregar	E-Learning and Physics Teaching Materials Based On Malay Ethnoscience On The East Coast	2023	Jurnal Pendidikan IPA Indonesia	2

This article examines the number of documents produced per year using *Harzing's Publish or Perish* software. Based on articles obtained from the keyword search "ethnoscience, physics learning, laboratory, practice", according to the Google Scholar database resulted in 804 articles. After going through the filtering process, 410 relevant articles were obtained. Furthermore, the author saves the data from this search into the RIS format used in the VOSViewer application. Based on the results of the data acquisition shown in Figure 1, there are 10 articles that have the most citations. The number of citations of all articles used in this study is 188672, with the number of citations per year as much as 23584.00, the number of citations per article is 460.18, the average author in the article used is 2.67, the h-index of all articles is 28 and the g-index is 410. Ta is presented data on articles with the most citations from 2016-2024.

In table 2 above, it can be seen from the 15 most cited articles is W. Sumarni, S and Kadarwatiwith a total of 246 citations, this study aims to explore the effect of ethno-STEM project-based learning on students' critical and creative thinking skills and to see changes in students' critical and creative thinking skills after following ethno-STEM project-based learning. Ethno-STEM project- based learning involves the use of local (ethno) cultural contexts in the teaching of science, technology, engineering and math (STEM). The projects undertaken in this learning may involve exploration, observation, experimentation, field trips, or related to the students' local cultural context. In the ethno-STEM project-based learning model, laboratory experiments are part of the project implementation stage. Students conduct experiments or research involving observation, data collection, analysis and conclusion in a laboratory or appropriate environment [19].

In addition, the second most cited finding is A. Ramdani, A. W. Jufri, Gunawan, M. Fahrurrozi, M. Yustiqvar with a total of 192 citations, this study aims to examine the effect of using science teaching materials based on the 5E learning cycle integrated with local wisdom on students' critical thinking skills, taking into account gender differences. The 5E learning cycle stage integrated with local wisdom includes five main stages: *engagement*, exploration, *explanation, elaboration*, and evaluation. The engagement stage aims to arouse students' interest in the learning topic. The exploration stage involves students in practical activities to observe, collect data, and formulate questions. The explanation stage involves presenting concepts and theories that support student understanding. The elaboration stage involves applying concepts in real contexts and developing deeper understanding. The evaluation stage involves assessing student understanding and learning effectiveness [20].

The third finding with a total of 71 citations, this study aims to measure the effectiveness of the CCLBE *(Contextual Collaborative Learning Based Ethnoscience) learning* model in improving students' scientific literacy skills in the aspects of content, process, and scientific attitudes. The stages of the CCLBE *(Contextual Collaborative Learning Based Ethnoscience) learning* model include identifying Eth*noscience* Context, Collaborative Group Formation, Explanation of Science Content (the teacher provides an explanation of science concepts related to the selected ethnoscience context), Research and Exploration (students conduct research and further exploration of the selected ethnoscience context), Collaboration and Discussion (students work collaboratively in their groups to share knowledge, solve problems, and make conclusions), Reflection and Evaluation (students reflect on their learning process and evaluate their understanding of science concepts and ethnoscience contexts), Application in Real Life Contexts students are given the opportunity to apply their understanding in real life contexts [21].

In addition to these three research results, another study conducted by Ebere Ibe, Appolonia A. Nwosu with a total of 47 citations also showed that ethnoscience-based teaching by involving alternative laboratory practices that are relevant to the cultural context of students. For example, the use of natural materials available around them as materials for experiments or observations has the potential to improve students' mastery of science process skills, and it is recommended that this approach be integrated in teaching [22]. Another study conducted by Sakila Wati, Agil Al Idrus, and Abdul Syukur with 14 citations also described handouts containing science learning materials integrated with guided inquiry-based ethnoscience to improve students' scientific literacy. The learning handout developed allows students to be actively involved in scientific activities, such as interacting directly with local culture and investigating knowledge in the surrounding environment. There are practicum activities in the development of science learning materials integrated with ethnoscience based on guided inquiry. These practicum activities allow students to be directly involved in the scientific process, such as making observations, data collection, interpretation, prediction, conclusion, and communication during the practicum [23]. Another study conducted by Ni Nyoman Sri Putu Verawati, Ahmad Harjono, Wahyudi, Syifa'ul Gummah with a total of 9 citations showed that creative-inquiry learning integrated with ethnoscience has a better impact in training critical thinking skills of prospective science teachers compared to traditional learning. The study highlighted the advantages of the ethnoscience-integrated creative-inquiry learning approach in improving science teacher candidates' critical thinking skills and provided implications for the widespread application of this approach in science education. The researcher compared 2 classes, namely the experimental class and the control class. The difference between the learning stages in the experimental and control classes lies in the learning methods applied. The experimental class applied creative-inquiry learning integrated with ethnoscience, which includes orientation to the problem, making hypotheses, designing creative experiments, solving science problems creatively, and concluding creatively. Meanwhile, the control class applied traditional teaching that tended to be expository without involving creative- inquiry and ethnoscience aspects. Thus, the experimental class focused more on developing critical thinking skills through innovative approaches, while the control class tended to follow conventional teaching approaches. In the experimental class, in the creative experimentation activity phase, participants are given the opportunity to test hypotheses, carry out projects, or see the impact of the creative solutions they find [24].

3.2 Analysis of Research Titles and Abstracts

Title and Abstract Analysis *Systematic literature review* in this article starts with the title and abstract. Of the 804 articles harvested using the Publish or Perish software, the author filters out articles relevant to the topic of 410 articles, then the author visualizes the database obtained using VOSviewer software. So that 31 keywords were obtained. In the results of this visualization, researchers found several clusters related to one another *science, module, physics learning, scientific literacy, project, local wisdom, practice and ethnoscience. Science* is the largest cluster in the visualization. The mapping visualization analyzed in this study is divided into 3 parts, namely 1) Network visualization (see Figure 2), 2) Density visualization (see Figure 3), and 3) Overlay visualization (see Figure 4)

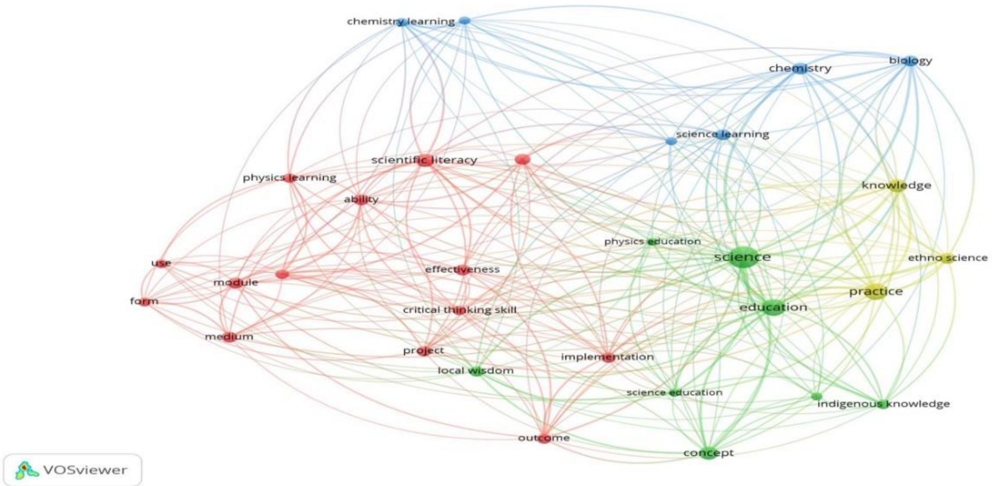

Figure 2. Visualization results of 410 metadata of google scholar indexed articles.

In Figure 2, it is analyzed and can be seen that there are four keyword clusters consisting of many keywords according to the research topic, which explains that each keyword has a network connected to one another. This means that each keyword has an attachment to one another, according to the theme of *ethnoscience, physics learning, laboratory, practice.* Figure 2 shows that VOSviewer analyzed relevant keywords from 410 articles and found 31 keywords. The keywords are divided into 4 large clusters. In Figure 2, there are 4 main clusters, namely science (in green), scientific literacy (in red), science learning (in blue), and practice (in yellow). This means that these keywords are the most dominant or most used.

1. Group 1, marked in red, has 14 terms, namely *ability, critical thinking skill, e module, effectiveness, ethoscience approach, form, implementation, medium, module, outcome, physics*

learning, project, scientific literacy, and use.

2. Group 2 marked in green has 8 terms, namely *concept, education, indigenous knowledge, local wisdom, physics education, science, science education, and term.*
3. *Group 3, marked in blue, has 6 terms: biology, chemistry, chemistry learning, ethnoscience study, influence, science learning.*
4. Group 4, marked in yellow, has 3 terms *ethnoscience, knowlwdge. and practice.*

The relationship between terms and other terms is shown in each cluster. Each term is marked with a colored circle [25]. The size of the circle for each term differentiates the frequency of occurrence of that term. The size of the label circle shows a positive correlation with the occurrence of the term in the the title or abstract. The more frequently the term appears, the larger the circle size.

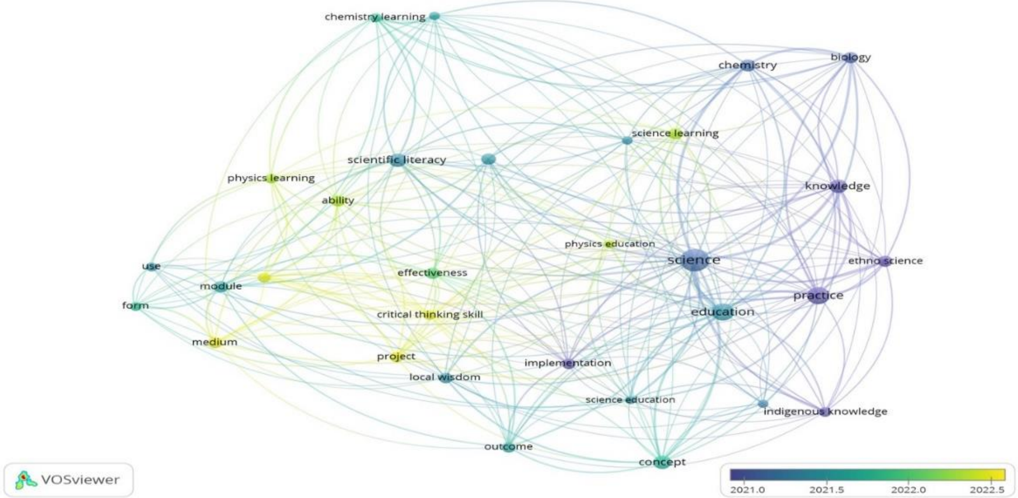

Figure 3. Visualization result of overlay.

Based on Figure 3 shows the visualization of the overlay, the color difference of each year shows the range of publication years. The purple network indicates the oldest publication year, while the yellow network indicates the latest publication year. The latest terms that appear are project, critical thinking skill, physics learning, medium, physics education, and science learning. Based on the results of overlay data mapping, it can be seen that research on the topic of ethnoscience-based physics learning is still relatively new, so it is very necessary to conduct research on the topic.

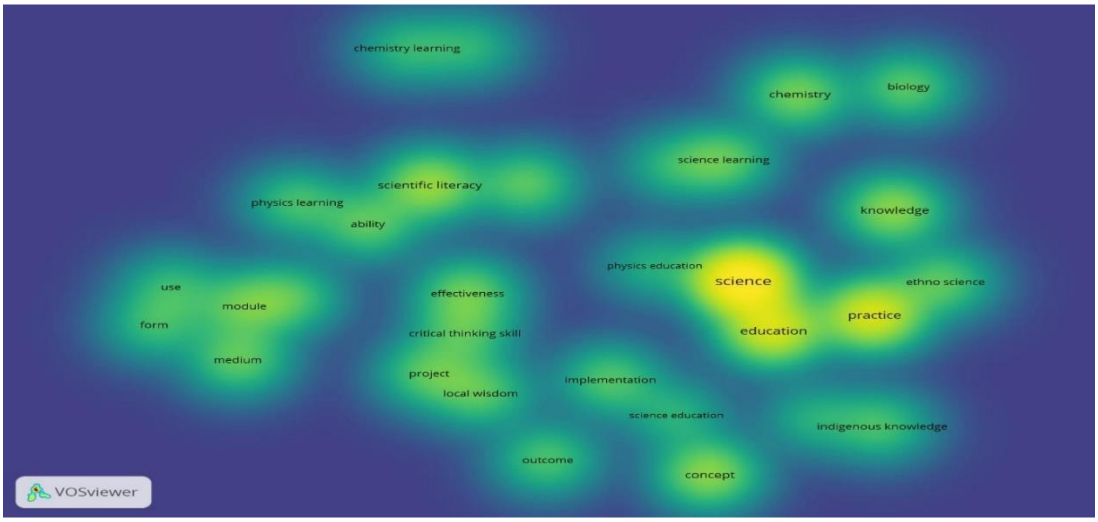

Figure 4. Density visualization results

Based on the Density Visualization results in the figure above, it provides knowledge that, the brighter the yellow color and the larger the diameter of the term label, the more often the term appears. Conversely, if the yellow color is faded, it means that the number of people researching the term is small [25,26], If the density is less, it can be an opportunity for new research [27]. Referring to the results of the Density Visualization, above it can be seen that research related to the terms science, *education*, *practice*, *scientific literacy*, and practice is the number of studies that are widely researched

3.3. *Co-Authorship Analysis*

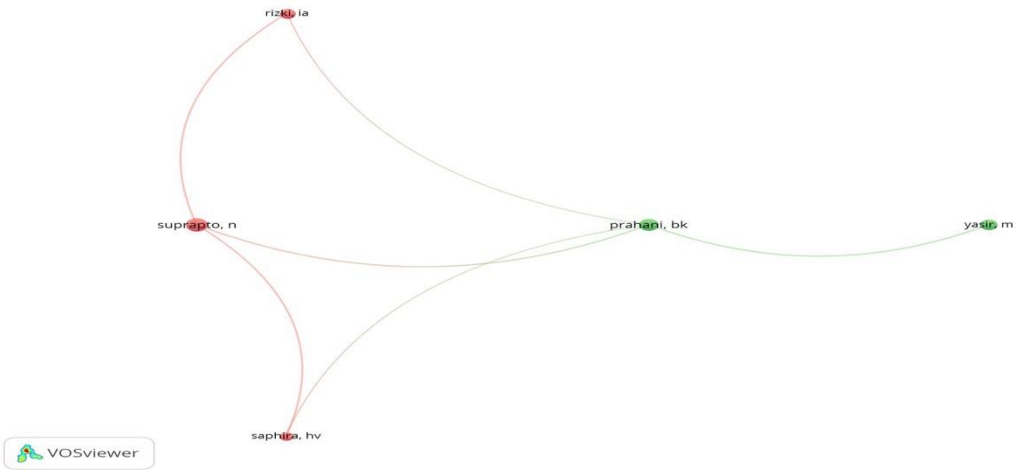

Figure 5. Co-authorship related.

Figure 5 above explains that the authors are interrelated and related to each other. The author network in the figure has two colors, red and green, which means that the color is the strongest network. Regarding collaborative authorship (co-authorship) this can be seen from the connected collaboration). Figure 5 describes the connected co-authorship. For the group of authors who do there are 5 authors who are in 2 clusters. As for cluster 1 which consists of 3 author groups, namely Rizki, he, Saphira, hv, Suprapto, n. While cluster 2 consists of 2 groups of authors, namely Prahani, bk, Yasir, m. The author Suprapto n is a key author and a liaison for collaboration with the author group incluster 2, namely Prahani, bk.

4. **Summary**

Based on bibliometric analysis of articles examining ethnoscience-based physics learning, it can be concluded that there are 410 articles relevant to this topic, which were analyzed using VOSviewer software. The results of the analysis show that there are 31 terms grouped into 4 clusters, with terms that often appear including science, education, and practice. The overlay visualization also illustrates the latest terms that appear in 2022, such as *project, critical thinking skill, physics learning, medium, physics education, and science learning*. In addition, the most cited article was "Ethno-Stem Project-Based Learning: Its Impact To Critical And Creative Thinking Skills" by W. Sumarni, S. Kadarwati, which was cited 246 times. Findings from the analysis of research titles and abstracts show that studies related to *ethnoscience-based* physics learning involving laboratory practice include topics such as students' critical thinking skills, the effect of using science teaching materials based on the 5E learning cycle integrated with local wisdom, the effectiveness of the CCLBE *(Contextual Collaborative Learning Based Ethnoscience) learning* model, the use of *ethnoscience-based* handouts, ethnoscience-integrated creative-inquiry and other ethnoscience-based teaching relevant to the cultural context of students. From this, it can be concluded that ethnoscience-based physics learning is an interesting and important topic for further study in an effort to improve the quality of physics learning in Indonesia. So it is highly recommended that researchers conduct research related to ethnoscience learning in more depth.

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