JPPIPA 12(4) (2026)

Jurnal Penelitian Pendidikan IPA

http://jppipa.unram.ac.id/index.php/jppipa/index

The Development, Research Trends, and Emerging Opportunities of Ethno-PjBL in Chemistry Education: A Bibliometric Study

Dina Dania Navieta[1*], Jaslin Ikhsan[2]

[1] Master of Chemistry Education, Universitas Negeri Yogyakarta, Yogyakarta, Indonesia.
[2] Chemistry Education, Universitas Negeri Yogyakarta, Yogyakarta, Indonesia.

Received: September 02, 2025
Revised: March 02, 2026
Accepted: April 25, 2026
Published: April 30, 2026

Corresponding Author:
Dina Dania Navieta
danianaviietadina@gmail.com

DOI: 10.29303/jppipa.v12i4.12723

Abstract: This study is a bibliometric research aimed at discussing the development of research on Ethno-Project-Based Learning (Ethno-PjBL) in chemistry education from 2017 to 2024. This study utilised the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) approach with data extracted from Google Scholar using the Publish or Perish (PoP) software. A total of 23 relevant articles were analysed using VOSviewer to identify the highest number of publications, authors with the most publications, research trends, and opportunities for further research. The results of the study indicate that interest in Ethno-PjBL research during 2017 to 2024 showed stable but limited growth, as it experienced both increases and decreases. The highest number of publications occurred in 2021 and 2024, with five publications each. The author with the most publications was Sudarmin from Semarang State University with 7 documents. Ethno-PjBL research focused on several themes, such as ethnochemistry, ethno-STEM, creative thinking skills, development, and teaching materials. The visualisation results show that Ethno-PjBL research focuses on the integration of local culture in project-based chemistry learning. Meanwhile, new topics such as "natural products" and "Ethno-STEM approach" have great potential for further research.

Keywords: Bibliometric analysis; Chemistry education; Ethno-PjBL; Ethno-STEM Approach

Introduction

Most students consider chemistry to be unattractive due to its abstract nature (Huangfu et al., 2025). If it is not taught in a concrete manner, it will be difficult for students to understand it, especially in its application in everyday life (Muti'ah et al., 2021).

Learning activities become more interesting and beneficial when students have the opportunity to rebuild their knowledge about the phenomena of life around them and relate it to science (Halimah et al., 2024). This can be done by incorporating elements of culture in everyday life into learning. Learning that integrates cultural elements is called ethnoscience-based learning (Fitri et al., 2024; Pertiwi et al., 2021).

Ethnoscience aims to bridge the gap between traditional knowledge passed down from generation to generation and existing scientific developments so that it can be scientifically justified (Sudarmin et al., 2017). In addition, ethnoscience is a very useful medium to support students in discovering the connection between social phenomena and science (Harjono et al., 2025). According to Jofrishal et al. (2020), ethnoscience is divided into several specific disciplines, namely ethnomathematics, ethnobiology, ethnobotany, ethnophysics, ethnomedicine, and ethnochemistry. In learning, ethnochemistry is used to understand the cultural elements in daily life that are related to the chemistry material being studied. Thus, it is hoped that this can improve chemistry learning to be more enjoyable and relevant to real life (Jofrishal & Seprianto,

How to Cite:
Navieta, D. D., & Ikhsan, J. (2026). The Development, Research Trends, and Emerging Opportunities of Ethno-PjBL in Chemistry Education: A Bibliometric Study. *Jurnal Penelitian Pendidikan IPA*, *12*(4), 29–39. https://doi.org/10.29303/jppipa.v12i4.12723

2020). From previous research results, ethnochemistry can be used as a learning resource (Irawati et al., 2023; Umam & Wahyudiati, 2023).

Medicinal plants commonly used by local communities are studied as ethnochemistry, which can foster cultural awareness and make learning more meaningful (Nursaadah et al., 2017; Pertiwi et al., 2021). To be more effective, ethnochemistry in learning can be collaborated by applying certain learning models. One learning model that can be applied is project-based learning combined with ethnochemistry, known as Ethno Project-Based Learning or Ethno-PjBL. Ethno-PjBL is an innovative learning model that adapts cultural values into chemistry learning, enabling the learning process to become more meaningful and aligned with real-life contexts (Rahman et al., 2023; Wahyudi et al., 2023). Ethno-PjBL can be a solution for teachers to train students' creative, innovative, and problem solving skills as well as their science literacy through the completion of ethnochemistry-based projects (Dewi et al., 2019; Sudarmin et al., 2020; Sumarni & Kadarwati, 2020; Widarti et al., 2025).

Research on Ethno-Project-Based Learning (Ethno-PjBL) has been developing since 2017, with most existing studies still focusing on model implementation, module development, and testing its effectiveness in the classroom (Mirnawati et al., 2021; Ramadhina et al., 2025; Susilo & Salirawati, 2025). In addition, several studies only show changes in behaviour and learning outcomes due to the integration of cultural values into learning (Permatasari et al., 2019). To date, there has been no comprehensive systematic study mapping the development, research patterns, and research collaboration networks of Ethno-PjBL, particularly in chemistry education, using a bibliometric approach. Most previous studies also tend to place ethnochemistry in a broader framework such as Ethno-STEAM or culturally responsive learning (Alqhorina & Effendi, 2024; Aqilla & Effendi, 2022; Fikrina et al., 2022), without specifically analysing the research landscape of Ethno-PjBL as a stand-alone pedagogical model. Therefore, bibliometric analysis is needed to identify publication trends, productive authors and institutions, dominant keywords, and emerging research clusters in this field.

This study provides a structured bibliometric mapping of Ethno-PjBL research in chemistry education, thereby providing a macro-level understanding of the intellectual structure and future direction of research. This study provides an overview of how Ethno-PjBL has developed over time. By identifying research gaps and thematic concentrations, this study can assist future researchers in designing more focused research and avoiding redundancy. In addition, bibliometric mapping is also important for strengthen the theoretical and methodological foundations of Ethno-PjBL in chemistry education research.

Therefore, this article will discuss bibliometric analysis, which is a quantitative analysis aimed at observing trends and patterns in research on Ethno-Chemistry Integrated Project-Based Learning (Ethno-PjBL) (Kurdi & Kurdi, 2021). Bibliometrics was chosen because it can provide an overview of the development of Ethno-PjBL research (Kılınç Şehide, 2024; Mu'yidarrahmatillah et al., 2024).

The main focus of this study is to examine the direction and distribution of research, prolific authors, and research opportunities for Ethno-PjBL based on successfully identified research trends. In addition, these results can also be used by teachers or other researchers as a reference for conducting research on Ethno-PjBL topics in the future. Thus, it can be stated that the questions for this study are: RQ1: How many Ethno-PjBL research publications were there from 2017 to 2024? RQ2: Who are the authors with the most publications on Ethno-PjBL from 2017 to 2024?RQ3: How can the research trends on Ethno-PjBL from 2017 to 2024 be visualised? RQ4: What are the opportunities for future research on Ethno-PjBL in chemistry education?

Method

This study is a bibliometric analysis, which is a quantitative analysis method that aims to identify publication groups in specific fields using a database of research articles published on Google Scholar (Irwanto et al., 2024). Google Scholar was chosen as the database for this study because ethnochemistry is widely practised in Indonesia and published in journals indexed by Google Scholar, and the published articles are easily accessible and freely available. This bibliometric analysis uses the PRISMA approach. The PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) method is an analysis method used to review literature in scientific research. The PRISMA method used in this study includes data identification, screening, data eligibility assessment, and data presentation (Moher et al., 2009; Page et al., 2021).

Keyword Selection

Data search utilised Publish or Perish (PoP) software using relevant keywords, namely "Ethno Project Based Learning", "Ethno PjBL", "Ethno Project Based Learning Chemistry", and "Ethnochemistry PjBL". In addition, Mendeley Desktop was used to assist in the citation management and manual data cleaning processes.

Data Collection

The initial search phase using the Publish or Perish (POP) software yielded a total of 400 documents, with each keyword yielding 100 documents. Only articles, conferences, and proceedings that were open access were selected, applying the predetermined inclusion and exclusion criteria. To maximise the analysis results, the selected documents were limited to the use of Indonesian and English, and only on Chemistry Education in Indonesia.

After screening, the documents were saved in RIS format and imported into Mendeley Desktop for manual cleaning. Subsequently, after data cleaning was completed, 23 documents were obtained that met the criteria for further analysis using VOSviewer. The data collection steps can be seen in Figure 1.

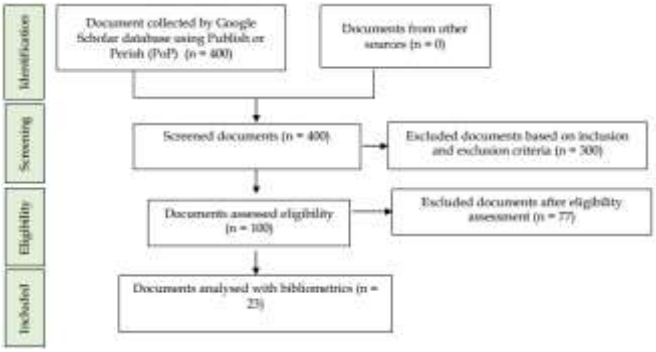

Figure 1. Data collection steps with PRISMA methods

Data Analysis

The data analysis stage begins by entering the selected documents into the VOSviewer application. VOSviewer is used as an aid to visualise the interconnected networks regarding Ethno-PjBL in chemistry learning (Meng et al., 2020). VOSviewer was chosen because it produces good mapping; as the number of documents increases, the visualised nodes become larger (van Eck & Waltman, 2010; Zupic & Čater, 2015). In addition, the relationships between groups of items can also be seen in the connecting lines. The thicker the lines, the higher the collaboration between item groups (Yuliana et al., 2021). The data analysis conducted included the number of publications, authors with the most documents, mapping research trends, and future research opportunities for Ethno-PjBL, particularly in Chemistry Education, based on mapping from 2017 to 2024.

Result and Discussion

Number of Ethno-PjBL Publications in 2017 to 2024

The number of publications on Ethno-PjBL research topics during 2017 to 2024 is presented in Figure 2.

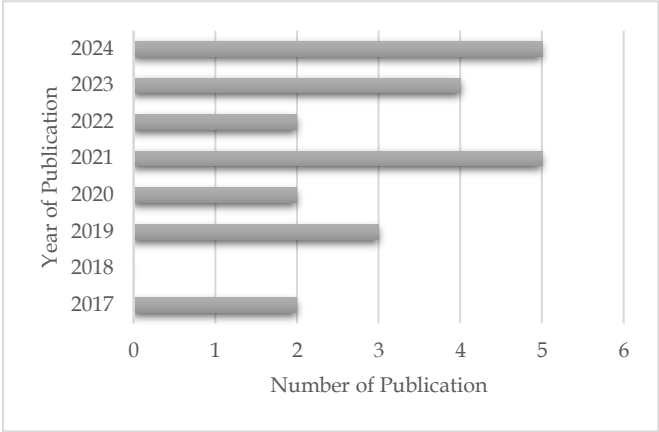

Figure 2. Number of publications Ethno-PjBL from 2017–2024

Figure 2 shows that Ethno-PjBL research is still rarely studied. Research on Ethno-PjBL applied to chemistry learning only began in 2017 with 2 documents, 2018 had no related publications, 2019 had 3 documents, 2020 had 2 documents, 2021 had 5 documents, 2022 experienced a decline of 2 documents, 2023 had 4 documents, and 2024 had 5 documents. This means that over the last 8 years, Ethno-PjBL research has grown from 2017 to 2024, with the highest number of publications in 2021 and 2024, each with 5 documents, despite experiencing increases and decreases during that period. The decline occurred between 2017 and 2020. This was because Ethno-PjBL was still relatively new to researchers during that period. In addition, in 2020, Indonesia experienced the Covid-19 pandemic, which caused all activities to be carried out from home, including teaching and learning activities at school. This condition also had an impact on the implementation of field research, which had to be adjusted to the situation at that time (Indawati et al., 2022; Rifai et al., 2021). Ethno-PjBL research during this period included projects related to traditional foods, batik, customs such as traditions and culture packaged in student's worksheet, E-modules, vlogs, products such as soap, practical guides, and Lesson Plans.

Authors with the Most Publications on Ethno-PjBL in 2017 to 2024

Mapping of authors with the most publications on Ethno-PjBL in 2017 to 2024 utilised Co-Authorship mapping in VOSviewer software (Sa'adi et al., 2024). The mapping is presented in Figure 3. Figure 3 shows that the author with the most publications on Ethno-PjBL from 2017 to 2024 is Sudarmin. He is an ethnoscience expert from Universitas Negeri Semarang, Indonesia. The mapping results are shown by Sudarmin's position as the largest node at the centre of the network. Larger nodes reflect a greater number of publications, while the lines indicate collaboration

with other authors (Fitri et al., 2023). Sudarmin published a total of seven documents from 2017 to 2024 (Carnawi et al., 2017; Nur et al., 2024; Sudarmin et al., 2024; Sudarmin et al., 2024; Sudarmin et al., 2023; Sudarmin et al., 2019; Sudarmin et al., 2019). In this research, Sudarmin had many collaborators in his network, such as collaborations with Handayani, Sarwi, and Sumarni, which demonstrated his contribution to collaborative research on the topic of Ethno-PjBL. Details of the Ethno-PjBL research conducted are presented in Table 1

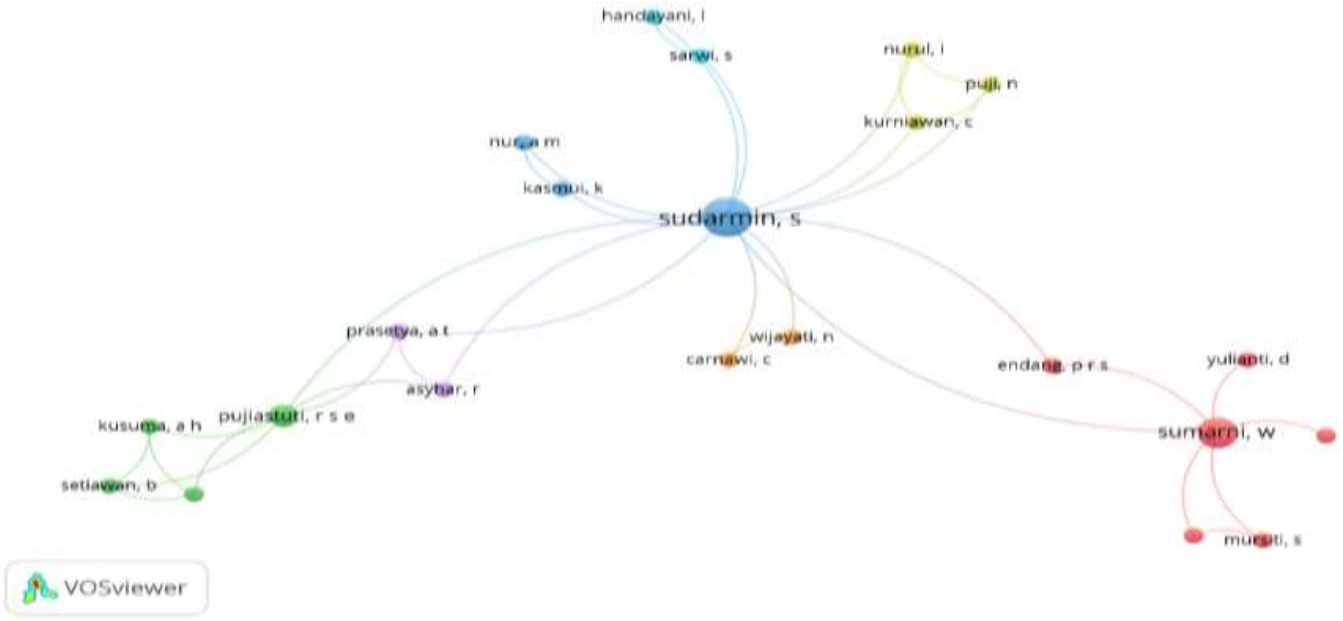

Figure 3. Results of Mapping Authors with the Most Publications from 2017–2024

Table 1. Details of the Ethno-PjBL Research Conducted by Sudarmin

Title	Year	Content
Application of Project-Based Learning (PBL) Model for Materials of Salt Hydrolysis to Encourage Students' Entrepreneurship Behaviour	2017	Local practices of salt utilisation in food products (such as salted eggs) as a learning context for salt hydrolysis salt, which was then developed
The Influence of the Project Based Learning Integrated Ethno-STEM of Chemical Equilibrium on the Pancasila Student's Profile of 's Mutual Cooperation Dimension	2024	Ethno-STEM is used to develop project based learning on chemical equilibrium material through the local phenomenon of *ganjel rel* food.
The Implementation of a Chemical Project Learning Model Integrated with an Ethno-STEM Approach on the Topic of Water Treatment Using Kelor (*Moringa oleifera*) Seed Extract as a Bio-Coagulant	2019	A project-based learning model that integrates ethno-science on the use of moringa (Moringa oleifera) seeds as a bio-coagulant in water treatment with the concept of colloid chemistry.
Chemistry Project-Based Learning for Secondary Metabolite Course With Ethno-STEM Approach to Improve Students' Conservation and Entrepreneurial Character in The 21st Century	2022	Ethnoscience-based Project-Based Learning utilising traditional medicinal plants as a source of secondary metabolites, integrated with the STEM approach STEM approach to develop students' conservation and entrepreneurial characters
Implementing the Model ff Project-Based Learning: Integrated With Ethno STEM to Develop Students' Entrepreneurial Characters	2019	Project-Based Learning based on ethnoscience in batikmaking, particularly traditional natural dyes, integrated with the Ethno-STEM approach to develop students' entrepreneurial character.
Development of Innovative Ethno-Vlog Media Based on Ethno-STEM to Equip Students' Creativity and Realise UNNES Conservation Vision	2024	Project-Based Learning based on the exploration of local wisdom packaged in Ethno-vlog products, integrated with the Ethno-STEM approach to support environmental conservation values
How to Increase Students' Global Diversity Character: A Study of the Influence of Ethno STEM-Integrated Project Learning Model on Indonesian Tea Aroma Volatile Compounds	2024	Ethnoscience-based project-based learning on Indonesian tea processing and aroma characteristics integrated with volatile compound analysis to develop students' global diversity awareness

Visualisation of Ethno-PjBL Research Trends in 2017 to 2024

Bibliometric mapping with VOSviewer produces three different visualisations, namely network visualisation, overlay visualisation, and density visualisation (Fitri et al., 2023; Gandasari et al., 2024). Network visualisation serves to map and display the relationships between elements in bibliometric data, such as authors (co-authorship), keywords (co-occurrence), and citations, so that the intellectual structure of a field of research can be seen systematically (Saiz-Alvarez, 2024).

Each element is represented as a node (circle), while the relationships between elements are depicted through lines (links) that indicate the strength of the connection; the size of the node reflects the frequency of occurrence or number of publications, while the thickness of the line indicates the strength of the relationship, and the colour marks clusters of interrelated themes (Paolone et al., 2025; van Eck & Waltman, 2010). The network visualisation is shown in Figure 4. Based on the figure, it can be seen that the network visualisation contains 23 items grouped into 4 interconnected clusters.

Each cluster shows developments in Ethno-PjBL research and its relationship with other clusters and items. For more details, the cluster groups with specific colours can be seen in Table 2.

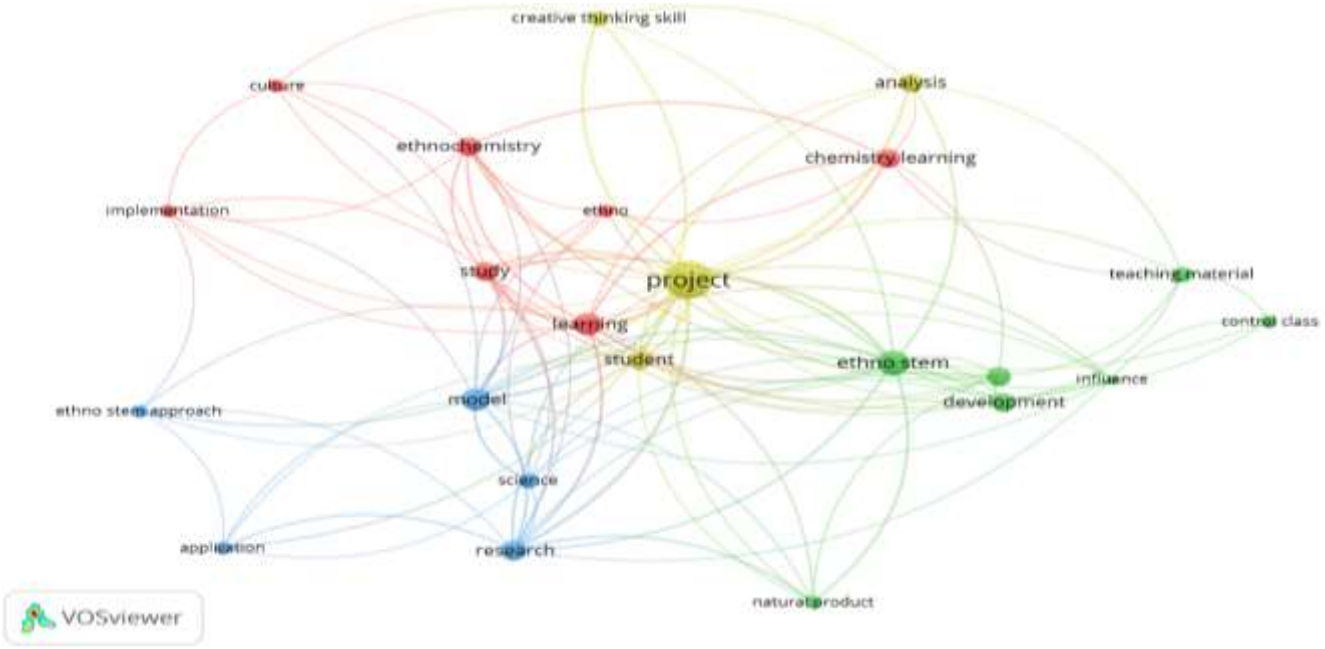

Figure 4. Network Visualisation of Ethno-PjBL Topics from 2017–2024

Table 2. Research Topics Ethno-PjBL in Each Cluster

Cluster Colour	Number of Items	Items
Red	7	Chemistry learning, culture, ethnology, ethnochemistry, implementation, study, learning
Green	7	Control class, development, ethno-stem, ethnoscience, influence, natural product, teaching material.
Blue	5	Application, ethno-stem approach, model, research, science
Yellow	4	Analysis, creative thinking skills, project, student

The network visualisation shows that the focus of Ethno-PjBL research covers several themes such as ethnochemistry, ethno-STEM, creative thinking skills, development, and teaching materials. Key terms such as project, student, learning, and model indicate that the research focuses on a project-based learning approach with the integration of ethnoscience. "Project" is the central node, indicating that project based learning is at the core of this research. Topics such as ethno-STEM and chemistry learning have a strong relationship with the aspects of student and model development. In addition, the development of Ethno-PjBL research topics can also be seen through overlay visualisation (Guo et al., 2025; Ramadhani et al., 2024).

The overlay visualisation can be seen in Figure 5. It can be seen that research related to Ethno-PjBL began to grow in 2019, despite experiencing fluctuations in the number of publications. Publications with the theme of Ethno-PjBL became increasingly relevant between 2021 and 2023, as indicated by the green to yellow colours in the graph. The green area indicates that the Ethno-PjBL research theme and STEM approach are the focus of

current trends. In terms of time, research related to Ethno-STEM has shown a recent increase (2021–2023), while older themes such as culture and ethnochemistry formed the basis at the beginning of the research period.

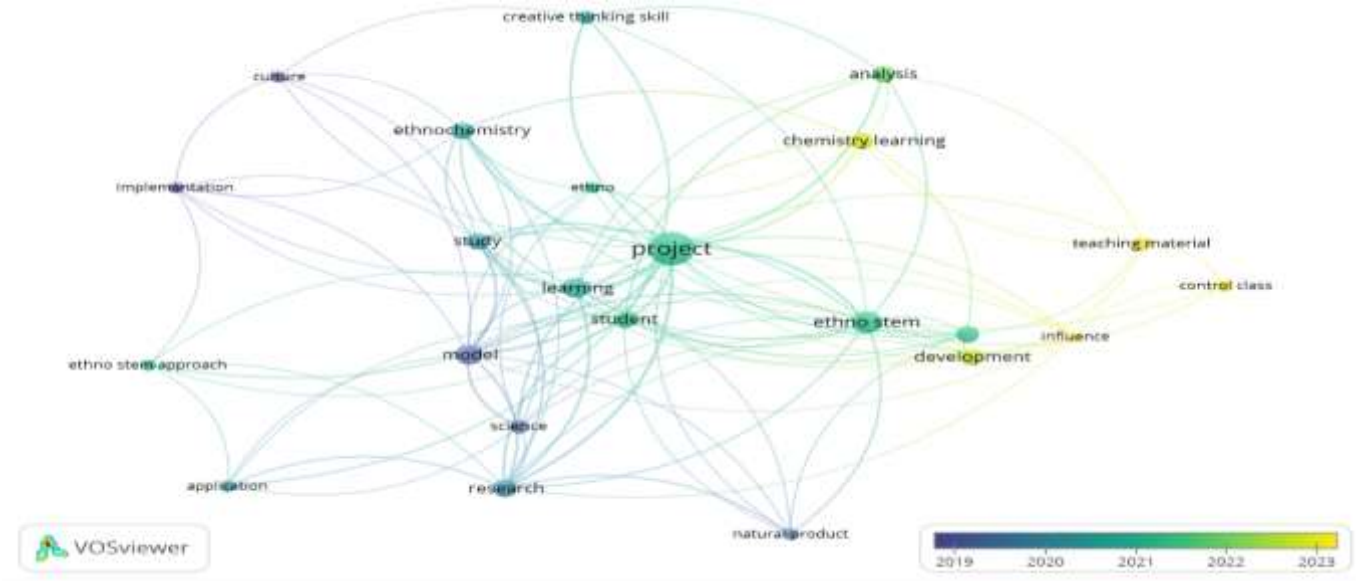

Figure 5. Overlay Visualisation of Ethno-PjBL Topics from 2017–2024

Future Research Opportunities for Ethno-PjBL

Density visualisation in VOSviewer serves to show the level of density of occurrence and interconnection of bibliometric elements in a research map (Adima et al., 2024; van Eck & Waltman, 2010). Lighter coloured areas indicate topics or keywords that appear frequently and have strong connections, while darker colours indicate lower intensity (Patty et al., 2024). This visualisation helps to identify the focus and dominance of research themes quickly and systematically. The intensity of the topics discussed in Ethno-PjBL research can be seen in the density visualisation shown in Figure 6.

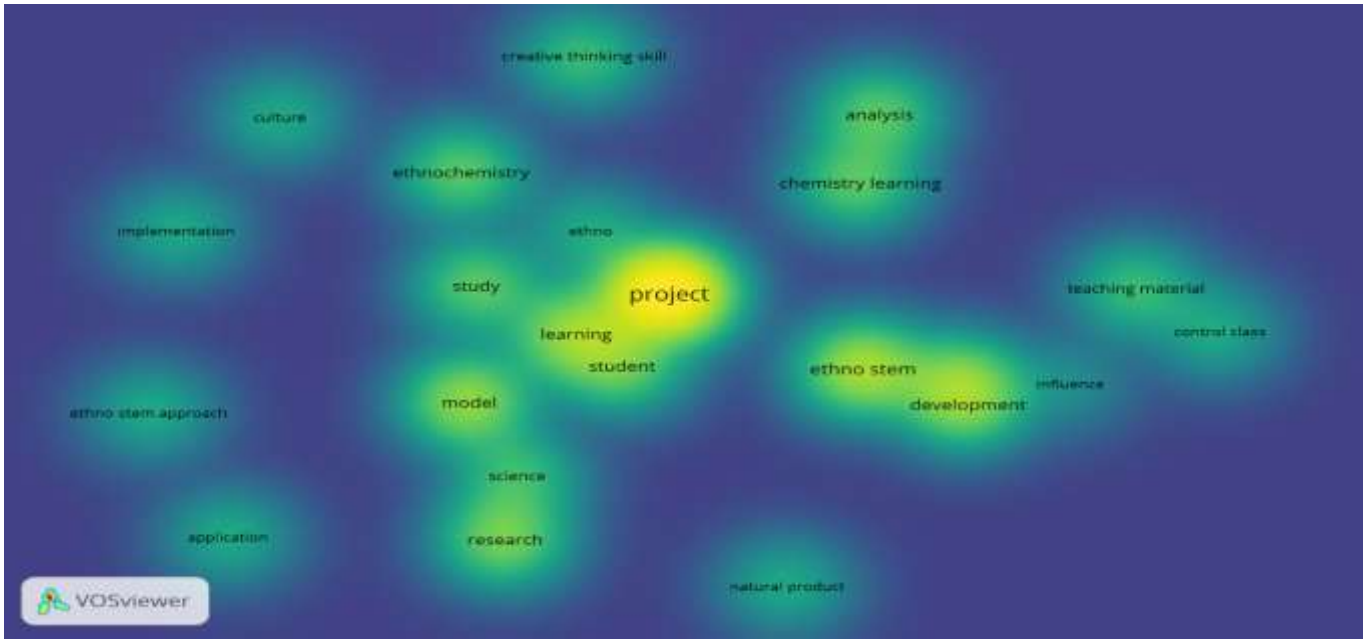

Figure 6. Density visualisation of ethno-PjBL topics 2017 - 2024

It can be seen that the density of research topics centres on "Project" as the main theme, followed by "Ethno-STEM" and "Development". Topics such as "Ethnochemistry" and "Chemistry learning" have the potential to grow further. However, areas with low density, such as "Natural product" and "Ethno-STEM approach", open up great opportunities for new research exploration.

Conclusion

Ethno-PjBL research during 2017 to 2024 shows stable but still limited growth. During the 8-year period, research related to Ethno-PjBL experienced both declines and increases. This is because Ethno-PjBL was indeed experiencing growth during that period. The highest number of publications was in 2021 and 2024, with 5 documents each. The author with the most publications was Sudarmin, with 7 documents. Topics such as ethnochemistry, ethno-STEM, creative thinking skills, development, and teaching materials were the centre of attention. This trend continues to develop, with the current focus on creative thinking skills and teaching material development. For the future, research opportunities include exploring "natural products" and "Ethno-STEM approaches" that can be applied in project-based chemistry learning with cultural integration to support teaching materials and specific skills that teachers and students want to achieve.

Acknowledgments
The author would like to express sincere gratitude to all parties who have contributed to the development of this research, including family, relatives, lecturers, and State University of Yogyakarta.

Author Contributions
This article was written and reviewed by two authors, namely D.D.N. as the researcher and J.S. as the supervisor.

Funding
The research and writing of this article were not funded by any parties other than the main author and the supervisor.

Conflicts of Interest
The authors have no conflicts of interest to declare.

References

Adima, M. F., Baharudin, Syafe'i, I., Zulaikha, S., Susilawati, B., & Shabira, Q. (2025). Digital literacy trends in islamic perspective in higher education: A Bibliometric Review. *Jurnal Penelitian Pendidikan IPA*, *10*(12), 1012–1026. https://doi.org/10.29303/jppipa.v10i12.9847

Alqhorina, V., & Effendi. (2024). Praktikalitas LKPD makromolekul berbasis etnosains terintegrasi STEAM pada pembelajaran Kimia. *Jurnal Pendidikan Kimia Universitas Riau*, *9*(2), 29–35. Retrieved from https://ajoas.ejournal.unri.ac.id/index.php/jpkur/article/view/974

Andani, D., Gani, A., Pada, A., & Rahmatan, H. (2020). Ethnoscience-based student worksheet development to improve Senior High School student creativity. *Jurnal Penelitian Pendidikan IPA*, *7*(1), 26-33. https://doi.org/10.29303/jppipa.v7i1.457

Anugrah, I. R. (2020). Scientific content analysis of batik Cirebon and its potential for high school STEM-approached project-based instruction. *International Conference on Mathematics and Science Education (ICMScE)*, *1806*, 107. https://doi.org/10.1088/1742-6596/1806/1/012215

Aqilla, V. T., & Effendi. (2022). Pengembangan LKPD hakikat ilmu kimia berbasis etnosains terintegrasi STEAM pada pembelajaran di SMA. *Jurnal Pendidikan Kimia Universitas Riau*, *7*(2), 96–104. Retrieved from https://jas.ejournal.unri.ac.id/index.php/jpkur/article/view/940

Ariyatun. (2021). Analysis of project based learning integrated with ethno-STEM on students' critical thinking and creative thinking skills. *Journal of Educational Chemistry, 3*(1), 35-44. https://doi.org/10.21580/jec.2021.3.1.6574

Asmaningrum, H. P., Pongkendek, J. J., & Marpaun, D. N. (2021). The design of vlogs as ethnochemical learning media by project based learning. *Proceedings of the International Joined Conference on Social Science (ICSS 2021), 603*, 1-5. https://doi.org/10.2991/assehr.k.211130.087

Asrizal, Daulay, Hermalina., Amnah, R., Hidayati, & Helma. (2024). Digital teaching material of sustainable lifestyle theme with ethno-PjBL to promote students' knowledge and creative thinking abilities. *Journal of Law and Sustainable Development, 12*(10), 1-26. https://doi.org/10.55908/sdgs.v12i10.3963

Averta, S. O., Putri, R. A., Malika, F. F., Fajar, M. A., & Rienovita, E. (2024). Potensi pemanfaatan aplikasi canva sebagai alat kreatifitas guru dalam mendesain media pembelajaran interaktif: Analisis bibliometrik dengan metode prisma. *Edutech*, *23*(2), 189–201. https://doi.org/10.17509/e.v23i2.69007

Carnawi, C., Sudarmin, S., & Wijayati, N. (2017). Application of project based learning (PBL) model for materials of salt hydrolysis to encourage students' entrepreneurship behaviour. *International Journal of Active Learning*, *2*(1), 50–58. Retrieved from https://journal.unnes.ac.id/nju/ijal/article/view/10603

Dewi, C. A., Khery, Y., & Erna, M. (2019). An ethnoscience study in chemistry learning to develop scientific literacy. *Jurnal Pendidikan IPA Indonesia. 8*(2), 279-287. https://doi.org/10.15294/jpii.v8i2.19261

Fikrina, Q. A., Sudarmin, Sumarni, W., & Sumarti, S. S.

(2022). Pengembangan e-modul Kimia Larutan terintegrasi Etno-STEAM bahan kajian batik Pekalongan. *Prosiding Seminar Nasional Pendidikan IPA III*, 40–48. https://doi.org/10.26858/semnaspendipa.v2i0.40636

Fitri, C. N., Saminan, Safitri, R., Ramadhan, T. M. H., Evendi, & Safrida S. (2024). Ethnoscience-based inquiry learning to increase students' critical thinking skills and collaboration skills. *Jurnal Penelitian Pendidikan IPA*, *10*(11), 8810–8818. https://doi.org/10.29303/jppipa.v10i11.9736

Fitri, M. M., Iswandi U, Syah, N., & Yuniarti, E. (2023). Bibliometric analysis of spatial stunting using VOSviewer. *Jurnal Penelitian Pendidikan IPA*, *9*(12), 1298–1305. https://doi.org/10.29303/jppipa.v9i12.5914

Gandasari, D., Tjahjana, D., Dwidienawati, D., & Sugiarto, M. (2024). Bibliometric and visualized analysis of social network analysis research on Scopus databases and VOSviewer. *Cogent Business and Management*, *11*(1), 1–17. https://doi.org/10.1080/23311975.2024.2376899

Guo, X., Lei, Q., Li, X., Chen, J., & Yi, C. (2025). A visualized analysis of research hotspots and trends on the ecological impact of volatile organic compounds. *Atmosphere*, *16*(8), 1–30. https://doi.org/10.3390/atmos16080900

Halimah, N., Mulyanti, S., & Wibowo, T. (2024). Etnosains pada makanan khas serta implikasi dalam pembelajaran Kimia. *Jurnal Pendidikan Kimia Universitas Riau*, *9*(2), 29–35. Retrieved from https://jist.ejournal.unri.ac.id/index.php/jpkur/article/view/984/734

Hanum, Lutfia., Hasan, M., Pada, A.U.T., Rahmatan, H., Rahmayani, R.F.I., Elisa., & Yusrizal. (2023). Development of learning devices based on ethnoscience project based learning to improve students' critical thinking skills. *Jurnal Pendidikan Sains Indonesia (Indonesian Journal of Science Education)*, 11(2), 288-305. https://dx.doi.org/10.24815/jpsi.v11i2.28294

Harjono, A., Verawati, N. N. S. P., Wahyudi, Gummah, S., & Prayogi, S. (2025). Integrating ethnoscience in inquiry-creative learning: a new breakthrough in enhancing critical thinking. *International Journal of Evaluation and Research in Education*, *14*(1), 636–647. https://doi.org/10.11591/ijere.v14i1.29259

Huangfu, Q., Wang, H., & Zhu, L. (2025). Examining the influences of peer and teacher support on chemistry learning satisfaction: an analysis of a serial mediation model. *Chemistry Education Research and Practice*, *26*(3), 734–747. https://doi.org/10.1039/D5RP00074B

Indawati, N., Sari, Y. I., & Susanti, N. E. (2022). Dampak pandemi covid-19 terhadap aktivitas pengauditan. *JPIG (Jurnal Pendidikan Dan Ilmu Geografi)*, *7*(2), 168–179. https://doi.org/10.37058/jak.v18i2.8440

Irawati, R. K., Wicaksono, A. T., Salamiyah, S., Sofianto, E. W. N., & Wijaya, T. T. (2023). Exploration and inventory of Banjar etnochemistry as a learning source in Indonesia Senior High School Chemistry context. *JTK (Jurnal Tadris Kimiya)*, *8*(1), 42–58. https://doi.org/10.15575/jtk.v8i1.22380

Irwanto, I., Afrizal, A., & Lukman, I. R. (2024). Research trends in Chemistry Education: A bibliometric review (1895–2022). *AIP Conference Proceedings*, *1-12*. https://doi.org/10.1063/5.0182936

Jofrishal, J., & Seprianto, S. (2020). Implementasi modul Kimia Pangan melalui pendekatan etnokimia di SMK Negeri Aceh Timur program keahlian tata boga. *Jurnal IPA & Pembelajaran IPA*, *4*(2), 168–177. https://doi.org/10.24815/jipi.v4i2.17262

Junaidi, E., Sudatha, I. G. W., Suartama, I. K., & Santosa, M. H. (2025). Ethnochemistry in Chemistry Learning: Insights from Indonesian local wisdom. *Jurnal Pendidikan MIPA*, *26*(3), 1642-1658. https://doi.org/10.23960/jpmipa.v26i3.pp1642-1658

Juwita, R. (2022). Best practice membangun keterampilan proses sains melalui model *project based learning* pendekatan STEAM materi asam basa kelas XI IPA SMAN 1 Bontang. *LEARNING: Jurnal Inovasi Penelitian Pendidikan dan Pembelajaran*, *2*(3), *268-277*. https://doi.org/10.51878/learning.v2i3.1581

Kılınç Şehide. (2024). Integrated educational research: A bibliometric analysis. *Pegem Journal of Education and Instruction*, *14*(4), 195–214. https://doi.org/10.47750/pegegog.14.04.17

Kurdi, M. S., & Kurdi, M. S. (2021). Analisis bibliometrik dalam penelitian bidang pendidikan: Teori dan implementasi. *Journal on Education*, *3*(4), 518–537. https://doi.org/10.31004/joe.v3i4.2858

Meng, L., Wen, K. H., Brewin, R., & Wu, Q. (2020). Knowledge atlas on the relationship between urban street space and residents' health-a bibliometric analysis based on vos viewer and cite space. *Sustainability (Switzerland)*, *12*(6), 1–20. https://doi.org/10.3390/su12062384

Mirnawati, Fuldiaratman, & Yusnidar. (2021). Penerapan model *project based learning* (PjBL) berbasis etnosains pada materi koloid dan kaitannya dengan kemampuan berpikir kreatif siswa di SMA Negeri 2 Kota Jambi. *Jurnal Penelitian Pendidikan Kimia: Kajian Hasil Penelitian Pendidikan Kimia*, *8*(1), 85-96. Retrieved from https://jppk.ejournal.unsri.ac.id/index.php/jurpenkim/article/view/14932

Moher, D., Liberati, A., Tetzlaff, J., & Altman, D. G.

(2009). Preferred reporting items for systematic reviews and meta-analyses: The PRISMA statement. *PLoS Medicine*, *6*(7). https://doi.org/10.1371/journal.pmed.1000097

Mu'yidarrahmatillah, A. A., Winoto, Y., & Anwar, R. K. (2024). Pemetaan penelitian literasi lingkungan: Analisis bibliometrika tahun 1971 s/d 2024. *Jurnal Ekologi, Masyarakat dan Sains (EMS)*, *5*(2), 241–250. https://doi.org/10.55448/ayqvsc64

Muti'ah, M., Siahaan, J., & Sukib, S. (2021). Upaya meningkatkan motivasi dan pemahaman ilmu kimia melalui demonstrasi Kimia bagi siswa SMA N 1 Labuapi. *Jurnal Pengabdian Magister Pendidikan IPA*, *4*(2), 236–241. https://doi.org/10.29303/jpmpi.v4i2.704.

Nur, A. M., Sudarmin, Kasmui, & Susilaningsih, E. (2024). The influence of the Project-Based Learning integrated ethno-STEM of chemical equilibrium on the Pancasila student profile mutual cooperation dimension. *International Journal of Acvtive Learning, 9*(1), 30–39. Retrieved from https://journal.unnes.ac.id/journals/ijal/article/view/8586

Nursaadah, E., Eva Wijayanti, I., Zidny, R., Solfarina, & Siti Aisyah, R. (2017). Inventarisasi pengetahuan etnokimia masyarakat Baduy untuk pembelajaran Kimia. *Prosiding Seminar Nasional Pendidikan FKIP UNTIRTA*, 25–32. Retrieved from https://jurnal.untirta.ac.id/index.php/psnp/article/view/25-32

Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., ... & Moher, D. (2021). The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ*, 372. https://doi.org/10.1136/bmj.n71

Paolone, G., Piazza, A., Pilotti, F., Paesani, R., Camplone, J., & Di Felice, P. (2025). A map of the research about lighting systems in the 1995–2024 time frame. *Computers*, *14*(8), 313. https://doi.org/10.3390/computers14080313

Patty, E. N. S., Yorman, Miswaty, T. C., Syahid, A., & Muti'ah. (2024). Bibliometric analysis of the use of VOSviewer in educational research: Trends and implications. *Cypriot Journal of Educational Sciences*, *19*(1), 61–76. https://doi.org/10.18844/cjes.v19i1.9376

Permatasari, F., Madlazim, & Widodo, W. (2019). Pengembangan perangkat pembelajaran dengan model inkuiri terbimbing berbantuan etnoid (etnosains android) pada materi getaran dan gelombang. *Jurnal Pembelajaran Sains*, *3*(2), 70-74. https://doi.org/10.17977/um033v3i2p70-74

Pertiwi, W. J., Solfarina, & Langitasari, I. (2021). Pengembangan lembar kerja peserta didik (LKPD) berbasis etnosains pada konsep larutan elektrolit dan nonelektrolit. *Jurnal Inovasi Pendidikan Kimia*, *15*(1), 2717–2730. Retrieved from https://journal.unnes.ac.id/nju/JIPK/article/view/23228

Putri, D., Supriatna, A., & Rahmawati, T. (2024). Soap making project from waste cooking oil for high school students' chemistry learning: Qualitative content analysis. *Jurnal Penelitian Pendidikan IPA, 10*(6), 3147–3154. https://doi.org/10.29303/jppipa.v10i6.7701

Rahman, A. A., Santosa, T. A., Nurtamam, M. E., Widoyo, H., & Rahman, A. (2023). Meta-analysis: The effect of ethnoscience-based project based learning model on students' critical thinking skills. *Jurnal Penelitian Pendidikan IPA*, *9*(9), 611–620. https://doi.org/10.29303/jppipa.v9i9.4871

Rahmawati, Y., Ridwan, A., & Nurbaity. (2017). Should we learn culture in chemistry classroom? Integration ethnochemistry in culturally responsive teaching. *AIP Conference Proceedings 1868,* 1-13. https://doi.org/10.1063/1.4995108

Ramadhani, A. M., Setiawan, R., Gunawan, R. N., Zafrullah, Z., & Ayuni, R. T. (2024). Trends use of technology research for early childhood education: A bibliometric & biblioshiny analysis (1971-2024). *Jurnal Penelitian Pendidikan IPA*, *10*(11), 831–849. https://doi.org/10.29303/jppipa.v10i11.8147

Ramadhina, S., Arumning, R., & Wilujeng, I. (2025). Empowering 21st-century skills through ethno-PjBL: The case of 'Geplak' in Science Education. *SEMESTA Journal of Science Education and Teaching, 8*(2), 165–182. https://doi.org/10.24036/semesta/vol8-iss2/735

Rifai, B., Yayusman, M. S., & Barid, V. B. (2021). Can digital research be an alternative method during the covid-19 pandemic in Indonesia? *Journal of Indonesian Social Sciences and Humanities*, *11*(1), 75–91. https://doi.org/10.14203/jissh.v11i1.208

Sa'adi, P., Misbah, Arlinda, R., Harto, M., & Muhammad, N. (2024). Bibliometric analysis: Augmented reality in science education research trends. *Jurnal Penelitian Pendidikan IPA*, *10*(1), 12–24. https://doi.org/10.29303/jppipa.v10i1.6547

Saiz-Alvarez, J. M. (2024). Innovation management: A bibliometric analysis of 50 years of research using vosviewer® and scopus. *World*, *5*(4), 901–928. https://doi.org/10.3390/world5040046

Saputra, A., Hijriyah, U., Romlah, L. S., Susanti, A., Sunarto, & Shabira, Q. (2025). Trends and developments in gamification for science education: A bibliometric review from 2019 to 2023. *Jurnal Penelitian Pendidikan IPA*, *11*(1), 30–44. https://doi.org/10.29303/jppipa.v11i1.10169

Sholahudin, A., Hayati, N., Iriani, R., Saadi, P., & Susilowati, E. (2021). Project-based learning on

ethnoscience setting to improve students' scientific literacy. *AIP Conference Proceedings* 2330, 1-8. https://doi.org/10.1063/5.0043571

Sudarmin, Handayani, L., Sarwi, Hardianti, R. D., Eralita, N., Sumarni, W., & Hutagalung, F. D. (2024). Development of innovative ethno-vlog media based on ethno-stem to equip students' creativity and realize UNNES conservation vision. *Journal of Innovation in Educational and Cultural Research*, *5*(3), 529–539. https://doi.org/10.46843/jiecr.v5i3.1749

Sudarmin, Prasetya, A. T., Kusuma, A. H., Setiawa, B., Pujiastuti, R. S. E., Binti Mohd Zain, H. H., & Winarto. (2024). How to increase students' global diversity character: Study of the influence of ethno-stem-integrated project learning model on indonesian tea aroma volatile compound. *Pakistan Journal of Life and Social Sciences*, *22*(1), 4707–4722. https://doi.org/10.57239/PJLSS-2024-22.1.00347

Sudarmin, S., Kurniawan, C., Puji, N., & Nurul, I. (2019). The implementation of chemical project learning model integrated with Ethno-stem approach on water treatment topic using kelor (Moringa oleifera) seed extract as bio-coagulant. *UNNES International Conference on Research Innovation and Commercialization 2018, KnE Social Sciences,* 492–501. https://doi.org/10.18502/kss.v3i18.4740

Sudarmin, S., Mastur, Z., & Parmin, P. (2017). Pengetahuan ilmiah berbasis budaya dan kearifan lokal di Karimunjawa untuk menumbuhkan *soft skills* konservasi. *JPPS (Jurnal Penelitian Pendidikan Sains)*, *6*(2), 1363–1369. https://doi.org/10.26740/jpps.v6n2.p1363-1369

Sudarmin, S., Pujiastuti, R. S. E., Asyhar, R., Prasetya, A. T., Diliarosta, S., & Ariyatun, A. (2023). Chemistry project-based learning for secondary metabolite course with ethno-STEM approach to improve students' conservation and entrepreneurial character in the 21St Century. *JOTSE*, *13*(1), 393–409. https://doi.org/10.3926/jotse.1792

Sudarmin, Sumarni, W., Endang P, R. S., & Susilogati S, S. (2019). Implementing the model of project-based learning: Integrated with ethno-STEM to develop students' entrepreneurial characters. *Journal of Physics: Conference Series*, *1317*, 1–8. https://doi.org/10.1088/1742-6596/1317/1/012145

Sudarmin, Sumarni, W., Mursiti, S., & Sumarti, S. S. (2020). Students' innovative and creative thinking skill profile in designing chemical batik after experiencing ethnoscience integrated science technology engineering mathematic integrated ethnoscience (ethno-stem) learnings. *Journal of Physics: Conference Series*, *1567*(2), 1–7. https://doi.org/10.1088/1742-6596/1567/2/022037

Sumarni, W., & Kadarwati, S. (2020). Ethno-stem project-based learning: Its impact to critical and creative thinking skills. *Jurnal Pendidikan IPA Indonesia*, *9*(1), 11–21. https://doi.org/10.15294/jpii.v9i1.21754

Susilo, B., & Salirawati, D. (2025). Improving students' creative thinking in macromolecule lessons through AI-based ethnochemistry project-based learning. *Journal of Educational Sciences*, *9*(6), 5277–5296. https://doi.org/10.31258/jes.9.6.p.5277-5296

Syahmani., Rahmatilah, J., Winarti, Atik., Kusasi, M., Iriani, Rilia., & Prasetyo, Y.D. (2022). Development of guided inquiry lesson based on ethnoscience e-modules to improve students' problem-solving ability in chemistry class. *Journal of Innovation in Educational and Cultural Research*, *3*(4), 670-682. https://doi.org/10.46843/jiecr.v3i4.363

Umam, K. K., & Wahyudiati, D. (2023). Ethno-chemistry: Relevance analysis of electron valence subject material to sasak local wisdom as a chemistry learning resource. *Hydrogen: Jurnal Kependidikan Kimia*, *11*(5), 710. https://doi.org/10.33394/hjkk.v11i5.9069

van Eck, N. J., & Waltman, L. (2010). Software survey: VOSviewer, a computer program for bibliometric mapping. *Scientometrics*, *84*(2), 523–538. https://doi.org/10.1007/s11192-009-0146-3

Wahyudi, W., Verawati, N. N. S. P., Islahudin, I., & Agustina, S. (2023). Hybrid Ethno-Project Based Learning Integrated With Virtual Assistive Technology to Enhance Students' Critical Thinking in Fundamental Physics Course. *Tem Journal, 12*(4), 2006. https://doi.org/10.18421/TEM124-11

Wahyudiati, D., & Qurniati, D. (2023). Ethnochemistry: Exploring the potential of Sasak and Javanese local wisdom as a source of chemistry learning to improve the learning outcomes of pre-service chemistry teachers. *Jurnal Pendidikan Sains Indonesia (Indonesian Journal of Science Education)*, *11*(1), 12-24. https://dx.doi.org/10.24815/jpsi.v11i1.26790

Wardani, L. K., Mulyani, B., Ariani, S. R. D., Yamtinah, S., Masykuri, M., Ulfa, M., & Shidiq, A. S. (2023). Effect of an ethnochemistry-based Culturally Responsive Teaching approach to improve cognitive learning outcomes on green chemistry material in high school. *Jurnal Penelitian Pendidikan IPA*, *9*(12), 11029–11037. https://doi.org/10.29303/jppipa.v9i12.5532

Widarti, H. R., Wiyarsi, A., Yamtinah, S., Shidiq, A. S., Sari, M. E. F., Fauziah, P. N., & Rokhim, D. A. (2025). Analysis of content development in chemical materials related to ethnoscience: A review. *Journal of Education and Learning*, *19*(1), 422–

430.
https://doi.org/10.11591/edulearn.v19i1.21210
Wiratma, I. G. L., & Yuliamiastuti, I. A. A. (2023). Ethnochemistry potential of vines contained in lontar usada taru pramana on students' scientific explanation skills through task-based learning. *Jurnal Pendidikan IPA Indonesia*, *12*(2), 208-220. https://doi.org/10.15294/jpii.v12i2.42826
Yuliana, I., Cahyono, M. E., Widodo, W., & Irwanto, I. (2021). The effect of ethnoscience-themed picture books embedded within context-based learning on students' scientific literacy. *Eurasian Journal of Educational Research, 92,* 317-334. Retrieved from https://eric.ed.gov/?id=EJ1294081
Zupic, I., & Čater, T. (2015). Bibliometric methods in management and organization. *Organizational Research Methods*, *18*(3), 429–472. https://doi.org/10.1177/1094428114562629