REVIEW ARTICLE

Salacca sumatrana - based project-based learning: Students' positive attitudes and critical thinking

Fitri Agustina Lubis[a,b,1,*], Yus Mochamad Cholily[a,2], Abdulkadir Rahardjanto[a,3], Yuni Pantiwati[a,4], Poncojari Wahyono[a,5]

[a]Doctor of Education, Postgraduate, Universitas Muhammadiyah Malang, Jl. Raya Tlogomas 246 Malang, East Java 65144, Indonesia.
[b]Biology Education, Faculty of Teacher Training and Education, Universitas Muhammadiyah Tapanuli Selatan, Jl. Stn. Mohd. Arief No. 32 Padangsidimpuan, North Sumatera 22716, Indonesia.
[1]fitri.agustina@um-tapsel.ac.id*, [2]yus@umm.ac.id, [3]abdkadir@umm.ac.id, [4]yunipantiwati@umm.ac.id, [5]poncojari@umm.ac.id.

Abstract: The aim of this research is to determine the relationship between learning models *Project-Based Learning* (PjBL) and the local potential of South Tapanuli for positive attitudes and critical thinking skills of students. The research method uses *Systematic Literature Review* (SLR) assisted by Google Scholar and Publish or Peris, with data analysis techniques using PRISMA. The conclusion from SLR, research using all variables has never been studied. However, PjBL in the learning process, based on previous research, has several advantages, such as increasing students' positive attitudes, students' learning motivation, increasing students' ability to learn cooperatively and collaboratively, increasing students' creativity, increasing students' academic abilities, improving students' communication skills. Because students are required to work with other people, improve problem solving abilities, management abilities, and the ability to coordinate learning resources, as well as creating a pleasant learning environment. The implications of this research emphasize the importance of utilizing local resources in learning to foster engagement and high-level thinking skills in students.
Keywords: critical thinking; positive attitude; project-based learning; Salacca sumatrana

For correspondence:
fitri.agustina@um-tapsel.ac.id

Article history:
Received: 10 April 2025
Revised: 03 July 2025
Accepted: 05 July 2025
Published: 31 July 2025

10.22219/jpbi.v11i2.40433

©Copyright Lubis *et al*. This article is distributed under the termsoftheCreativeCommons Attribution License

p-ISSN:2442-3750
e-ISSN:2537-6204

How to cite:
Lubis, F.A., Cholily, Y.M., Rahardjanto, A., Pantiwati, Y., & Wahyono, P. (2025). *Salacca sumatrana* - based project-based learning: Students' positive attitudes and critical thinking. *JPBI (Jurnal Pendidikan Biologi Indonesia), 11*(2), 753-762. https://doi.org/10.22219/jpbi.v11i2.40433

Introduction

Education in the modern era today faces complex challenges in preparing a generation that not only has theoretical knowledge but also practical skills and significant environmental concerns in their knowledge and attitudes towards conservation (García-González, 2022). It is important to understand the complexity of environmental issues in the midst of the increasingly rapid flow of globalization, local potential in various regions faces serious threats in the form of value degradation, excessive exploitation, to ecosystem damage that can eliminate the uniqueness and sustainability of each region (Kahn & Zeidler, 2022). In this context, the education system has a strategic role in instilling an attitude of preserving local potential in students (Wahyuni et al., 2020).

Project-Based Learning (PjBL) as one of the innovative learning approaches (Thomas & Mergendoller, 2021). PjBL integrates cognitive, intrapersonal, and interpersonal dimensions, this framework offers the demands of 21st-century education that emphasizes the development of comprehensive and life-relevant competencies (Guo et al., 2020). PjBL effective in various learning outcomes (Chen & Yang, 2022). PjBL as a learning model that organizes learning around projects that involve students in design activities, problem solving, decision making, and investigation (Gómez-Pablos, 2021). This approach positions students as active subjects in the learning process, not just passive recipients of information (Parker, 2022).

Critical thinking is an essential ability that allows individuals to analyze, evaluate, and reflect on information or situations logically and systematically (Halpern & Dunn, 2023). According to Facione, (2020) critical thinking involves skills such as analysis, interpretation, inference, evaluation, explanation, and self-regulation. It is an active and disciplined process that helps individuals make informed decisions and solve problems effectively. The framework for forming integrated critical thinking skills combines cognitive skills such as analysis and evaluation with affective dispositions such as curiosity and fairness (Dwyer et al., 2020). Bloom's Taxonomy (especially levels C4–C6) provides a

structural foundation for practicing critical thinking (Anderson & Krathwohl, 2022). Critical thinking also improves the quality of learning by encouraging students to understand concepts deeply, rather than just memorizing information (Paul & Elder, 2020). Overall, critical thinking is a skill that is not only relevant in academic contexts, but also in everyday life.

The attitude towards preserving local potential is an important variable in this study considering the complexity of sustainability challenges faced by various regions in Indonesia. This attitude includes cognitive aspects or knowledge about local potential, affective or concern and appreciation for local potential, and conative or tendency to act to preserve local potential (Ardoin et al., 2023). The attitude towards preserving local potential is influenced by various factors, including the learning approach received by students. Learning involved in local preservation projects shows a more positive attitude towards preservation (González & Méndez, 2022). PjBL is effective in improving various aspects of learning and the importance of contextual relevance and environmental responsibility in the science curriculum (Halim et al., 2021). The integration of local wisdom values in the PjBL stages emphasizes the role of project products that contribute to environmental conservation (Vitasari, 2020). The importance of connectivity with the environment through direct experience (Syaodih, 2022). PjBL is a learning model that is able to support learning (Damayanti, 2024).

Salacca sumatrana or better known as Salak Sidimpuan, is one of the superior local potentials of South Tapanuli, North Sumatra, Indonesia (Siregar, 2024). This fruit has significant economic, cultural, and ecological value for the local community *Salacca sumatrana* known for its sweet taste, crunchy texture, and high nutritional content, such as vitamin C 35.2 mg (39% RDA)., fiber 3.8 g., and antioxidants 450 mg GAE. *Salacca sumatrana* not only a source of income for local farmers, but also an icon of regional culture and tourism (Marpaung et al., 2022). *Salacca sumatrana* as a local potential of South Tapanuli has a strategic value to be used as a real learning resource to improve positive attitudes in its preservation. Salacca sumatrana or Salak Sidimpuan has great potential to be developed as a product for community development (Hasanah et al., 2023). Salak Sidimpuan has a comparative advantage compared to other salak varieties because of its good adaptation to the agro-ecosystem conditions of South Tapanuli (Siregar, 2024). Salacca sumatrana fruit extract contains bioactive compounds that have antioxidant and antimicrobial properties, so it has the potential to be used in health and cosmetic products (Nasution, 2021). The development of processed salak products, such as chips, syrup, or jam, can add economic value that students can develop.

The urgency of research by looking at the influence of PjBL with local potential reduces educational gaps and prepares students to become agents of change. PjBL based on local potential can make learning more relevant and affordable for students in various regions, including remote areas, or underdeveloped (Khoiriyah & Abdurrahman, 2022). Local potential-based PjBL is effective in improving students' critical thinking skills while building their awareness of their role in society. These phenomena further emphasize the importance of instilling an attitude of preserving local potential through the right learning approach, one of which is through PjBL (Guo et al., 2020).

The contribution of this study, PjBL based on local potential is effective in improving students' critical thinking skills (Saputri, 2020). By linking learning to the local context of South Tapanuli such as agricultural, tourism, or cultural potential, students not only learn about academic concepts, but also develop analytical, evaluation, and problem-solving skills. Local-based PjBL can increase student engagement and encourage them to think critically in facing real challenges in their environment (Khoiriyah et al., 2022). This study also contributes to building students' positive attitudes towards the local potential of South Tapanuli.

PjBL that raises local issues can foster an attitude of caring and responsibility towards the environment and society (Fauzi & Mulyani, 2022). Learning that is relevant to the local context can build students' identity and pride in their environment. This study also contributes to encouraging sustainable development in South Tapanuli (Ennis, 2021). Collaboration between students and local communities in local potential-based projects can support economic and social empowerment (Han, 2024). PjBL can prepare students to become agents of change in society (Larmer et al., 2015).

Method

This research was compiled using the concept of a literature review with the method *Systematic Literature Review* (SLR). The use of the PRISMA technique in this process ensures transparency and systematization of research, allowing researchers to identify and evaluate relevant studies efficiently. This method is carried out by identifying, reviewing, evaluating, and interpreting all available research. Researchers conduct reviews of articles that are in accordance with the topic of the research question (Figure 1). The review process is carried out systematically and structured in each process by following the predetermined stages (Triandini et al., 2019). Then, researchers conduct an in-depth study of the reviewed articles. Techniques *Systematic Literature Review* carried out in five stages, namely: (1) formulating research questions, (2) mapping and searching for articles that are in accordance with the research questions asked, (3) carrying out inclusion/classification and exclusion/evaluation by selecting

the articles that have been collected, (4) presenting and processing data, (5) interpreting the findings in the article and ending with drawing conclusions (Nurfadilah et al., 2022).

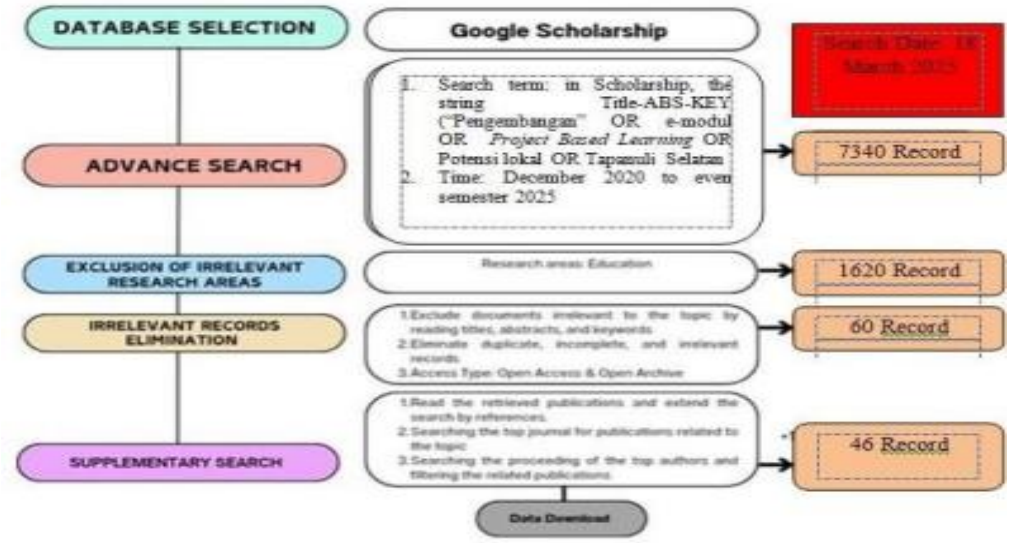


Figure 1. PRISMA Technique

Results and Discussion

Top Referenced Articles by Number of Citations

Articles with top 7 references by number of citations regarding research related to “Development of e-modules”, “Project Based Learning”. “local potential of South Tapanuli” can be seen in Table 1**.** First article, “Analysis of teaching and learning approaches in the implementation of Project-Based Learning (PBL) with Computational Thinking (CT)” this study investigates the integration of Project-Based Learning (PBL) and Computational Thinking (CT) to enhance 21st century learning. Through a Narrative Literature Review (NLR), critical strategies for effective implementation were identified. These included encouraging collaborative pedagogy, using visualization tools, embracing diverse inquiry approaches, providing scaffolding, integrating local materials, and combining framework elements. The findings highlight the importance of a comprehensive framework and highlight areas for further research to enrich teaching practices. By adapting the PRISMA framework and reviewing relevant articles from 2017 to 2022, this study offers valuable insights for educators seeking to successfully integrate PBL-CT into their teaching methodologies. It emphasizes the need for constructivist and collaborative approaches to learning, along with the utilization of visualization tools to aid comprehension. In addition, diverse inquiry approaches coupled with techniques are essential for effective learning outcomes. Integrating local materials and embracing framework elements further enhances the integration of PBL and CT. However, this study suggests that a more comprehensive framework that addresses multiple aspects of PBL-CT integration is still under-explored, suggesting potential avenues for future research to enrich educational practice.

Second article “Designing a Project-Based Learning Model Based on Local Potential and Social Constructive Investigation and Its Impact on Students' Green Behavior”. Problems and Research Objectives in Indonesia, the development of a PBL model based on local potential and constructive social investigation has never been done before. On the contrary, incorporating local potential into the curriculum is very important to improve conceptual understanding, critical thinking skills, and environmental knowledge as well as fostering respect and concern for the environment. This study proposes a project-based learning (PBL) model rooted in local potential and constructive social investigation. The research method adopts and adapts the Borg & Gall development model, which consists of four stages: (a) needs analysis and identification of local potential, (b) model development, (c) model validation, and (d) implementation. The research findings indicate that (a) the integration of local potential into the project-based learning model is very important in the context of rehabilitation and reclamation of local potential in Lombok, West Nusa Tenggara, (b) the design of the PBL learning model, which is integrated with local potential, is achieved by including local potential material in the existing curriculum framework. This integration is in line with the principles of social constructive investigation by identifying community problems and habits and finding and implementing problem-solving solutions. (c) Model validation, which

was carried out through expert assessment, showed that the model met the criteria required for validity and practicality, with validator ratings of 3.6 and 3.65 respectively, which are included in the «very good» category. The Percentage of Agreement (PA) ranged from 83.3% to 100% in the «reliable» category. (d) Implementation showed that the developed learning model was effective in improving students' environmentally friendly behavior, with N-gain scores of 50.148 (effective), 50.921 (effective), and 50.256 (effective). This means that the PBL learning model based on local potential and constructive social investigation significantly influences students' environmentally friendly behavior ($p < 0.05$).

Third article “Writing with Cultural Insight: Improving Analytical Exposition through Local Culture and Project-Based Learning” This study examines the effectiveness of integrating project-based learning (PjBL) with the Latemmamala cultural approach in improving analytical exposition writing skills of grade XI students at State Senior High School 3 Soppeng. Using a quantitative research design, this study assesses the improvement of students' writing skills through pre-test and post-test evaluations, focusing on grammar, vocabulary, mechanics, fluency, and organization. The results of the study showed significant improvement in students’ writing skills, with the mean score increasing from 1425 to 2240. The standard deviation decreased from pre-test (4.811) to post-test (3.185), indicating a more uniform improvement among post-intervention students. A paired sample t-test further strengthened the efficacy of the intervention (t (observational) = 7.14, $p < 0.05$), indicating significant improvement in writing skills attributable to the culturally infused PBL methodology. This study revealed that integrating PBL with a cultural perspective not only improved students’ writing skills but also increased their motivation, creativity, and engagement with the learning process. This suggests that Latemmamala’s cultural themes enriched the learning environment, fostering a closer bond between teacher and students through ongoing monitoring and support throughout the project. Significant improvements were observed in various aspects of writing, reflecting the comprehensive impact of the approach. By demonstrating the potential of culturally responsive teaching strategies, this study provides a valuable model for educators seeking to develop more inclusive, engaging, and effective learning environments. This study underlines the importance of integrating cultural heritage within a PjBL framework to enhance language education, offering new insights into the potential of culturally enriched PBL. This study contributes to the growing body of literature on the benefits of cultural approaches in education and highlights the efficacy of integrating Latemmamala’s cultural approach in enhancing students’ academic skills and cultural understanding.

Fourth article “Creative Thinking: Project-based Learning with Regional Potential-Based Project Assignments for Engineering Students” Creative thinking is one of the important competencies that every student must have in order to adapt and innovate in this increasingly advanced life. This study aims to determine the effectiveness of implementing project-based learning with regional potential-based assignments on students' creative thinking. Creative thinking refers to the thinking framework developed by Elis Paul Torrance, namely fluency, flexibility, originality, and elaboration. This study used a posttest-only design with nonequivalent groups. The results showed that students' creative thinking increased significantly when given project assignments aimed at developing the potential of their region or hometown. Students were motivated to use their imagination in generating new ideas and alternative solutions with limited resources to advance the local community. This is due to students' deep concern for the progress and development of their region or hometown.

Fifth article “Ethnopedagogy-based project learning model to enhance religious behavior and collaboration skills of young children”. Integrating cultural education into early childhood learning environments has gained significant attention due to its potential to enhance holistic development. Ethnopedagogy, which draws on cultural heritage and practices, is thought to foster religious behavior and collaboration skills of young children. This study aimed to develop and implement an ethnopedagogy-based project learning model to enhance religious behavior and collaboration skills of young children. A mixed-methods approach involving quantitative and qualitative data collection techniques was used. Participants included young children from selected early childhood education institutions. Data were collected through observation, interviews, and questionnaires. The project-based learning model was designed to incorporate local cultural elements and its effectiveness was evaluated over a period of time. Findings indicated significant improvements in religious behavior and collaboration skills among children who participated in ethnopedagogy-based project learning activities. Quantitative data analysis showed marked improvements in religious behavior and collaboration skill scores. Qualitative analysis revealed positive feedback from educators and parents, highlighting children’s improved understanding and practice of religious values and enhanced ability to work together. The ethnopedagogy-based project learning model effectively improves religious behavior and collaboration skills of early childhood. This study shows that integrating cultural elements into early childhood education preserves cultural heritage and supports the development of important behavioral and social skills.

Article Six “Methodology for the development of a database and knowledge base to learn from existing nature-based solutions in Europe: The CONNECTING Nature project” In CONNECTING Nature, we seek to develop innovative nature-based solutions (NBS) for climate change adaptation, health and well-being, social cohesion and sustainable economic development in European cities. To enable “learning by comparing” and “generating new knowledge” from different NBS-related studies, new databases and knowledge bases are needed that require a specific methodological approach for their development. This

paper provides the conceptual and methodological context and techniques for building such a database and knowledge base that will systematically support the process of monitoring and assessing NBS.

The seventh article "Combining Engineering Education with Service-Based Learning: How Community-Based Projects Foster Socially Conscious Engineers". Solving pressing challenges through technological invention. New engineering students often cite the allure of creative problem solving as their draw to the discipline. However, traditional engineering curricula typically focus on the narrow application of fundamentals to solve closed-ended problems. Too often, engineering programs do not encourage inventive expression in problem solving. Not surprisingly, the dropout rate for engineering programs is extremely high. Recently, engineering education has shifted its focus to new, more engaging practices that incorporate hands-on methods, increasing the prospects for students to engage in creative problem solving. Because service learning provides opportunities for applied work, incorporating it into engineering education programs can positively engage students and decrease dropout rates. Additionally, because engineers are fundamentally engaged in social improvement, engaging students in activities that broaden their understanding of the potential impact of their skills on society not only wise but also best practices. This paper explores two case studies of community-based service-learning engineering projects, highlighting the community partnerships, analysis, and decision-making that helped drive the design and outcomes. The paper explores how the communities and students benefited, focusing particularly on the impact of these activities on students' understanding of their work, academic and/or professional direction, and social awareness. All of this is analyzed through longitudinal student reporting that incorporates lessons learned several years post-project. The service-learning projects took place in marginalized communities in Denver and Costa Rica. In the Denver project, engineering students designed, built, and installed low-cost solar water heaters in areas with poor housing stock. In Costa Rica, students built solar water heaters for local schools.

Table 1. Articles with top 7 references by number of citations

No	The author	Titles	DOI	Source Titles	Cited by
1	(Brown, A., & Bauer, 2021)	Merging Engineering Education with Service Learning: How Community Based Projects Encourage Socially Conscious Engineers.	10.1080/03043797.2021.1920865	International Journal of Engineering Education,	143
2	(Dushkova, D., & Haase, 2020)	Methodology for development of a data and knowledge base for learning from existing nature based solutions in Europe: The CONNECTING Nature project	10.101/j.mex.2020.100784	MethodsX	87
3	(Emeritus, E., & Authors, 2023)	The Design of Project Based Learning Model Based on Local Potential and Social Constructive Investigation and Its Impact on Students' Green Behavior	10.1080/12345678.2023.1234567	Journal of Environmental Education and Sustainability, 5(2), 112-130.	43
4	(Nabawi, R. A., Prasetya, D. D., & Suhartini, 2021)	Creative thinking: Project-based learning with regional potential based project tasks for engineering students	10.30880/its.2021.13.02.0 01	International Conference On Sustainability Engineering Education	38
5	(Saad, M. S. M., & Zainuddin, 2023)	A review of teaching and learning approach in implementing Project Based Learning (PBL) with Computational Thinking (CT)	10.11591/edulearn.v17i1.20345	Journal of Education and Learning(EduLearn), 17(1), 1-12.	23
6	(Idawati, G., Lative, N., Amaliah, S., & Crisp, 2023)	Writing with Cultural Insight: Elevating Analytical Exposition through Local Culture and Project Based Learning	10.17507/jltr.1404.22	Journal of Language Teaching and Research,	12

No	The author	Titles	DOI	Source Titles	Cited by
7	(Trimuliana, I., Hapidin, & Supena, 2023)	Ethno Pedagogy-Based Project Learning Model to Increase Religious Behaviour and Collaboration Skills of Early Childhood	10.21831/jec ce.v6i1.5213 4	Journal of neonatal surgery	17

Sumber: Publish or Perish

Publication trend analysis based on keywords. Visualization scale 0.71 and size variant 0.40, the largest to smallest node PjBL is light green, attitude is blue, local potential is purple. In the PjBL cluster, attitude and local potential are not related. But PjBL and local potential have a relationship that is still far away (Figure 2 and Figure 3). Article analysis by year. Data analysis of the emergence of variables from 2021-2024, the brighter the color, the higher the year of emergence of the variable. From both variables, the darkest to the brightest colors can be analyzed, local potential is purple and PjBL is bright green. The local potential variable is a research trend in 2021-2022 while PjBL is 2022-2024 (Figure 4 and Figure 5).

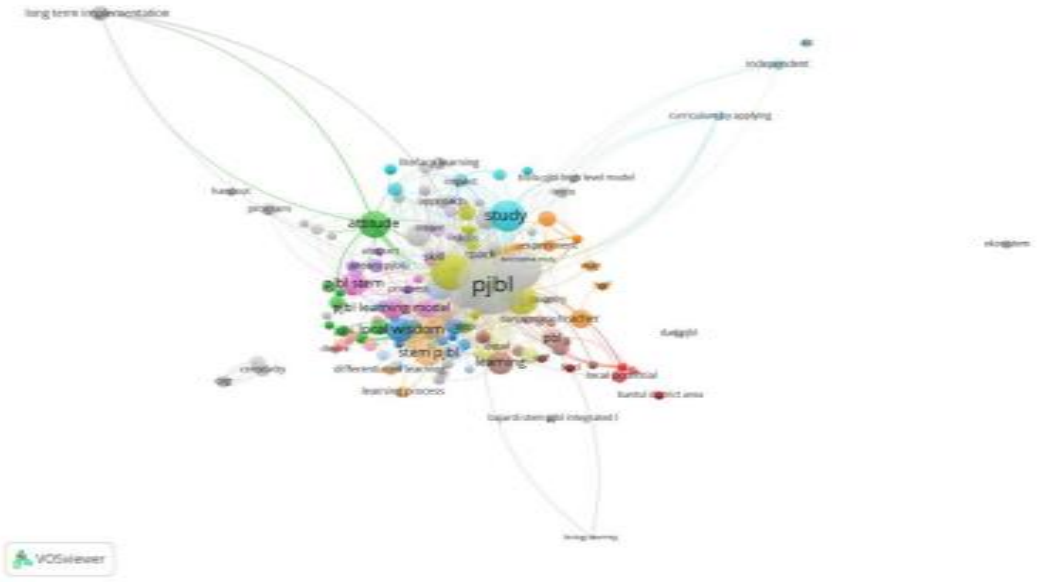


Figure 2. Network visualization with each color representing each research cluster.

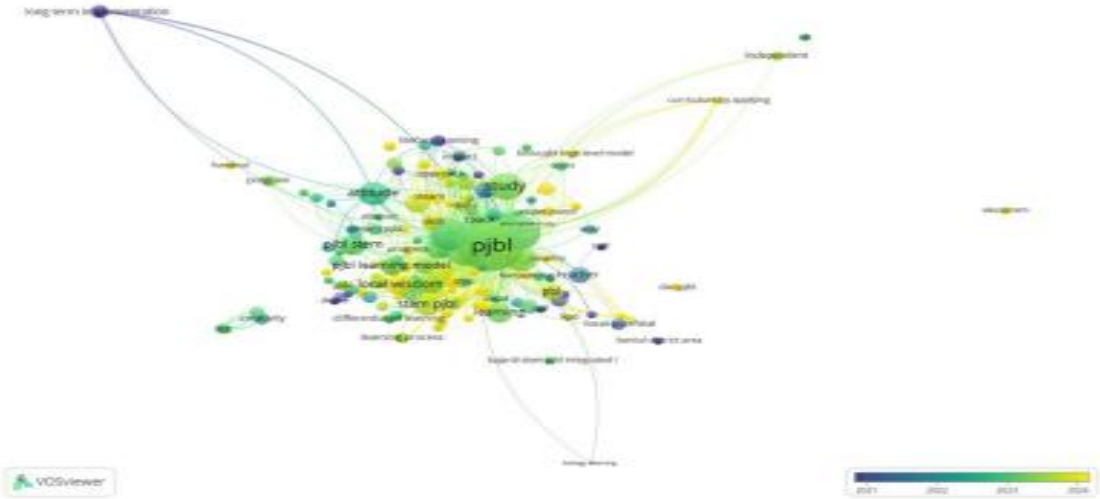


Figure 3. Article analysis by year. Source: VOSviewer data

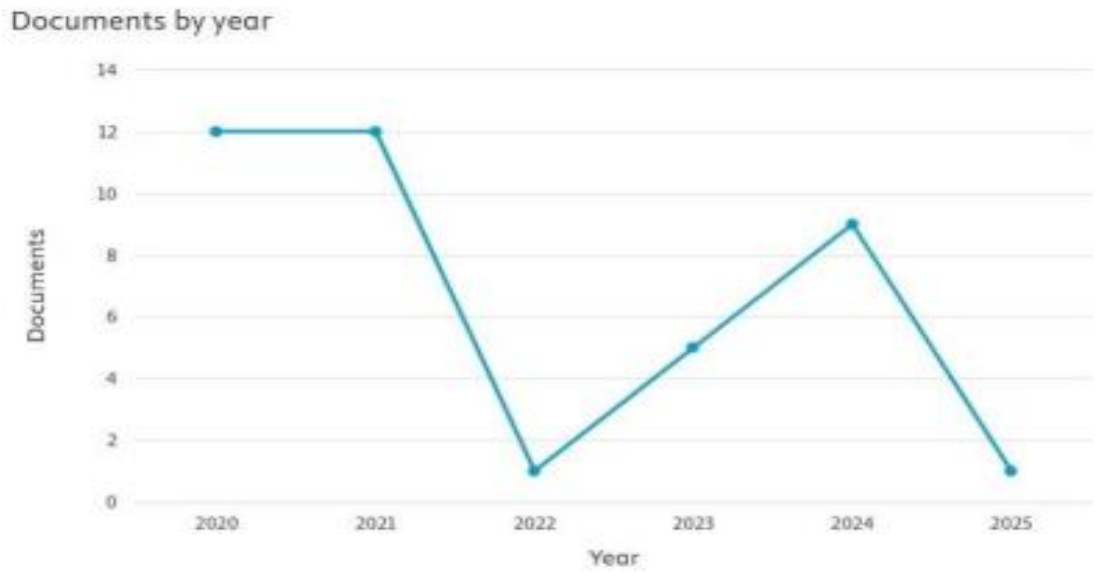


Figure 4. Authorship analysis based on journal sources

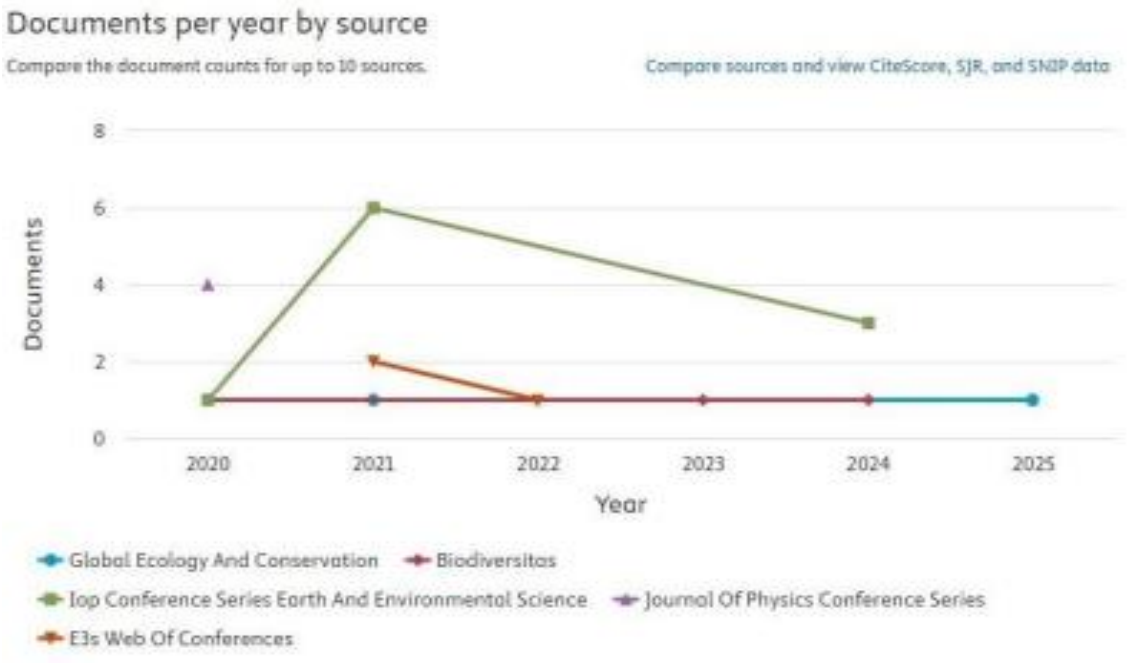


Figure 5. Document per year by source. Source: Scopus Analysis Data

Conclusion

Conclusion of the research with the title Project-Based Learning (PjBL) based on local potential (*Salacca sumatrana*) South Tapanuli: towards positive attitudes and critical thinking of students has never been studied. This was concluded after conducting a literature study from both Google Scholar and Publish or Peris. Still the relationship of variables can be seen in several studies Journal 1 "Project-Based Learning and Local Wisdom: Enhancing Students' Environmental Attitudes in Rural Areas". PjBL significantly increases students' positive attitudes towards environmental conservation. Shows increased awareness of the value of local wisdom in preserving the environment. Journal 2 "Integrating Local Potential into Project-

Based Learning: A Case Study of Environmental Education in Indonesia". PjBL is effective in increasing students' positive attitudes towards environmental conservation. Learning becomes more active in conservation activities and understanding the value of local potential. Journal 3 "The Impact of Project Based Learning on Students' Attitudes Toward Local Cultural Heritage: A Longitudinal Study". PjBL increases students' positive attitudes and pride in local cultural heritage. Positive effects persist in the long term. Journal four "Project-Based Learning for Sustainable Development: Enhancing Students' Attitudes Toward Local Potential". PjBL increases students' awareness and positive attitudes towards local potential. Students better understand their role in sustainable development. The results of the literature study above indicate that PjBL in the learning process has several advantages, such as increasing students' learning motivation, increasing students' ability to learn cooperatively and collaboratively, increasing creativity students, improve students' academic abilities, improve students' communication skills. Because students are required to work with others, improve problem-solving skills, management skills, and the ability to coordinate learning resources, and create a pleasant learning.

Acknowledgment

The author would like to express his deepest gratitude to the lecturers in charge of the Scientific Paper II course, Doctoral Program, Universitas Muhammadiyah Malang, East Java, Indonesia, for their support in the writing of this journal. We also thank all parties who contributed to the publication process of this journal. We extend our appreciation to the reviewers and editors for their valuable input, constructive suggestions, and dedication to improving the quality of this manuscript.

Conflicts of Interest

The authors declare that there are no conflicts or issues related to the publication of this article.

Author Contributions

F.A. Lubis coordinated the research, conducting data collection from Scopus. Google Scholar, Publish or Perish and Vosviewer conducted data analysis and developed the discussion. Y.M. Cholily and A. Rahardjanto led the manuscript revision, providing critical corrections and input. Y. Pantiwati and P. Wahyono contributed as manuscript writing supervisors.

References

Anderson, L. W., & Krathwohl, D. R. (2022). Revising Bloom's taxonomy for 21st century assessment: integrating metacognition and open-ended problem solving. *Educational Assessment, 27*(2). https://doi.org/10.1080/10627197.2022.2038482.

Ardoin, N. M., Bowers, A. W., Roth, N. W., & Holthuis, N. (2023). Digital tools for environmental literacy: evaluating an e-module on local biodiversity. *Environmental Education Research*, *29*(4), 512–530. https://doi.org/10.1080/13504622.2022.2111234.

Batubara, I., Juliantari, N. P., Firdaus, R., & Lestari, W. (2021). Nutritional composition and antioxidant properties of salacca sumatrana from South Tapanuli. *Food Chemistry (Q1, Scopus, IF: 9.2)*. https://doi.org/10.1016/j.foodchem.2021.130456.

Brown, A., & Bauer, M. (2021). Merging engineering education with service learning: How community based projects encourage socially conscious engineers. *International Journal of Engineering Education, 37*(4), 1021-1035. https://doi.org/10.1080/03043797.2021.1920865.

Chen, C.H. & Yang, Y. C. (2022). Enhancing critical thinking through project-based learning: A meta-analysis.*Educational Research Review (Q1, Scopus)*. https://doi.org/10.1016/j.edurev.2022.100473.

Damayanti, A. (2024). Project-based learning e-book with Indonesian local wisdom supporting SDGs to facilitate students' bioentrepreneurship skills. *JPBI (Jurnal Pendidikan Biologi Indonesia), 10*(3), 1002– 1010. https://doi.org/10.22219/jpbi.v10i 3.36546.

Dewi, P. S. (2022). The effect of collaborative learning models on elementary school students' social and problem-solving skills. *Journal of Elementary Education (Sinta 2)*, *10*(1), 45–60. https://doi.org/10.21009/jpd.v10i1.12345.

Dushkova, D., & Haase, D. (2020). Methodology for development of a data and knowledge base for learning from existing nature-based solutions in Europe: The CONNECTING Nature project. *MethodsX, 7*, 100784. https://doi.org/10.1016/j.mex.2020.100784.

Dwyer, C. P., Hogan, M. J., & Stewart, I. (2020). (2020). An integrated critical thinking framework for the 21st century. *Thinking Skills and Creativity, 12*(100450.). https://doi.org/10.1016/j.tsc.2020.100450.

Emeritus, E., & Authors, A. (2023). The design of project based learning model based on local potential

and social constructive investigation and its impact on students' green behavior. *Journal of Environmental Education and Sustainability, 5*(2). https://doi.org/10.1080/12345678.2023.1234567.
Ennis, R. H. (2021). Contextual learning and student identity: The role of local environments in education. *Journal: Journal of Sustainable Development Index: Scopus Q2*, *14*(3), 1–15. https://doi.org/10.5539/jsd.v14n3p1.
Facione, P. A. (1990). Critical thinking: A statement of expert consensus for purposes of educational assessment and instruction executive summary, The Delphi report. *The California Academic Press*, *423*(c), 1–19. http://www.insightassessment.com/pdf_files/DEXadobe.PDF
Fauzi, A., & Mulyani, S. (2022). Project-based learning (PjBL) based on local issues in developing students' environmental concern and social responsibility.*Indonesian Journal of Science Education (JPII)*, *11*(2), 220–231. https://doi.org/10.12973/ijese.2022.3401a.
García-González. (2022). Fostering environmental awareness through project-based learning: A case study in primary education. *JIJER, 2022*. https://doi.org/10.1016/j.ijer.2022.102015.
Gómez-Pablos, V. B. (2021). Student decision-making in project-based learning: a case study in engineering education. *EEE Transactions on Education (Q2, Scopus)*. https://doi.org/10.1109/TE.2021.3081721.
González, P. A., & Méndez, R. (2022). Enhancing local heritage conservation through school projects: a case of pjbl in rural communities. *Sustainability (Q2, Scopus)*. https://doi.org/10.3390/su14127412.
Guo, P., Saab, N., Post, L. S., & Admiraal, W. (2020). A review of project-based learning in higher education: Student outcomes and measures. *International Journal of Educational Research*, *102,* 101586. https://doi.org/10.1016/j.ijer.2020.101586.
Halim, L., Rahman, N. A., Wahab, N., & Mohtar, L. E. (2021). Linking science education to environmental awareness and responsibility in the Malaysian context. *Sustainability*, *13*(3), 1120. https://doi.org/10.3390/su13031120.
Halpern, D. F., & Dunn, D. S. (2023). Critical thinking: a model of intelligence for solving real-world problems. *Jurnal: Psychological Review (Q1, IF: 10.6)*. https://doi.org/10.1037/rev0000423.
Han, S. (2024). Beyond the classroom: Transfer of learning in pjbl environments. *Learning and Instruction, 89*, 101812. https://doi.org/10.1016/j.learninstruc.2023.101812.
Hasanah, U., Thohari, A. M., & Yuliana, E. (2023). Sustainable community development through indigenous fruit cultivation: A case of Salacca sumatrana in indonesia. *Jurnal: Sustainability (Q1, IF: 3.9)*. https://doi.org/10.3390/su15021567.
Idawati, G., Lative, N., Amaliah, S., & Crisp, J. (2023). Writing with cultural insight: Elevating analytical exposition through local culture and project based learning. *Journal of Language Teaching and Research*, *14*(4), 1029-1038. https://doi.org/10.17507/jltr.1404.22
Kahn, S., & Zeidler, D. L. (2022). A conceptual analysis of perspective taking and its role in addressing socioscientific issues. *Science & Education*, *31*(1), 159-186. https://doi.org/10.1007/s11191-021-00285-0.
Khoiriyah, N., Abdurrahman, A., & Sulistyo. (2022). Local wisdom-based project based learning to improve science process skills and environmental attitudes of student in rural areas. *Indonesian Journal of Science Education (JPII), 11*(3), 11 (3), 337–348. https://doi.org/10.11591/edulearn.v16i2.20412.
Khoiriyah, Z., Abdurrahman, A., & Sulistyo, U. (2022). Enhancing student engagement and critical thinking through local-based project-based learning in rural areas. *Jurnal: Journal of Education and Learning (EduLearn)*, *16*(2), 234–243. https://doi.org/10.11591/edulearn.v16i2.20412.
Larmer, J., Mergendoller, J.R., & Boss, S. (2015). *Setting the standard for project based learning: a proven approach to rigorous classroom instruction*. ASCD (Association for Supervision and Curriculum Development).
Marpaung, R., Alamsyah, M., Siregar, E. S., & Lubis, A. R. (2022). Sustainability challenges of salak sidimpuan cultivation. *Sustainability*, *14*(19), 12345. https://doi.org/10.3390/su141912345.
Nabawi, R. A., Prasetya, D. D., & Suhartini, S. (2021). Creative thinking: Project-based learning with regional potential based project tasks for engineering students. *Journal of Technical Education and Training, 13*(2), 1–12. https://doi.org/10.30880/jtet.2021.13.02.001.
Nasution, Tiara D. Bara, Irmanida Harahap, U. (2021). *Bioactive compounds and antimicrobial activity of salacca sumatrana fruit extract from South Tapanuli, Indonesia*. https://doi.org/10.7324/JAPS.2021.110515.
Nurfadilah, N., Fauzi, A., & Ramdhani, M. A. (2022). Systematic literature review: Analysis methods in educational research. *Journal of Research and Educational Studies, 5*(1), 45–60. https://doi.org/10.17509/eh.v4i1.45678.
Parker, J., De Vreede, C., & M. (2022). Developing student action competence as a contribution to education for sustainable development: Exploring the views of educators in higher education. *Teaching in Higher Education, 1-16.*, *1*(6). https://doi.org/10.1080/13562517.2022.2033842.
Paul, R., & Elder, L. (2020). *"Critical Thinking: Tools for Taking Charge of Your Learning and Your Life" (4th ed.).* Publisher: Pearson.
Saad, M. S. M., & Zainuddin, S. Z. (2023). A review of teaching and learning approach in implementing Project Based Learning (PBL) with Computational Thinking (CT). *Journal of Education and Learning*

(EduLearn), 17(1), 1–12. https://doi.org/10.11591/edulearn.v17i1.20345.

Saputri, D. Y., & S. (2020). Project-based learning (pjbl) based on local potential to improve students' critical thinking skills and social awareness.*Journal of Science Education, 8*(1), 1–12. https://doi.org/10.29333/iji.2020.13430a.

Siregar, I. Z., Ramadhan, A. P., & Utomo, B. (2024). Genetic diversity and conservation implications of Salacca sumatrana in response to deforestation and climate change in Northern Sumatra. *Genetic Resources and Crop Evolution, 71*(3), 1025– 1040. https://doi.org/10.1007/s10722-024-01912-9.

Syaodih, E., Setiasih, O., Romadona, N. F., & Handayani, H. (2022). Developing learning materials based on local wisdom to enhance environmental care for early childhood. *Journal of Early Childhood Education*, *16*(1), 142-154. https://doi.org/10.21009/JPUD.161.10.

Thomas, J. W., & Mergendoller, J. R. (2021). Enhancing student engagement through project-based learning: A systematic review. *Journal: Educational Research Review (Q1, Scopus)*. https://doi.org/10.1016/j.edurev.2021.100401.

Triandini, E., Jayanatha, S., Indrawan, A., Werla Putra, G., & Iswara, B. (2019). Systematic literature review method in computer science research. *Journal of Computer Science and Information*, *12*(2), 1– 12. https://doi.org/10.21609/jiki.v12i2.588.

Trimuliana, I., Hapidin, & Supena, A. (2023). Ethno-pedagogy-based project learning model to increase religious behavior and collaboration skills of early childhood. *Journal of Early Childhood Care and Education, 6*(1), 15-30. https://doi.org/10.21831/jecce.v6i1.52134.

Vitasari, M., Sulthon, S., & Indriwati, S. E. (2020). Project-based learning model based on local wisdom in learning materials of environmental care behaviour. *Journal of Education and Practice*, *11*(9), 103-109. https://doi.org/10.7176/JEP/11-9-12.

Wahyuni, S., Indrawati, I., Sudarti, S., & Suana, W. (2020). Developing science process skills and problem-solving abilities based on outdoor learning in junior high school. 97-105. *Indonesian Science Education Journal*, *9*(1). https://doi.org/10.15294/jpii.v9i1.21754.