

Discovery Learning Based on Local Potential Ternate Island: Strategies for Enhancing 21st Century Skills and Scientific Process of Multiethnic Students

Ade Haerullah¹⁾, Jailan Sahil²⁾, Said Hasan³⁾, Arini Z. N.⁴⁾, Iswadi M. Ahmad⁵⁾,
Jassia I. Pagala⁶⁾

^{1,2,3,4)}Departement of Biologi Education, Universitas Khairun

⁵⁾Universitas Nahdatul Ulama Maluku Utara (UNUTARA)

⁶⁾MTs Sahabat Cendikia Kota Ternate

Email: ade.haerullah@unkhair.ac.id

Abstrak

Penelitian ini bertujuan untuk menguji efektivitas model *Discovery Learning* berbasis potensi lokal Pulau Ternate dalam meningkatkan keterampilan abad ke-21 dan pemahaman proses sains siswa kelas VII di Madrasah Tsanawiyah (MTs) Sahabat Cendikia Kota Ternate yang memiliki latar belakang budaya beragam. Metode penelitian ini menggunakan kuasi-eksperimen dengan desain *pretest-posttest control group*, penelitian ini melibatkan 40 siswa dari kelas VII^A dan VII^B sebagai sampel. Instrumen yang digunakan adalah tes keterampilan abad ke-21 dan tes pemahaman proses sains siswa multietnis. Analisis statistik inferensial menunjukkan pengaruh signifikan ($p < 0,05$) dari implementasi *Discovery Learning* berbasis potensi lokal terhadap peningkatan keterampilan abad 21 siswa multietnis sebesar ($p = 0,013$) dan pemahaman proses sains siswa multietnis sebesar ($p = 0,000$). Hal ini dapat diartikan bahwa penggunaan *Discovery Learning* berbasis potensi lokal efektif dalam mengembangkan kedua aspek tersebut. Selain itu, hasil penelitian ini mengungkap bagaimana siswa multietnis dengan gaya belajar yang berbeda dapat mencapai tujuan pembelajaran yang sama dan saling menghargai keberagaman di saat dan setelah menggunakan *Discovery Learning* berbasis potensi lokal pulau Ternate.

Kata Kunci: *discovery learning*, keterampilan abad 21, potensi lokal Ternate, proses sains, siswa multietnis

Abstract

This research aims to test the effectiveness of the local potential-based *Discovery Learning* model on improving 21st-century skills and students' understanding of the science process in seventh-grade students at Madrasah Tsanawiyah (MTs) Sahabat Cendikia Kota Ternate, who come from diverse cultural backgrounds. The research method uses a quasi-experimental design with a pretest-posttest control group, involving 40 students from classes VIIA and VIIB as samples. The instruments used were 21st-century skills tests and tests of the science process understanding of multiracial students. Inferential statistical analysis shows a significant effect ($p < 0.05$) of the implementation of local potential-based *Discovery Learning* on improving the 21st-century skills of multiracial students ($p = 0.013$) and the understanding of the science process of multiracial students ($p = 0.000$). This can be interpreted that the use of *Discovery Learning* based on local potential is effective in developing both aspects. Additionally, the results of this study reveal how multi-ethnic students with different learning styles can achieve the same learning goals and appreciate diversity during and after using *Discovery Learning* based on the local potential of Ternate Island.

Keywords: discovery learning, local potential of ternate, 21st century skills, science process, multicultural students

INTRODUCTION

The era of globalization demands individuals to possess a set of essential skills to adapt and contribute effectively to a complex and dynamic society. 21st-century skills, which include critical thinking, creativity, collaboration, and communication, are becoming an

important foundation for individual success in various aspects of life (Partnership for 21st Century Skills, 2007). Furthermore, a deep understanding of the processes of science is becoming increasingly important in facing future scientific and technological challenges (National Research Council, 2012).

Currently, the government is striving to integrate 21st-century skills and enhance understanding of the science process in education, which continues to be a primary focus. The 2013 curriculum, for example, emphasizes a student-centered and contextual learning approach. However, the implementation of this approach in various regions in Indonesia faces diverse challenges, including the diversity of students' backgrounds in multi-ethnic classes.

Ternate Island, as one of the regions with abundant natural resources and culture in North Maluku Province, holds great potential to be integrated into the learning process. The local potential of Ternate, ranging from biodiversity (spices, marine ecosystems), historical heritage (Islamic kingdoms), to local wisdom (traditions, folklore), can serve as a relevant and engaging context for students in understanding science concepts and developing 21st-century skills.

Discovery Learning as a constructivist learning approach provides opportunities for students to actively explore, discover, and build their own understanding through direct experiences (Bruner, 1961). When Discovery Learning is integrated with the local potential of Ternate Island, students not only learn science concepts abstractly but also connect them with their own environment and culture. This is expected to increase student engagement, motivate them to learn more deeply, and ultimately strengthen their understanding of the science process.

Furthermore, schools in Indonesia, including those in Ternate, often consist of students with diverse ethnic, cultural, and linguistic backgrounds (multicultural schools). In this context, learning approaches and strategies that accommodate diversity and encourage collaboration among students become very important. Discovery Learning designed by utilizing local potential can serve as a platform for students to share knowledge and different perspectives based on their cultural experiences, thereby enriching the learning process and developing collaboration and communication skills.

Learning with the use of the appropriate model, especially the Discovery Learning model based on local wisdom, is closely related to biology education, which is a subject that is closely connected to the environment (Latri et al., 2022; Parmin & Fibriana, 2019; Suhartini et al., 2019). Next explained by Hadi & Dazrullisa (2018) that if the teaching materials are good, they should be developed and designed according to the characteristics and needs of the students by considering geographical factors, ethnography, and the richness of the region. Fuad et al. (2020) & Dewinta et al. (2021) It explains that teaching materials are considered ideal if they meet several criteria, one of which includes content of local wisdom that aims to engage students with biological material objects through activities and experiments.

The utilization of local natural resource potential in the learning process can improve student learning outcomes in various forms such as 21st-century skills, metacognitive skills, scientific process skills, and critical thinking among multiethnic students (Boleng et al., 2017; Haerullah et al., 2019, 2025; Nofiana & Julianto, 2018). It is further explained in the research results (Haerullah et al., 2023, 2024; Lase et al., 2016; Novick & Catley, 2016; Prabowo et al., 2016; Sahil et al., 2023) that learning becomes interesting and enjoyable when designing teaching materials by utilizing the potential of local natural resources, thereby improving learning outcomes and mastery of biological concepts among students.

As explained in the previous paragraph, the rapid development of technology in this era of globalization demands that students possess 21st-century skills. In addition, mastery of the

science process is an important foundation for understanding natural phenomena and developing inquiry abilities. Currently, various approaches, strategies, models, and innovative learning methods have been implemented by teachers to achieve these goals, one of which is discovery learning, which emphasizes students' direct experiences in discovering scientific concepts and principles. The local potential of a region, including natural resources and culture, can serve as a contextual and engaging source of learning for students.

The uniqueness of Ternate Island lies in its interesting geographical combination, significant spice heritage, and the cultural diversity of its multiethnic society. This wealth presents an extraordinary potential for local learning resources that are highly relevant to the educational world. The distinctive natural environment, proud historical traces, and diverse social and cultural interactions can provide an authentic and meaningful learning context for students. However, research that specifically integrates the discovery learning model with the utilization of Ternate Island's local potential to simultaneously enhance 21st-century skills and the scientific process for students from multiethnic backgrounds is still limited. Meanwhile, learning that is based on local contexts is believed to have the potential to increase student engagement, deeper understanding, and appreciation for their own environment and culture. Therefore, this research aims to develop and test the effectiveness of a discovery learning model based on the local potential of Ternate Island in improving 21st-century skills and the scientific process of students from various ethnic backgrounds.

METHODS

This research uses a quantitative approach with a type of quasi-experimental research. The research design is based on practical and ethical considerations, where the allocation of research subjects is not randomly assigned to either the experimental or control groups. Therefore, the design used is the pre-test control group design. In this design, two naturally existing groups (not the result of randomization) will have their initial conditions of the dependent variable measured through a pre-test. After the initial measurement, the experimental group will receive the treatment or intervention that is the focus of the research, which is the use of the Discovery Learning model based on the local potential of Ternate Island in enhancing 21st-century skills and understanding of the science process among multi-ethnic students. Meanwhile, the control group will not receive that treatment. Meanwhile, the control group will not receive the treatment. After the intervention, a post-test will be administered to both groups to measure changes in the dependent variables, namely 21st-century skills and multiethnic students' understanding of the science process. The comparison of score changes between the pre-test and post-test in the experimental group and the control group will be analyzed to determine the effectiveness of the treatment on the researched variables. The research design can be described as follows:

Table 1. Research Design

| | | |
|----------|-------|----------|
| O_1O_3 | X_1 | O_2O_4 |
| O_1O_3 | X_2 | O_2O_4 |

(Sumber: Sugiyono, 2019)

This research was conducted at SMP Negeri 2 Ternate, located on Sultan Babullah Airport Road, North Ternate. The research was carried out on seventh-grade students at SMP Negeri 2 Ternate. The variables in this study include the independent variable, which is the Guided Discovery Learning model assisted by video learning based on the potential of local natural resources in the city of Ternate (x), and the dependent variables are science process skills (Y_1) and cognitive learning outcomes (Y_2).

A sample of 76 students consisting of 38 students from Class VII A (control group) and 38 students from Class VII B (experimental group) from the total number of Class VII students at SMP Negeri 2 Kota Ternate. The instruments used in this study are: (1) an observation sheet for the implementation of learning and a questionnaire to measure science process skills. (2) Essay questions for the pretest and post-test to measure students' learning outcomes. Hypothesis testing was conducted using ANCOVA (analysis of covariance) based on the results of the ANCOVA statistical analysis.

RESULTS AND DISCUSSION

1. The Influence of Discovery Learning Model Based on the Potential of Local Natural Resources of Ternate Island on 21st Century Skills of Multicultural Students

The hypothesis test used to assess the influence of learning outcomes on the Discovery Learning model assisted by video learning based on the potential of local natural resources in the city of Ternate and the Discovery Learning model is tests of ANOVA (analysis of covariance). The results of the data analysis indicate a significant value obtained using the Discovery Learning model assisted by video learning and the Discovery Learning model of 0.000. The value obtained from the pretest and post-test data shows that the significant values of the pretest and post-test are smaller than the value of α (0.05), hence H_0 is rejected. The rejection of H_0 means that the hypothesis H_1 , which states that there is an influence on the student learning outcomes in the Discovery Learning model assisted by video learning based on the potential of local natural resources in the city of Ternate and the Discovery Learning model, is accepted. This indicates that both learning models used have different effects on student learning outcomes. The summary of the Anacova tests (analysis of covariance) can be seen in the table below.

Table 2. Analysis of the anacova test of the discovery learning model based on the potential of local natural resources of Ternate Island on 21st-century skills

| Tests of Between-Subjects Effects | | | | | |
|--|------------------------|----|-------------|---------|------|
| Dependent Variable:Postes 21st Century Description of Multicultural Students | | | | | |
| Source | Type II Sum of Squares | Df | Mean Square | F | Sig. |
| Corrected Model | 363.082 ^a | 2 | 181.541 | 3.795 | .027 |
| Intercept | 10997.786 | 1 | 10997.786 | 229.914 | .000 |
| Pretes_Ket. Abad 21 | 38.753 | 1 | 38.753 | .810 | .371 |
| Model_Pembelajaran | 313.347 | 1 | 313.347 | 6.551 | .013 |
| Error | 3491.905 | 73 | 47.834 | | |
| Total | 460175.000 | 76 | | | |
| Corrected Total | 3854.987 | 75 | | | |

a. R Squared = ,094 (Adjusted R Squared = ,069)

Based on Table 2 above, it can be seen that the significance value of the influence of Discovery Learning based on the potential of local natural resources of Ternate Island on the 21st-century skills of multiethnic students is 0.013 with a significance value of < 0.05 , thus H_0 is rejected and the alternative hypothesis is accepted. The results of this hypothesis testing indicate that the use of the Discovery Learning model based on the potential of local natural resources of Ternate Island has an influence on the 21st-century skills of students and is effective when applied in learning in culturally diverse or multiethnic classrooms.

The results of this study significantly show the positive influence of the Discovery Learning model based on the potential of local natural resources of Ternate Island on the 21st-century skills of multi-ethnic students. This finding is in line with the results of the research Haerullah et al. (2025) which states that learning about genetic diversity through the exploration of local potential in the Maluku Islands can enhance the 21st-century skills of multi-ethnic students with different learning styles. Moreover, the results of this research align with the principles of constructivism (Bruner, 1961) underlying the Discovery Learning model, where students actively build knowledge and skills through exploration and discovery. The integration of the potential of local natural resources in the city of Ternate in the learning process provides a real and relevant context for students from various cultural or ethnic backgrounds, thus enhancing their engagement and motivation in their learning.

The increase in 21st-century skills of students due to the Discovery Learning model encourages students to think critically in analyzing information they obtain from exploring local natural resources. They are faced with authentic problems that require creative problem-solving, such as identifying the benefits of certain spice plants or understanding the impact of human activities on the marine ecosystem around Ternate Island. This aligns with their views Paul & Elder (2007) that critical thinking involves the ability to analyze, evaluate, and synthesize information reflectively. This model is also designed in groups which inherently trains students' collaboration skills. Students must share ideas, discuss, and work together to achieve learning goals, for example, they collectively design a simple project related to the sustainable use of local natural resources. According to Vygotsky (1978) In the theory of Social Constructivism, social interaction plays an important role in cognitive development and learning. Through collaboration, students learn to appreciate different perspectives, build a shared understanding, and develop 21st-century skills.

In the framework of 21st-century skills, it also highlights the importance of effective communication, both verbal and written, as an essential competency Trilling & Fadel (2009) In the framework of 21st-century skills, it also highlights the importance of effective communication, both verbal and written, as an essential competency. In addition, the Discovery Learning model implicitly encourages students' creativity. When they are given the freedom to explore and find solutions on their own, they are encouraged to think and generate innovative ideas related to the utilization or conservation of local natural resources Robinson (2011) argue that 21st-century education must prioritize the development of student creativity because it is the key to innovation and adaptation in the future.

The findings in this study also indicate that utilizing the potential of local natural resources of Ternate Island as a focus for learning can serve as a bridge between the experiences and knowledge brought by students from various cultural or ethnic backgrounds. For example, students from fishing family backgrounds may have a different understanding of marine resources compared to students from spice plantation areas. Through the Discovery Learning process, they can share experiences and learn from each other, enriching their collective understanding of local potential. The results of this study also reveal that students from different cultural and ethnic backgrounds have different learning styles and can achieve the same learning goals while appreciating differences. This indicates that the local potential-based Discovery Learning model is capable of accommodating the diversity of students in the classroom.

The use of local natural resources to improve students' 21st-century skills is also in line with the statement Haerullah et al. (2023) that the study of local wisdom of North Maluku should have been included in the education curriculum taught in schools in the city of Ternate. In addition Haerullah et al. (2023) It also reveals that 96% of high school students stated that they really need interactive modules based on local wisdom of Ternate, North Maluku, because it supports biology learning. This statement is supported by research

findings Karyadi (2016) that developing science learning resources by integrating local potential can be an option for educators to enhance students' love and concern for their surrounding environment. Furthermore Muktadir & Agustrianto (2014) conduct research and study the local wisdom of Bengkulu related to teaching materials based on local wisdom to enhance the character of elementary school students Lazuardi & Nugroho (2019) also conducted similar research on developing drama appreciation modules based on local wisdom. It is further explained by Nata (2021), In the research, a science module based on local wisdom of Ulu Musi in South Sumatra has been developed for junior high school.

The emergence of students' curiosity can be seen from their responses to the given problems, where students ask the teacher to clarify the issues to be solved. The curiosity that develops in the orientation stage of the students towards the problem can also be observed in the hypothesis formulation stage, where during this activity, students actively gather information by asking their groupmates, questioning the teacher, and reading books to formulate hypotheses from the problem. According to Rizkiani (2017), if students' souls are filled with a curiosity about something, they will be motivated to voluntarily and enthusiastically learn new things.

The results of this study are also supported by the opinion of Hosnan (2014) who stated that the Discovery Learning model has several advantages, namely: (1) It helps students improve and enhance their cognitive skills and processes; (2) The knowledge gained through this model is very personal and powerful because it reinforces understanding, memory, and transfer; (3) It can enhance students' problem-solving abilities; (4) It helps students strengthen their self-concept, as they gain confidence in collaborating with others; (5) It encourages student involvement and engagement; (6) It encourages students to think intuitively and formulate their own hypotheses; (7) It trains students to learn independently. Although Discovery Learning has advantages, it also has weaknesses. Among them is that the learning process can take a lot of time because teachers are required to change their teaching habits from generally being information providers to facilitators, motivators, and guides.

2. The Influence of the Guided Discovery Learning Model Based on the Potential of Local Natural Resources of Ternate Island on the Science Process Skills of Multicultural Students

The results of the data analysis show that the significance value obtained by students in the class using the Discovery Learning model based on the potential of local natural resources of Ternate Island and the Discovery Learning model is 0.000. This indicates that both learning models used have different effects on the students' science process skills. A summary of the results of the Independent Samples Test can be seen in the following table.

Table 3. Analysis of t-test (independent samples test) for the discovery learning model assisted by learning videos on science process skills.

| Independent Samples Test | | | | | | |
|---|------|------------------------------|--------|-----------------|-----------------|-----------------------|
| Levene's Test for Equality of Variances | | t-test for Equality of Means | | | | |
| F | Sig. | t | df | Sig. (2-tailed) | Mean Difference | Std. Error Difference |
| 2.277 | .136 | 12.939 | 74 | .000 | 10.684 | .826 |
| | | 12.939 | 70.670 | .000 | 10.684 | .826 |

The results in Table 3 show that there is an influence of the Discovery Learning model based on the potential of local natural resources on the science process skills of students at

SMP Negeri 2 Kota Ternate. This is indicated by the significance value of < 0.05 , so H_0 is rejected, and H_1 is accepted. Therefore, it can be concluded that there is an influence of the Discovery Learning model on the science process skills of students at SMP Negeri 2 Kota Ternate.

The results of this study significantly show a positive influence of the Discovery Learning model based on the potential of local natural resources of Ternate Island on the science process skills of multi-ethnic students. This means that the implementation of a learning model that integrates active learning experiences through discovery (Discovery Learning) with a familiar and relevant local context can enhance the abilities of multi-ethnic students in observing, formulating hypotheses, planning and conducting experiments, analyzing data, and communicating scientific results. These results are in line with Bruner (1961) constructivist theory that underlies Discovery Learning, which states that knowledge is actively constructed by students through interaction with their environment. The context of the local potential of Ternate Island provides a concrete foundation for students from various cultural and ethnic backgrounds to connect abstract concepts with their real-life experiences, thereby facilitating a deeper understanding and better information retention. Furthermore, this finding also supports the idea of the importance of context-based learning, which emphasizes the relevance of subject matter to students' lives and environments, proven to enhance engagement and learning outcomes (Hmelo-Silver et al., 2007).

The integration of the potential of local natural resources on Ternate Island in the Discovery Learning model also provides an opportunity for students from various cultural backgrounds to share their knowledge and experiences related to these resources. For instance, students from fishing families have a deep understanding of marine ecosystems and coastal biodiversity, while students from spice plantation areas possess knowledge about the types of plants and their growth processes. Through group activities in Discovery Learning, students can exchange this information and perspectives, which not only enriches their understanding of science concepts but also develops their collaboration and communication skills across cultures or ethnicities. This type of learning process allows students to learn not only from teachers and textbooks, but also from their peers with different learning styles and backgrounds, thus creating an inclusive learning environment that respects these differences.

Phenomena in the study of Natural and Social Sciences (IPAS) require in-depth analysis and evaluation (Bariyah, L, & Sugandi, 2022) (Rina R, 2022) (Tyas et al., 2020) (Yuniasih et al., 2022). In this context, teachers play an important role in implementing effective science and technology learning models to stimulate the development of students' scientific process skills. A well-designed learning model will facilitate holistic student-centered learning, encompassing cognitive, psychomotor, and affective aspects, thus actively honing thinking skills, including scientific processes. Several learning models that have proven to be effective in enhancing scientific process skills include Problem-Based Learning, Project-Based Learning, guided inquiry, Discovery Learning, and Direct Instruction. These models generally encourage students to collaborate in experimental groups, mimicking researchers' activities to build understanding and practice science process skills. However, the implementation of Discovery Learning models often encounters obstacles, especially during the problem formulation and hypothesis stages when identifying issues. A lack of student understanding of teacher demonstrations and minimal practical activities or experiments to reinforce concepts are inhibiting factors. Nonetheless, science process skills can be optimized through learning that is relevant to students' daily experiences, one of which involves utilizing the potential resources in their living environment (Siahaan et al., 2020; Triyanti & Nulhakim, 2022; Tyas et al., 2020; Wa Ode A. Y. R, 2024) Direct experiences accompanied by concrete examples in science process learning have proven capable of motivating students to demonstrate their curiosity.

The results of the research through the Discovery Learning model based on the potential of local natural resources in the city of Ternate show that students can actively express their opinions and think critically to find a conclusion or answer, leading to an improvement in understanding, rather than just memorizing concepts. A fun learning process also increases students' motivation to engage in learning (Putranto et al., 2013). According to Tawil & Liliasari, (2014), process skills can be defined as insights or guidelines for developing intellectual, social, and physical skills that stem from fundamental abilities that essentially exist within the students themselves. This aligns with the opinion of Ambarsari & Santosa (2013) stating that the empowerment of science process skills needs to be emphasized in the biology learning process. This is because once students have mastered the indicators of these science process skills, they will find it easier to learn biology by constructing their own knowledge and experiences, which are gained from teachers or others.

According to Ramli (2012) it is necessary to incorporate examples of local wisdom in biology learning so that the learning becomes meaningful and very close to students' daily lives. It is further explained by Parmin & Fibriana (2019) that an essential and very important part of reinforcing the biological content being studied is if the material is integrated with local wisdom.

The skills of the science process are a set of directed scientific skills that can be used to discover a concept, principle, or theory to develop existing concepts, or to challenge a discovery (Trianto, 2009). Moreover, scientific process skills have the advantage of making students active, creative, and skilled in thinking and gaining knowledge (Avianti & Yonata, 2015).

According to Ratnasari et al. (2016), classification is a skill based on observation skills, thus classifying skills are considered good because they are based on observation skills which are the final stage of inquiry stages. In the guided inquiry stage, the skill of drawing conclusions is developed through practical work and discussions. Through practical work, after analyzing data from observations, students draw conclusions by relating them to the hypothesis. This is in line with the research conducted by Asni & Dian (2015) which found that the implementation of the Guided Discovery Learning model can enhance students' science process skills, including the skill of drawing conclusions.

CONCLUSIONS

Based on the analysis of data from research on the influence of the Guided Discovery Learning model assisted by learning videos based on the potential of local natural resources in the city of Ternate on the science process skills and learning outcomes of seventh-grade students at MTs Sahabat Cendikia in Ternate, the following conclusions can be drawn: (1) There is an influence of the Discovery Learning model assisted by learning videos based on the potential of local natural resources in Ternate on the 21st-century science process skills of multi-ethnic students in seventh grade at MTs Sahabat Cendikia in Ternate, (2) the Discovery Learning model based on the potential of local natural resources in Ternate provides opportunities for students from various cultural and ethnic backgrounds to share their knowledge and experiences, (3) the Discovery Learning model based on the potential of local natural resources in Ternate gives opportunities for students with different learning styles to achieve the same learning objectives and appreciate differences.

REFERENCES

- Ambarsari, W., & Santosa, S. (2013). Penerapan Pembelajaran Inkuiri Terbimbing Terhadap Keterampilan Proses Sains Dasar pada Pelajaran Biologi Siswa Kelas VIII SMP Negeri 7 Surakarta. *Jurnal Pendidikan Biologi*, 5, 81–95. [https://doi.org/10.1016/s0065-2296\(08\)00803-3](https://doi.org/10.1016/s0065-2296(08)00803-3)
- Asni, & Dian, N. (2015). Penerapan Model Pembelajaran Inkuiri Terbimbing untuk Meningkatkan Keterampilan Proses Siswa pada Materi Laju Reaksi. *UNESA Journal of Chemical Education*, 4(1), 11–17.
- Avianti, R., & Yonata, B. (2015). Keterampilan Proses Sains Siswa Melalui Penerapan Model Pembelajaran Kooperatif Materi Asam Basa Kelas Xi Sman 8 Surabaya Science Process Skill Student Through Implementation of Cooperative Learning Model on Acid Base Material Class Xi in Sman 8 Surabaya. *UNESA Journal of Chemical Education*, 4(2), 224–231.
- Bariyah, L., & Sugandi, K. (2022). Project Based Learning untuk Meningkatkan Keterampilan Proses Sains Siswa pada Konsep Ekosistem. *Seminar Nasional Pendidikan*, 135–144.
- Boleng, D. T., Lumowa, S. V. T., Palenewen, E., & Corebima, A. D. (2017). The Effect of Learning Models on Biology Critical Thinking Skills of Multiethnic Students at Senior High Schools in Indonesia. *Problems of Education in the 21st Century*, 75(2), 136–143. <https://doi.org/10.33225/pec/17.75.136>
- Bruner, J. S. (1961). The Act of Discovery. In *Harvard Educational Review* (Vol. 31). Harvard Education Publishing Group.
- Dewinta, A., Nur, F., Sri, S., Imaniar, P., & Tahira, A. Z. (2021). Development of Teaching Material Local Wisdom-Based “Pati” in Elementary School. *Asian Pendidikan*, 1(2), 59–64.
- Fuad, M., Efendi, A., & Muhammad, U. A. (2020). The Use of Pepaccur Local Wisdom for Indonesian Literary Teaching Materials. *Jurnal Pendidikan Indonesia*, 9(2), 213–223. <https://doi.org/10.23887/jpi-undiksha.v9i2.22779>
- Hadi, K., & Dazrullisa. (2018). Pengembangan Bahan Ajar Biologi Berbasis Kearifan Lokal. *Prosiding Seminar Nasional Biotik*, 822–828.
- Haerullah, A., Hasan, S., & Sahil, J. (2023). Analysis of Needs for Biology E-Module Based on Local Wisdom North Maluku, Indonesia. *International Journal of Social Service and Research*, 3(6), 1551–1559. <https://doi.org/10.46799/ijssr.v3i6.395>
- Haerullah, A., Hasan, S., & Sahil, J. (2024). Development of a Reference Book Based on the Identification Data of Medicinal Plants in the Community of the Sultanate of Moloku Kieraha, North Maluku, Indonesia. *International Journal of Social Service and Research*, 4(6). <https://doi.org/10.46799/ijssr.v4i6.793>
- Haerullah, A., Mas’Ud, A., Nurhasanah, & Sundari. (2019). Lesson Learnt of the Lesson Study for Learning Community as the Learning Innovation in the 21st Century for Student. *AIP Conference Proceedings*, 2194(December). <https://doi.org/10.1063/1.5139766>
- Haerullah, A., Suparman, Roini, C., Pagala, J., & Ariyani, L. F. (2025). Building 21st Century Skills of Multiethnic Students: Studying Genetic Diversity in Research-Based Exploration and the Local Potential of the North Maluku Islands. *International Journal of Innovative Research and Scientific Studies*, 8(2), 2322–2333. <https://doi.org/10.53894/ijirss.v8i2.5685>
- Hmelo-Silver, C. E., Duncan, R. G., & Chinn, C. A. (2007). Scaffolding and Achievement in Problem-Based and Inquiry Learning: A Response to Kirschner, Sweller, and Clark (2006). *Educational Psychologist*, 42(2), 99–107.

- <https://doi.org/10.1080/00461520701263368>
- Hosnan, M. (2014). *Pendekatan Saintifik dan Kontekstual dalam Pembelajaran Abad 21: Kunci Sukses Implementasi Kurikulum 2013*. Ghalia Indonesia.
- Karyadi, B. (2016). Pengembangan Model Bahan Ajar Pendidikan Lingkungan Berbasis Masalah Untuk Siswa Sekolah Dasar. *IJEEM - Indonesian Journal of Environmental Education and Management*, 1(1), 22–35. <https://doi.org/10.21009/ijeem.011.02>
- Lase, N. K., Sipahutar, H., & Harahap, F. (2016). Pengembangan Lembar Kegiatan Siswa (LKS) Berbasis Potensi Lokal pada Mata Pelajaran Biologi SMA Kelas XII. *Jurnal Pendidikan Biologi*, 5(2), 99–107. <https://doi.org/10.24114/jpb.v5i2.4305>
- Latri, L., Rahman, H., Mahmud, R., Asti, A. F., Angraningsi, D., Jamaluddin, J., & Umar, U. (2022). Development of Social Science Textbooks Integrated with Islamic and Local Culture Values. *Journal of Educational Science and Technology (EST)*, 8(3), 188. <https://doi.org/10.26858/est.v8i2.38693>
- Lazuardi, D. R., & Nugroho, A. (2019). Mengoptimalkan Kearifan Lokal pada Matakuliah Apresiasi Drama. *Prosiding Seminar Nasional Bulan Bahasa (Semiba) 2019, December*, 78–92.
- Muktadir, A., & Agustrianto, A. (2014). Pengembangan Model Mata Pelajaran Muatan Lokal Berbasis Kearifan Lokal untuk Meningkatkan Karakter Di Sekolah Dasar Provinsi Bengkulu. *Jurnal Pendidikan Karakter*, 4(3), 318–331. <https://doi.org/10.21831/jpk.v0i3.5636>
- Nata, P. R. (2021). *Pengembangan Modul IPA Berbasis Kearifan Lokal Masyarakat Sumatera pada Materi Keanekaragaman Makhluk Hidup (Identifikasi dan Pemanfaatan Tanaman Tighau Mato Kerbau) di SMPN 1 Ulu Musi*. IAIN Bengkulu.
- Nofiana, M., & Julianto, T. (2018). Upaya Peningkatan Literasi Sains Siswa Melalui Pembelajaran Berbasis Keunggulan Lokal. *BIOSFER Jurnal Tadris Pendidikan Biologi*, 9(1), 24–35.
- Novick, L. R., & Catley, K. M. (2016). Fostering 21st-Century Evolutionary Reasoning: Teaching Tree Thinking to Introductory Biology Students. *CBE Life Sciences Education*, 15(4), 1–12. <https://doi.org/10.1187/cbe.15-06-0127>
- NRC. (2012). *A Framework for K–12 Science Education: Practices, Crosscutting concepts, and Core ideas* (N. R. Council (ed.)). National Academies Press.
- P21. (2007). *Partnership For 21st Century Skillscore Content Integration*. Ohio Department of Education.
- Parmin, P., & Fibriana, F. (2019). Prospective Teachers' Scientific Literacy through Ethnoscience Learning Integrated with the Indigenous Knowledge of People in the Frontier, Outermost, and Least Developed Regions. *Jurnal Penelitian Dan Pembelajaran IPA*, 5(2), 142. <https://doi.org/10.30870/jppi.v5i2.6257>
- Paul, R., & Elder, L. (2007). The Miniature Guide to Critical Thinking Concepts and Tools. In *The Foundation for Critical Thinking*. <https://doi.org/10.1002/pfi.4170340606>
- Prabowo, D. L., Nurmiyati, & Maridi. (2016). Pengembangan Modul Berbasis Potensi Lokal pada Materi Ekosistem sebagai Bahan Ajar di SMA N 1 Tanjungsari, Gunungkidul. *Proceeding Biology Education Conference*, 13(1), 192–195.
- Putranto, T. A., Susatyo, E. B., & Siadi, K. (2013). Pencapaian Ketuntasan Hasil Belajar dengan Model Snowballing Pendekatan Contextual Teaching and Learning. *Journal of Chemisry in Education*, 2(1).
- Ramli, M. (2012). Analisis Substansi Pendidikan Multikultural Sains di Buku Pelajaran Biologi untuk SMA. *Prosiding Seminar Biologi*, 1991, 135–141.
- Ratnasari, Gun, G. G., & Supriyanti, F. M. T. (2016). Profil Keterampilan pada Proses Sains Siswa SMA Pembelajaran Termokimia Menggunakan Model Inkuiri Terbimbing. *Jurnal Riset Dan Praktik Pendidikan Kimia*, 4(1), 61–69.

- Rina R, & R. I. (2022). Efektifitas Online Project Based Learning Berbasis Ethnosains Pada Pembelajaran IPA terhadap Keterampilan Proses Sains Mahasiswa Selama Pandemi. *Jurnal Pendidikan Mipa*, 12(4), 1065–1071.
- Rizkiani, D. P. (2017). *Penerapan Model Discovery Learning Untuk Menubuhkan Sikap Rasa Ingin Tahu dan Hasil Belajar Siswa Pada Subtema Macam-macam Sumber Energi*. Universitas Pasundan.
- Robinson, K. (2011). *Out of Our Minds: Learning to Be Creative*. Capstone.
- Sahil, J., Haerullah, A., Hasan, S., & Majid, I. (2023). Pengembangan E-Modul Pembelajaran Biologi Kelas X SMA Berbasis Potensi dan Kearifan Lokal Menggunakan Aplikasi Canva Design. *Edukasi*, 21(3), 592–605. <https://doi.org/10.33387/j.edu.v21i3.6747>
- Siahaan, K. W. A., Lumbangaol, S. T. P., Marbun, J., Nainggolan, A. D., Ritonga, J. M., & Barus, D. P. (2020). Pengaruh Model Pembelajaran Inkuiri Terbimbing dengan Multi Representasi terhadap Keterampilan Proses Sains dan Penguasaan Konsep IPA. *Jurnal Basicedu*, 5(1), 195–205. <https://doi.org/10.31004/basicedu.v5i1.614>
- Sugiyono. (2019). *Metode Penelitian Pendidikan (Kuantitatif, Kualitatif, Kombinasi, R&D dan Penelitian Pendidikan)*. Alfabeta.
- Suhartini, S., Sekarningrum, B., Sulaeman, M. M., & Gunawan, W. (2019). Social Construction of Student Behavior through Character Education based on Local Wisdom. *Journal of Social Studies Education Research*, 10(3), 276–291.
- Tawil, M., & Liliasari. (2014). *Keterampilan Sains dan Implementasinya Dalam Pembelajaran IPA*. Badan Penerbit UNM.
- Trianto. (2009). *Mendesain Model Model Pembelajaran-pembelajaran Inovatif Progresif*. PT. Fajar Interpratama Mandiri.
- Trilling, B., & Fadel, C. (2009). *21st Century Skills: Learning for Life in Our Times*. John Wiley & Sons.
- Triyanti, M., & Nulhakim, U. (2022). Keefektifan Model Guided Inquiry Terhadap Keterampilan Proses Sains Siswa Kelas XI IPA SMA Negeri 7 Lubuklinggau. *Jurnal Perspektif Pendidikan*, 16(1), 69–79. <https://doi.org/10.31540/jpp.v16i1.1585>
- Tyas, R. A., Wilujeng, I., & Suyanta, S. (2020). Pengaruh pembelajaran IPA berbasis discovery learning terintegrasi jajan lokal daerah terhadap keterampilan proses sains. *Jurnal Inovasi Pendidikan IPA*, 6(1). <https://doi.org/10.21831/jipi.v6i1.28459>
- Vygotsky, L. S. (1978). *Mind in Society* (M. Cole, V. Jolm-Steiner, S. Scribner, & E. Souberman (eds.)). Harvard University Press. <https://doi.org/10.2307/j.ctvjf9vz4>
- Wa Ode A. Y. R. (2024). Pengaruh Model Pembelajaran Problem Based Learning Berbasis Pendekatan Jelajah Alam Sekitar Terhadap Peningkatan Kemampuan Keterampilan Proses Sains Dan Metakognisi Siswa Di Sma Negeri 1 Napabalano”, *Jurnal Biofiskim. Pendidikan Dan Pembelajaran IPA*, 6(1), 52–63. <https://doi.org/https://doi.org/10.33772/biofiskim.v6i1.88>
- Yuniasih, E., Hadiyanti, A. H. D., Hadiyanti, A. H. D., Hadiyanti, A. H. D., Zaini, E., Zaini, E., & Zaini, E. (2022). Penerapan Model Project Based Learning untuk Meningkatkan Keterampilan Proses dan Hasil Belajar IPA Siswa Sekolah Dasar. *Edukatif: Jurnal Ilmu Pendidikan*, 4(5), 6670–6677. <https://doi.org/10.31004/edukatif.v4i5.3380>