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Research Trends on Ethnoscience-Based Learning Models with an Ethnopedagogical Approach to Train Students' Science Literacy and Learning Independence (2015-2024): A Systematic Review

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Abstract: This study aims to describe the research trend of ethnoscience-based learning models with an ethnopedagogy approach as an effort to train students' scientific literacy and learning independence. With the background of technological developments that demand quality human resources, as well as the challenge of low scientific literacy in Indonesia, the ethnopedagogy approach is considered relevant to instill knowledge based on local wisdom. Through a bibliometric analysis of 500 articles in the period 2015 to 2024, this study shows fluctuations in academic interest related to ethnopedagogy learning models. The data shows a significant increase in 2018, followed by a decline due to the COVID-19 pandemic, before increasing again in the following years. The visualization of the keyword network highlights the main focus of research such as science process skills, the impact of the pandemic, and other innovative learning approaches. These results are expected to encourage further research in the development of scientific literacy based on local culture.

Keywords: Ethnoscience; Ethnopedagogy; Scientific literacy; Learning independence

Introduction

Improving the quality of 21st century education The rapid development of science and technology (IPTEK) in the 21st century, especially in the world of education, demands the creation of quality human resources to be able to compete globally, both in terms of thinking, abilities, and skills (Ramdani et al., 2021). The existence and function of the curriculum are a reference for every educator in implementing the teaching and learning process, where in every process of curriculum change it cannot be separated from the development of the digital era, because in the current digitalization era it is one of the benchmarks for the emergence of a new curriculum, namely the independent learning curriculum.

The independent curriculum is one of the breakthroughs in the world of education to be able to adapt to the needs of the 21st century (Usmaedi, 2021). The independent learning curriculum is one of the curriculum concepts that demands independence for students. The concept of the independent curriculum requires students to be able to acquire knowledge independently both in formal and non-formal settings.

In preparing 21st century skills, it can also be done through scientific literacy. Through scientific literacy, students will be able to learn further and live in a modern society that is currently heavily influenced by the development of science and technology (Adijaya, 2023). Scientific literacy can be interpreted as the ability to use science in the context of everyday life (real-life context) (Nidiasari, and Massa, 2020).

The low level of scientific literacy of students is one of the educational problems in Indonesia. This is supported by data on the achievement of scientific literacy of Indonesian students in the Programme for

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International Student Assessment (PISA) science literacy assessment. The results of the 2018 Indonesian PISA stated that Indonesia experienced a decline compared to the results of the 2015 PISA. The decline in literacy was shown in reading literacy, namely from 397 to 371, mathematics literacy from 386 to 379, and followed by science literacy from 403 to 396. The low average value of scientific literacy of Indonesian students in PISA means that students' chemical literacy is low, because chemical literacy is part of science literacy (Cidgemoglu et al., 2017).

Chemistry is one of the sciences to prepare students to be able to develop into members of society who are science literate or have good science literacy, chemical Literacy is an understanding of the properties of material particles, chemical reactions, chemical laws and theories and general chemical applications in everyday life (Imansari et al, 2018). A person who has chemical literacy skills can communicate a general understanding of chemistry, conduct scientific research, draw conclusions of knowledge and explain an event (Rahmawati et al., 2020).

Based on the explanation of the theory, one of the efforts that can be used to improve science literacy (including chemical literacy) is to explore the local potential of the region, namely knowledge (science) that exists in the community through ethnoscience-based learning. Ethnoscience-based learning is a strategy for creating a learning environment and designing learning experiences by integrating culture as part of the learning process in schools (Fitriyeni, 2023). Ethnoscience can be integrated into learning in schools with various learning themes. In addition to preserving local culture, ethnoscience learning is considered to be able to improve the quality of education and the character of students (Sukesti et al., 2020).

The implementation of ethnoscience-based learning aims to instill and foster an attitude of love for the culture and local wisdom of the nation, increase students' knowledge and understanding of the potential of their region, and improve skills to continue the culture and local wisdom in their region. (Forniawan, 2022). In this case, teachers need to choose an approach, both methods, strategies and learning models that can combine original knowledge with scientific knowledge. An effective approach to connecting science and culture is ethnopedagogy (Rahmawati et al., 2020). Ethnopedagogy is a source of knowledge based on local wisdom as a source of skills, including learning related to nature, customs, culture, and the local environment (Fahrozy et al., 2022).

Several previous studies have shown that chemistry learning has been closely linked to the culture of communities in various places that originate from local social systems, value systems, and cultural products (Prasetyo et al., 2021; Silvini and Ginting, 2020). In particular, several cultural products from the Lombok community have been studied in relation to the concept of chemistry (Wahyudiati & Fitriani, 2021; Andayani, et al., 2022). Several of these studies prove that learning related to ethnoscience is able to create conceptual learning and make a positive contribution to improving the character values and behavior of students.

Teaching materials have a significant role in supporting the learning process (Linda et al., 2018). In creating more interesting and motivating learning, teaching materials are needed that can support the learning. Technology is one important aspect that can be utilized to create interesting teaching materials for students. Electronic modules are an example of the results of the integration between teaching materials and current technology (Hamid et al., 2017). Electronic modules can be an interactive source of information because they present information dynamically with the support of multimedia such as images, videos, and simulations (Irwansyah et al., 2009).

The use of multimedia in electronic modules can facilitate a more understandable, effective, and enjoyable learning process because the supporting multimedia can present clearer visualizations of learning materials to help students understand (Ramdhani & Muhammadiyah, 2015). Other advantages of electronic modules are that they are easily accessible anywhere and anytime using a laptop or smartphone and there is an evaluation that provides direct feedback to students (Violante & Vezzetti, 2015). Therefore, electronic modules can minimize the role of teachers in learning and support more independent learning for students (Hamid et al., 2017).

Based on the results of the questionnaire distribution in December 2022 to several chemistry teachers and students at SMAN 1 Keruak, it was revealed that 2 chemistry teachers had never used ethnoscience-based teaching materials, because they were not available at school and the teachers had never tried to develop ethnoscience-based chemistry e-modules. Information was obtained that the teaching materials often used by teachers were in the form of printed books that had been provided in the school library. Teachers, especially those who teach chemistry, argued or suggested that ethnoscience-based chemistry e-modules need to be developed in every school to facilitate the implementation of the teaching and learning process in the field in question. Based on the results of the student questionnaire, 82.4% were familiar with several cultures around them, but learning that integrates chemistry with the culture around students has never been taught in class. The results of the questionnaire showed that students were interested in learning using ethnoscience-based chemistry e-modules

(70.6%) and felt that the development of ethnoscience-based e-modules needed to be developed (88.2%). Thus, researchers are interested in developing teaching materials in the form of ethnoscience-based electronic modules packaged with an ethnopedagogical approach to chemistry subjects, as a form of integrating teaching materials with technology to meet the demands of the 21st century and the independent curriculum.

This ethnoscience-based e-module is presented by highlighting local regional wisdom known to students, so that it is expected to maximize student learning motivation and learning becomes more meaningful. The design of this e-module is expected to train students to be literate in science and technology, and to be able to learn independently because independent learning can increase literacy activities, develop knowledge, creativity, and communication (Manalu et al., 2022).

Students can use e-modules for independent learning because the characteristics of e-modules are self-instruction, meaning that students are able to learn themselves or learn independently (without the help of others), self-contained (covering one unit of competency as a whole), adaptive (high adaptive power to the development of science and technology), stand alone (stand alone), and user friendly (instructions and information presentation are clear so that they are easy to use).

This e-module can also improve teacher creativity in delivering lessons or materials and allow teachers to prepare students for independent learning and collaboration in solving complex problems, and they can be trained to find problems in their environment (Eliza, & Hutasuhut, 2023). Therefore, this study aims to develop an ethnoscience-based e-module with an ethnopedagogical approach to train students' scientific literacy and learning independence.

Method

The method in this study is a descriptive analytical method to understand and describe trends related to ethnoscience-based learning models with an ethnopedagogy approach to train scientific literacy and student learning independence . Data retrieval in this study through *Google scholar* using *Publish or Perish and Dimension AI* . The analysis in this study was conducted on 500 articles on *Google scholar* with a range of 2015 to 2024.

Result and Discussion

This study aims to describe the research trends of ethnoscience-based learning models with an ethnopedagogical approach to train scientific literacy and student learning independence conducted from 2015-2024.

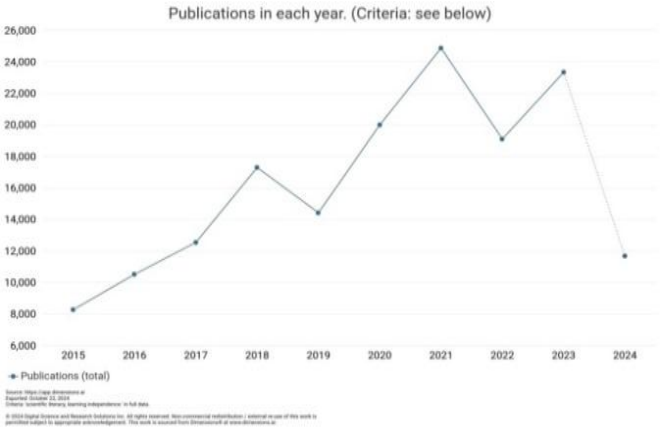

Figure 1. Research trends on ethnoscience-based learning models to train scientific literacy and learning independence

Figure 1 shows that the research trend of ethnoscience-based learning models with an ethnopedagogical approach to train scientific literacy and independent learning of chemistry students has fluctuated from 2015-2024. If we look at the graph of the development of publications related to the research trend of ethnopedagogical learning models to train scientific literacy and independent learning of students from 2015 to 2024, initially, there was a consistent increase from 2015 with around 8,000 publications, to peak in 2018 with more than 18,000 publications, indicating increasing interest. However, after 2018, the number of publications fluctuated, with a decrease in 2019 and 2020, which may have been influenced by external factors such as the COVID-19 pandemic which hampered research activities (Abidin & Yasin 2021). The trend increases significantly again in 2022 with more than 20,000 publications, but decreases again in 2023. The prediction for 2024 shows a decrease of about 10,000 publications, as indicated by the dotted line, which may be due to changes in research policy, academic focus, or funding. Overall, this graph shows dynamic changes in research interest and activity in the field of scientific literacy and independent learning, with external factors that may influence this trend throughout the year (Kurniawan & Sutrisno 2022).

Table 1. Research Trends on Ethnoscience-Based Learning Models to Train Science Literacy and Learning Independence Based on Type of Research Publication

Publication Type Article	Publication
Articles	108, 877
Chapters	62,842
Edited Books	54,384
Monographs	50,162
Proceedings Chapters	3,318
Preprints	2,317

Based on Table 1, research trends on ethnoscience-based learning models with an ethnopedagogical approach to train scientific literacy and student learning independence based on the type of research publication (Gunawan & Harjono 2023), it is known that the largest number of publications is in articles. Articles on the ethnopedagogical approach to train scientific literacy and student learning independence are 108,877 publications (Suyanto, 2022). While Chapter 62, 842, edited books 54, 384, monographs 50, 162. Proceedings of chapter 3, 318, preprints 2,317 publications (Zubaidah, 2021).

Table 2. Top 10 Sources of Titles Trending Ethnoscience-Based Learning Models

Name	Publications	Citations	Citations Means
Historian	1,768	4,195	2.37
Encyclopedia of the UN Sustainable Development	1,602	1,662	1.04
SSRN Electronic Journal	1,592	9,384	5.89
Behavioral and Brain Sciences	1,572	22,762	14.48
Lecture Notes in Computer Science	1,469	8,883	6.05
Epidemiology	1,188	790	0.66
Tobacco Induced Diseases	1,053	593	0.56
The Journal of Ecclesiastical History	1,002	135	0.13
Journal of the Royal Anthropological Institute	937	1,276	1.36
Encyclopedia of Indian Religions	918	176	0.19

Table 2 shows the most publications related to research trends on ethnoscience-based learning models with an ethnopedagogy approach to train scientific literacy and student learning independence, namely the historian journal (Historian, 2015-2024). This journal published 1,768 publications, 4,195 citations and an average citation of 2.37. (Behavioral & Brain Sciences 2015-2024). All editions in this journal are open and freely accessible or downloaded for free by anyone.

Table 3. Top 10 Citations About Research Trends on Ethnoscience-Based Learning Models to Train Students' Scientific Literacy and Learning Independence in 2015-2024.

Cites	Year	Author	Title
289	2016	H Reinders, C White	20 years of autonomy and technology
781	2021	SKW Chu, RB Reynolds	Springer
99	2017	CJ Ballen, JE Blum, S Brownell, S Hebert, J Hewlett	A call to develop course-based undergradute research experiences for nonmajors courses
192	2015	DA Dudley	A conceptual model of observed
176	2017	S Brostrom	A dynamic learning concept
146		J Ortiz-Revilla, A	A framework for epistemological
304		F Siddiq, OE Hattle	A future perspective by learning
202	2017	S De La Paz, C Monte-Sano, M Felton	A historical writing apprenticeship for adolescents:Integrating disciplinary learning with cognitive strategies
2145	2019	G DeBoer	A history of ideas in science educattion
163	2019	F Abd-El-Khalick, JY Myers, R Summers	A longitudinal of the extent and manner of representations of nature of science in US high school biology and physics textbooks

Based on Table 3, research on the trend of ethnoscience-based learning models to train scientific literacy and student learning independence in the period 2015-2024 shows an interesting variation in the number of citations. Of the top 10 citations, A History of Ideas in Science Education in 2019 occupies the highest position with 2,145 citations. This study not only provides a historical view of the development of science education, but also explains how ideas in science education have evolved over time. This work provides a deeper understanding of the importance of scientific thinking in science education, as well as how an ethnoscience-based approach can be applied to improve students' understanding of science through local wisdom. Thus, A History of Ideas in Science Education plays an important role in bridging the relationship between global science education and local contexts that are relevant to ethnoscience values (DeBoer, 2019). The second study 20 Years of Autonomy and Technology in 2016 with 289 citations. This study discusses the relationship between learning autonomy and the use of technology in education. Autonomy in learning here refers to the ability of students to take control of their own learning process. In the context of ethnoscience-based learning, technology can be used to enable students to learn more independently through exploration and research based

on local culture. Therefore, technology supports the creation of a more interactive and immersive learning environment that is relevant to the needs and characteristics of students (Reinders & White 2016).

In 2017, the work A Call to Develop Course-Based Undergraduate Research Experiences for Nonmajors Courses with 99 citations, highlighted the importance of developing course-based research experiences for nonmajors. This study showed that even though nonmajors do not have a deep focus on science, they can still benefit from course-based research experiences. In ethnoscience-based learning, these experiences can be used to introduce students to the application of science in their daily lives, including relevant cultural and local contexts (Ballen et al., 2017).

In addition, the work A Conceptual Model of Observed in 2015 with 192 citations, provides a conceptual model of how observations are made in the science learning process. This model is useful for understanding the ways in which students observe and interpret scientific phenomena in their context, which underlies their scientific literacy skills. The ethnoscience approach encourages students to observe and study natural phenomena from the perspective of their culture and local wisdom, while developing their scientific abilities (Dudley, 2015).

Another study that has made a major contribution is A Dynamic Learning Concept by S. Brostrom in 2017, which received 176 citations. The concept of dynamic learning put forward by Brostrom is relevant to the ethnopedagogy approach that prioritizes flexibility in the learning process. Dynamic learning allows students to be actively involved and more independent in developing their science knowledge and skills, while still paying attention to their social and cultural context. This kind of learning will encourage students to explore knowledge more deeply through discussions and reflections related to their life experiences.

Furthermore, the work A Future Perspective by Learning by F. Siddiq and O.E. Hattle (146 citations) also provides insight into how learning can be adapted to developments in the era and technology, which is important in increasing learning independence. Understanding the future of learning is very relevant in designing an ethnoscience-based curriculum that can facilitate students to remain relevant to global scientific developments while respecting and preserving their local culture. In addition to the works above, other studies such as A Framework for Epistemological by J. Ortiz-Revilla and A. (146 citations) and A Longitudinal of the Extent and Manner of Representations of Nature of Science in US High School Biology and Physics Textbooks (163 citations, 2019) have made significant contributions to the development of epistemological theories that underlie how scientific knowledge is constructed and applied in education. The concept of epistemology in ethnoscience helps students understand that scientific knowledge is not only limited to Western views, but can also include local knowledge that has its own scientific value (Brostrom, 2017).

Table 4. Keywords for Research Trends in Ethnoscience-Based Learning Models to Train Students' Scientific Literacy and Learning Independence

Term	Occurrences	Relevance
Science curricula	4	2.57
Chemistry	3	2.14
Science lesson	3	2.10
Students science literacy	3	2.03
peer	3	1.99
physics	3	1.78
math	4	1.75
correlation	3	1.73
Instructional strategy	3	1.72
schooling	3	1.72

Based on table 4 about the top 10 keywords about research trends in ethnoscience-based learning models with an ethnopedagogical approach to train students' scientific literacy and learning independence in 2015-2024. The keywords that often appear and are relevant in this study are science curriculum, which appears 4 times with a relevance level of 2.57, indicating the importance of the science curriculum in the context of ethnoscience-based learning with an ethnopedagogical approach. The emphasis on this science curriculum is in line with the findings of Reinders & White's (2016) study regarding the importance of technology integration in the curriculum to increase student autonomy in learning. An ethnoscience-based science curriculum can give students the freedom to access materials that are closer to their local context, while developing deeper scientific literacy. This is also supported by research by Chu and Reynolds (2021), which highlights the importance of a curriculum that is relevant to students' needs and can connect scientific knowledge to their everyday experiences. In addition, research by Ballen et al. (2017) and Dudley (2015) underline the importance of experiential learning, where students can conduct research that is directly connected to their culture, which enriches their understanding of science concepts. Thus, the implementation of an ethnoscience-based curriculum is very important in training science literacy and supporting students' learning independence.

The results of bibliometric mapping of articles related to research trends on ethnoscience-based learning models with an ethnopedagogical approach to train scientific literacy and student learning independence. Figure 2 shows the results of mapping research trends on ethnoscience-based learning models with an

ethnopedagogical approach to train scientific literacy and student learning independence.

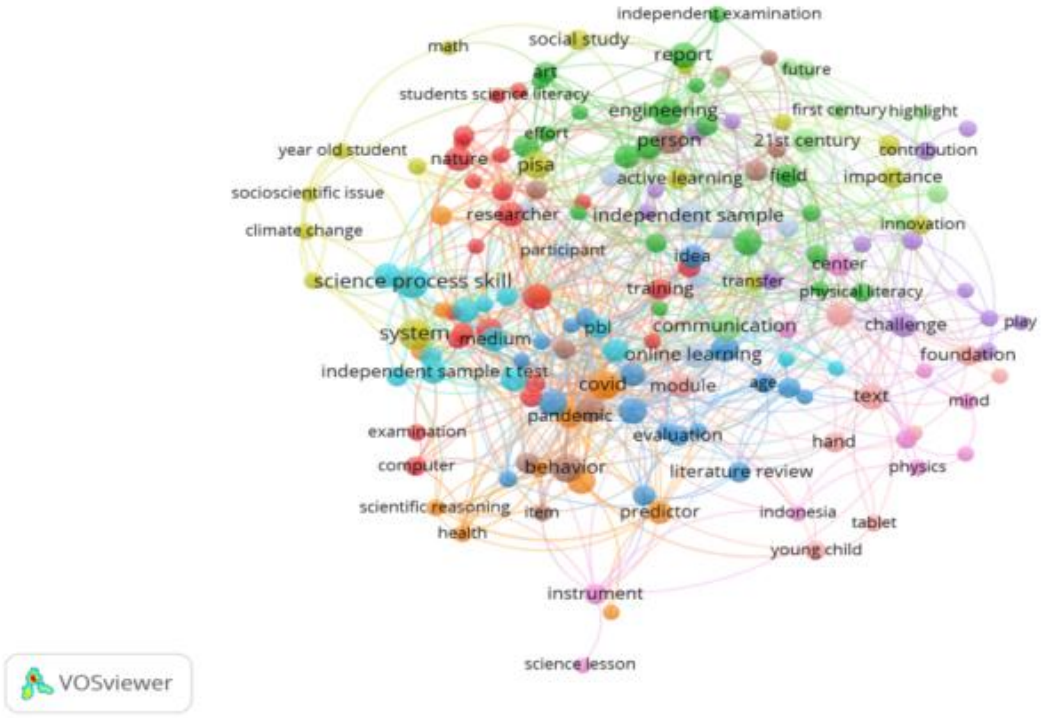

Figure 2. Network visualization of research trends on ethnoscience-based learning models to train students' scientific literacy and learning independence

Figure 2 is a bibliometric result that shows the relationship between various concepts in research with a focus on research trends in ethnoscience-based learning models with an ethnopedagogical approach to train scientific literacy and student learning independence. Based on the image, the visual network map displayed by VOSviewer in this image provides a clear picture of the main topics and relationships between keywords in research related to science education. The green color with the keywords future, innovation, communication, importance, and physical literacy, which focuses on the concept of innovation, shows a strong concern for the development of 21st century skills and innovation in the learning process (Reinders & White 2016). Meanwhile, the yellow color with the keywords climate change, science process skills, and socio-scientific issues focuses on socio-scientific issues, including climate change and science process skills, which emphasize how science education can be a means to understand and respond to global challenges. On the other hand, the light blue color highlighting keywords such as covid, pandemic, and behavior, underlines the significant impact of the COVID-19 pandemic on behavior, health, and learning, especially in the context of distance and online education (DeBoer, 2019). In red, the emphasis on educational evaluation with the keywords PISA, scientific reasoning, and math reflects the attention to measuring students' achievement and cognitive abilities. In addition, the orange color with the keywords science lesson and evaluation shows that research on science teaching and evaluation continues to grow, with a focus on how science lessons can be effectively evaluated using a variety of instruments. Finally, the purple color with the keywords play, young child, and tablet raises the theme of early childhood, play, and technology, such as the use of tablets, illustrating the interest in innovative approaches in educating young children, including through fun and interactive learning methods.

Figure 3 shows the trend of keywords related to the research trend of ethnoscience-based learning models with an ethnopedagogical approach to train scientific literacy and student learning independence where the color is dark blue to light blue in 2017 - 2018 with keywords that appeared earlier, around 2017 to 2018, including PISA, scientific reasoning, system, climate change, socio-scientific issue, science process skill, computer, Instrument, and health which show that the focus is on cognitive assessment and science skills and science skills measurement tools (OECD, 2017). The green and light yellow colors in 2019-2020 with the keywords covid, online learning, PBL (problem-based learning), communication, innovation, physical literacy, and play indicate that the focus of research is more modern, especially on the impact of the COVID-19 pandemic and the emergence of online learning methods and innovative

approaches in education such as problem-based learning (Gergen, & Barrett 2018). The bright yellow color in 2020 with the keywords covid and online learning indicates that the focus of research related to COVID-19 and online learning became very relevant and intense during that period. Research this year is more focused on educational challenges arising from the pandemic and efforts to keep the learning process going through technology (Hodges & Bond 2020).

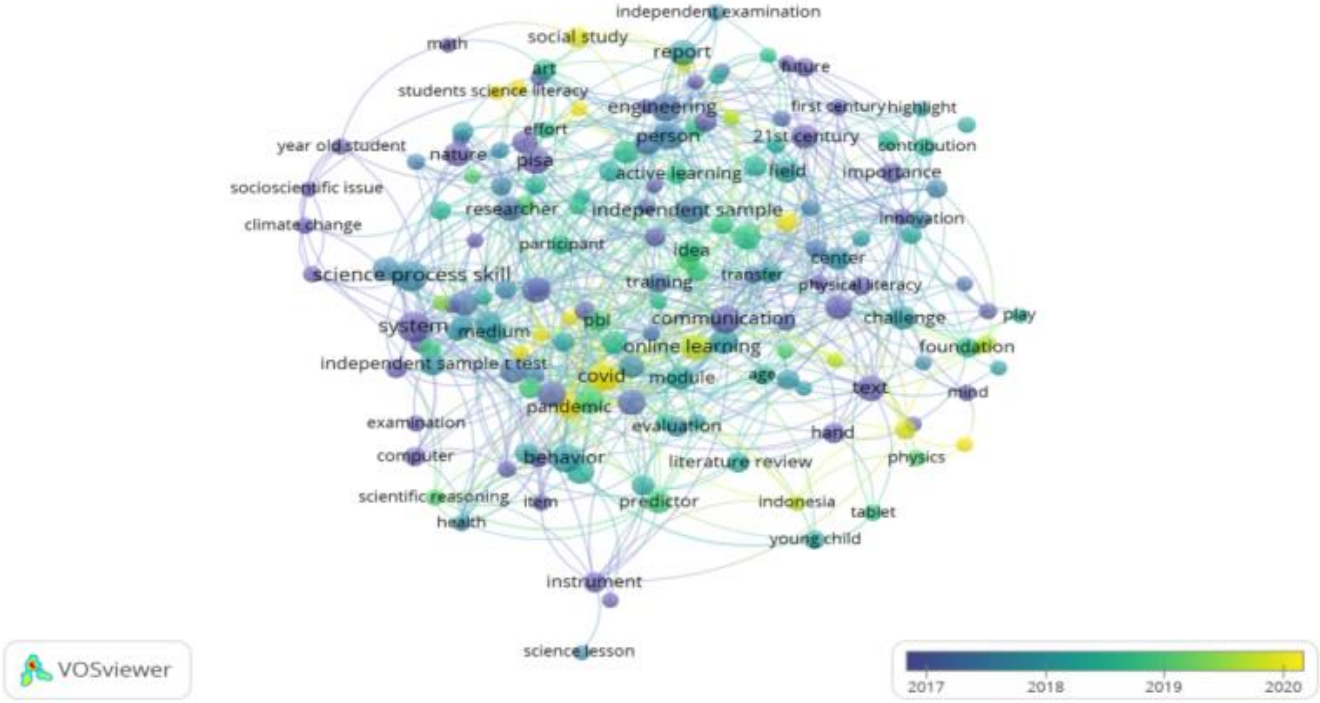

Figure 3. Overlay visualization of research trends on ethnosians-based learning models to train students' scientific literacy and learning independence

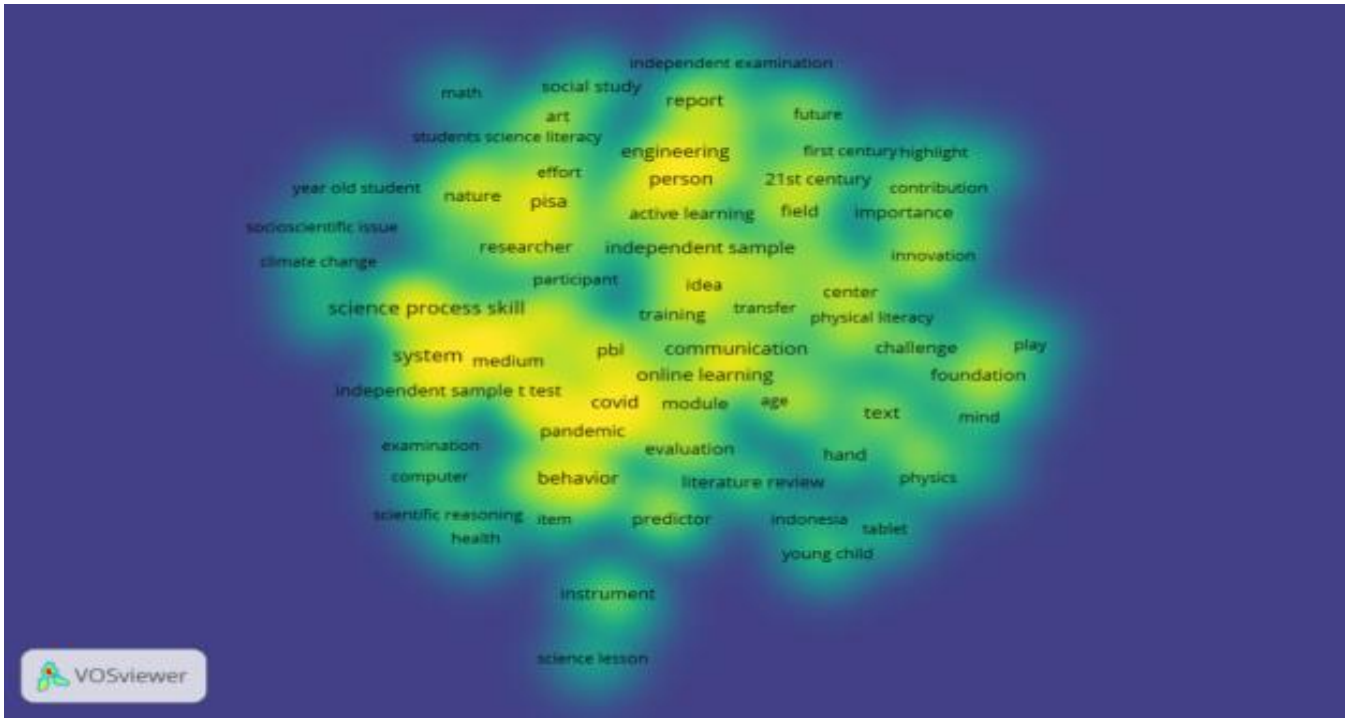

Figure 4. Density visualization of research trends on ethnoscience-based learning models to train students' scientific literacy and learning independence

Figure 4 is the result of density visualization using VOS Viewer that occurs in the topic of research trends in ethnoscience-based learning models with an ethnopedagogy approach to train scientific literacy and student learning independence. Topics that are more researched are shown in yellow, such as the keywords science process skill, system, communication, and PBL (problem-based learning), which often appear in many studies (Barrows, 2018). Meanwhile, topics that are less researched are shown in green to dark blue, such as the keywords literature review, evaluation, and physics, which have a lower frequency of occurrence. Overall, topics with lighter colors illustrate a greater focus of research, while topics with darker colors require further exploration (Dori & Belcher 2019).

Conclusion

The conclusions from the results of this study are training scientific literacy and students' learning independence shows the relevance of ups and downs in ethnoscience-based learning. And this study shows a new direction for training scientific literacy and students' learning independence.

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Conflicts of Interest
No conflict interest.

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