Bioedukasi
Jurnal Biologi dan Pembelajarannya

Vol. 22 No 1, February 2024, page 20-27
e-ISSN: 2580-0094; p-ISSN:1693-3931
DOI: 10.19184/bioedu.v22i1.42021
jurnal.unej.ac.id/index.php/BIOED

Effectiveness of Advanced Technology and Engineering in Biology Learning Model for SDGs in Changing Student's Conservation Perceptions about Phytoplankton Group

Ghauts Mannah Aji Abdillah[1], Hadi Suwono[2], Rifka Fachrunnisa[3]
[1,2,3] Biology Education, University of Malang, Indonesia

Article Info

Article history:
Received July 26, 2022
Revised August 8, 2022
Accepted December 6, 2022

Keywords:
Learning Effectiveness
Perceptions of Conservation
Phytoplankton

ABSTRACT

Indonesia has a very diverse biodiversity, but its people still have a low awareness of conservation. The purpose of this study is to determine the effectiveness of applying advanced technology and engineering in biology learning models for SDGs to change students' perceptions of conservation. This research is applied to the material of biodiversity and environmental change. This study's sample are 10th-grade students of State Senior High School Turen, which were taken using a purposive sampling technique. Methods of data collection using one-group pretest-posttest design, questionnaires, and reflective essays. Data analysis used the Pearson Product Moment validity test, Kolmogorov-Smirnov normality test, homogeneity test, N-Gain score for learning effectiveness, Likert scale descriptive analysis for analyzing questionnaires, and thematic analysis for analyzing reflective essays. This study's results are the effectiveness of applying this learning model on biodiversity material and environmental change material, both of them are classified as quite effective in changing students' perceptions of conservation. Previously student's conversation awareness is classified as strong, and now become to very strong. The reflective essay's result showed this learning provides new insights regarding phytoplankton which makes students aware of the existence of these phytoplankton so that they have an interest in doing conservation.

Corresponding Author:
Hadi Suwono,
Biology Education, University of Malang
Semarang Street No. 05, Malang, Indonesia
Email: hadi.suwono.fmipa@um.ac.id

1. INTRODUCTION

Indonesia has a very diverse and abundant biodiversity. This is caused by the geographical location between regions in Indonesia which are separated and have different environments. However, over time, that diversity began to decline due to the destruction of many environments. Approximately 22.8 million ha of conservation areas in Indonesia, and around 2.7 million ha have been damaged (Qodriyatun, 2019). This diversity is not only in land ecosystems, but also in aquatic ecosystems, especially in the oceans. Approximately 75% of Indonesia's territory is in the form of oceans and coastal areas with diverse biodiversity potential, one of which is the diversity of coral reefs. As much as 16% of the world's coral reef population is found in Indonesia (Ridona, 2015). Coral reef areas are the habitat of microorganisms to small organisms. Just like on the mainland, around 45.28% of the coral reef population in Indonesia is in a state of severe damage (Arisandi et al., 2018). One of the factors that causes this is human activity in carrying out work for daily survival without regard to habitat conservation and the species found in the environment (Arsyad, 2017). This shows that Indonesian people still have low conservation awareness.

In fact, the Indonesian government has stated the importance of biodiversity conservation activities in Indonesia in Law no. 5 of 1990. However, government regulations alone are insufficient to raise awareness of conservation in the minds of the people. Thus, conservation education is needed in biology learning at the high school level as a basis for raising conservation awareness. Learning biology has material that is closely related to conservation, namely biodiversity and environmental change. In this case, students learn about the importance of conserving a group of species that have an important role for the environment and other living things, but not many people know about it. One example of such a group of species is phytoplankton.

Phytoplankton is a type of aquatic microorganism that has the ability to absorb a greater amount of carbon compared to plants on land and produces the most oxygen on earth (Vallina et al., 2017). Another interesting fact is that phytoplankton has a role as a pump for carbonate compounds in the carbon cycle which can help the calcification process of sedimentary rocks in the sea (Firdaus & Wijayanti, 2019). However, this information is not well disseminated in society. For the general public, phytoplankton are only bio-indicators of water pollution by looking at the abundance of species in it (Rasyid et al., 2018). In addition, the habitat for phytoplankton is found in coral reefs. According to the explanation above which says that almost 46% of coral reefs in Indonesia are in a damaged condition, so this also has an impact on the presence of phytoplankton. Therefore, we need a learning that can disseminate information about phytoplankton from the results of learning that have been obtained in schools.

So far, learning related to conservation only aims to determine the level of students' knowledge about conservation and conservation behaviour after learning, without changing students' perceptions regarding the importance of conservation. This learning model is based on the moral character of conservation which only looks at students' learning motivation regarding conservation, and does not see changes in students' perceptions of conservation (Nisa et al., 2021). Through this learning, it has not had a significant impact on changing perceptions in a person. Therefore, a learning model is needed that can have a significant impact on changing perceptions, namely by using advanced technology and engineering in biology learning models for SDGs.

Advanced technology and engineering in biology learning model for SDGs is a technology and engineering-based biology learning model for disseminating solutions to problems that have been discussed in class. This learning model is considered suitable to be applied to raise students' conservation awareness because it presents problems related to the impact of an imbalance of species groups on the surrounding environment based on existing facts. Presentation of the problem is then discussed to get the best solution. In reaching the best solution, students will begin to have thoughts about the importance of conserving a group of species for the balance of the surrounding ecosystem. This solution is linked to the SDGs regarding climate change which can have a global impact. Apart from that, the solutions from this learning can also be linked to other aspects of the SDGs in accordance with the learning objectives to be achieved. This learning is applied to grade 10 using the independent curriculum.

The purpose of having an independent curriculum is very compatible with this learning, namely to increase student creativity through the use of technology (Hasanah et al., 2022). In line with research conducted by (Suriyana & Novianti, 2021), it shows that the application of technology and engineering-based learning provides significant increases in students' inquiry, exploration and communication abilities. Based on the explanation above, it is necessary to carry out this research considering that research on the application of learning based on advanced technology and engineering in biology learning models for SDGs is very useful, especially in biology subjects related to environmental problems.

2. RESEARCH METHOD

This research was conducted from August 2022 to November 2022 at the State Senior High School of Turen Malang. The population for this study was 10th grade students at State Senior High School of Turen Malang for the academic year 2022/2023. Sampling used a purposive sampling method, namely a sampling method by determining certain criteria (Rosdianto et al., 2017). In this case, the samples taken were 10th grade students at State Senior High School of Turen Malang for the 2022/2023 academic year with a total of 36 students. All students in this research use pseudonyms.

This research approach uses a mixed method, namely combining a quantitative approach with a qualitative approach which will produce a better understanding, making it suitable for researching someone's perceptions (Dawadi et al., 2021). In this case, the type of mixed method used is an embedded design which prioritizes quantitative data as the main data and is supported by qualitative data using data triangulation techniques (Vebrianto et al., 2020) as shown in figure 1.

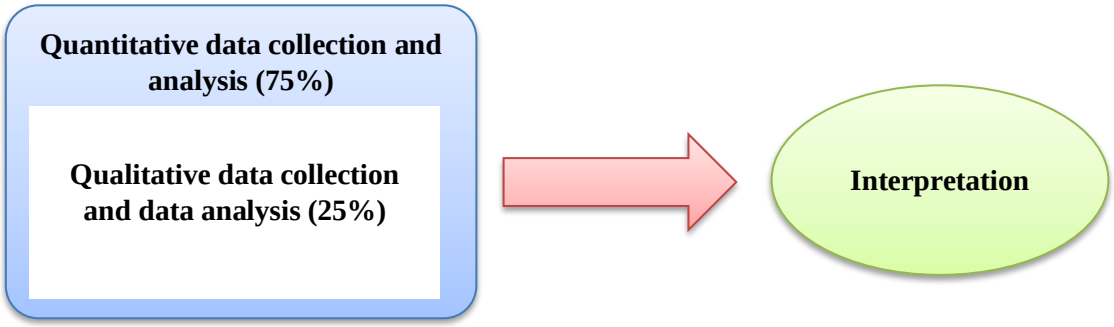

Figure 1. Embedded Design

The advanced technology and engineering in biology learning model for SDGs learning design is a development of a problem based learning model that is integrated with the STEAM approach (science, technology, engineering, the arts and mathematics) and the principles of transformative learning (self knowing, relational knowing, social knowing, visionary knowing, and practical knowing) (Taylor, 2013). Advanced technology and engineering in biology learning model for SDGs has 9 learning stages including introductory concept; ethical and rhetorical questions; organization in learning; human-nature relationship; scientifically and statistically information; cultural application in historical perspective; prospective applications; effectiveness evaluation; and innovative persuasion.

At the beginning of the lesson students were introduced to a problem that is currently happening that is related to sustainable development or SDGs. Furthermore, students are given dilemma questions to build the basic concept of students' perceptions of the problem. After that, students carry out investigative activities in groups to find solutions to the problem. Solutions from each group are evaluated to get the best solution. The results of the solutions are poured into persuasive works and disseminated through social media to attract wider public awareness. This learning design is applied to the material on biodiversity and environmental change which has the goal of learning outcomes in the affective domain in the form of changes in students' conservation perceptions and increasing learning outcomes in the cognitive and psychomotor domains which can be seen in figure 2.

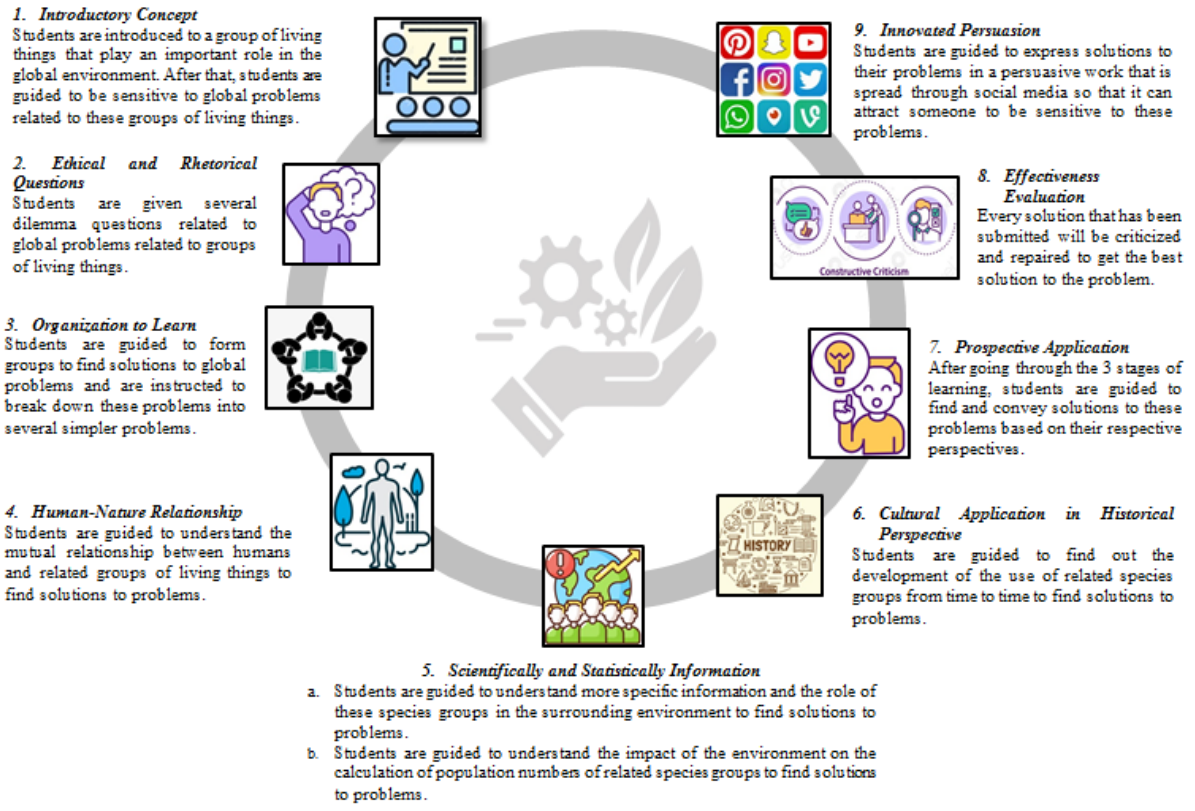

Figure 2. Design of Advanced Technology and Engineering in Biology Learning Model for SDGs

Quantitative Methods

The type of quantitative research used is pre-experimental using a research design in the form of a one-group pretest-posttest design to determine the state of the subjects at the beginning and end of learning (Wahyuningrum, dkk., 2021). In this case, each material is given a pre-test and post-test that measure the subject's cognitive level, both material on biodiversity and global warming. The following is the one-group pretest-posttest design in table 1.

Table 1. One Group Pretest-Posttest Design

Pre-test	Treatment	Post-test
O_1	X	O_2

O_1 : Pre-test conducted before the subject was given treatment
X : The treatment is in the form of Advanced Technology and Engineering in Biology Learning Model for SDGs
O_2 : Post-test conducted after the subject was given treatment

In addition to the pre-test and post-test, this research also used a conservation awareness questionnaire to measure the subject's perception of conservation in the affective domain. Conservation perceptions are developed based on three principles, namely the principles of protection, preservation, and utilization (Rusch et al., 2022) and (Westermann & von Oheimb, 2021). Each principle has ten indicators which are developed into statement items. These indicators include genetic diversity, species diversity, ecosystem diversity, functional diversity, human impact, symbols, language, norms, values, and artifacts which are components of biodiversity (Westermann & von Oheimb, 2021). On the other hand, this research also measures the psychomotor domain which is devoted to student's communication and collaboration skills using communication and collaboration observation sheets.

The results of the conservation awareness questionnaire and the pretest-posttest were tested for the validity of the Pearson Product Moment, reliability test, Kolmogorov-Smirnov normality test, homogeneity test, and difference test. After testing the validity, reliability, normality, and homogeneity tests, the results of the pretest-posttest on biodiversity material were carried out with a different test using the Wilcoxon test, while the results of the pretest-posttest on environmental change using a paired T-test. In addition, the results of the conservation awareness questionnaire were also subjected to a different test using the Chi-Square test. After the different tests were carried out, the pre-test and post-tests results were tested for the N-gain score to determine the effectiveness of the application of learning using the formula which can be seen in below.

$$N - Gain\ Score = \frac{Posttest\ Score - Pretest\ Score}{Maximum\ Score - Prestest\ Score}$$

The results of the N-Gain score analysis is then interpreted based on the N-Gain grouping criteria which can be seen in table 2.

Table 2. N-Gain Grouping Criteria

N-Gain Score	Criteria
< 0,4	Ineffective
0,4 – 0,6	Less effective
0,6 – 0,7	Quite effective
> 0,7	Effective

Source: (Hake, 1999)

As for the data from the conservation awareness questionnaire, it was analyzed using a likert scale descriptive analysis technique with several questionnaire indicator criteria that can be seen in table 3.

Table 3. Questionnaire Indicator Criteria

Likert Scale	Criteria
< 40	Very weak
40 – 60	Weak
61 – 80	Strong
81 – 100	Very strong

Source: (Sugiyono, 2010)

Qualitative Methods

The qualitative data collection technique of this study used reflective essays that were done by the subject in the first pre-learning material, namely biodiversity material and the second post-learning, namely environmental change material. Reflective essays are used to find out the learning experiences that students have gained after going through learning (Habibi et al., 2018). The development of this reflective essay is based on the problems raised in learning. This reflective essay data supports the conservation perception data that has been obtained from the conservation awareness questionnaire. The data analysis technique used is thematic analysis which is applied by going through the process of understanding the data, compiling the code, and grouping it into certain themes (Junaid, 2016).

3. RESULT AND DISCUSSION

Based on the results of students' pre-test and post-test work, it is known that the application of the advanced technology and engineering learning model to the biology learning model for SDGs at 10th grade SMAN 1 Turen shows a proportion of an N-gain score of 0.7 in the biological swing material, while in the environmental change material it shows the proportion of 0.62 which can be seen in Table 4. According to the criteria in Table 2 from (Hake, 1999), the effectiveness of applying this learning is quite effective in improving learning outcomes in the cognitive domain.

Table 4. N-Gain Score of Advanced Technology and Engineering in Biology Learning Model for SDGs in the Material of Biodiversity and Environmental Change

Material	N-Gain Score	Criteria
Biodiversity	0,7	Quite effective
Environmental changes	0,62	Quite effective

In accordance with research (Handarini & Wulandari, 2020), there are several factors for the effectiveness of a lesson, namely self-learning skills and the effectiveness of learning time. Self-learning skills are one of the factors in the learning effectiveness of advanced technology and engineering in biology learning model for SDGs. In this case students will search, find and conclude for themselves the knowledge they have learned during learning. In addition to self-study skills, another factor is the effectiveness of learning time. According to (Dista & Marta, 2022) that the learning time which is quite short with material that students have just heard is an important factor that causes the effectiveness of learning to only reach quite effectively.

The application of advanced technology and engineering learning in biology learning model for SDGs also causes student learning outcomes in the cognitive domain to increase after following the advanced technology and engineering learning model in biology learning model for SDGs steps. This is consistent with research (Pratiwi et al., 2022), which shows that the presence of technology and engineering in classroom learning can increase student learning independence because students can explore sources from anywhere. This can foster students' curiosity to learn by themselves. In line with research (Suwono et al., 2019) which shows that technology and engineering-based learning can improve students' self-learning skills also have an effect on increased cognitive learning outcomes.

Apart from the cognitive domain, advanced technology and engineering in biology learning model for SDGs learning is also quite effective in increasing learning outcomes in the affective domain in the form of conservation perceptions. Based on the results of a conservation awareness questionnaire by 10th grade students, it showed an increase in each indicator of genetic diversity, species diversity, ecosystem diversity, functional diversity, human impact, symbols, language, norms, values, and artifacts from each principle. The highest increase was in the protection principle of the functional diversity indicator which increased by 38%, while the lowest increase was in the principle of preservation of the artifacts indicator which increased only by 18% which can be seen in figure 4.

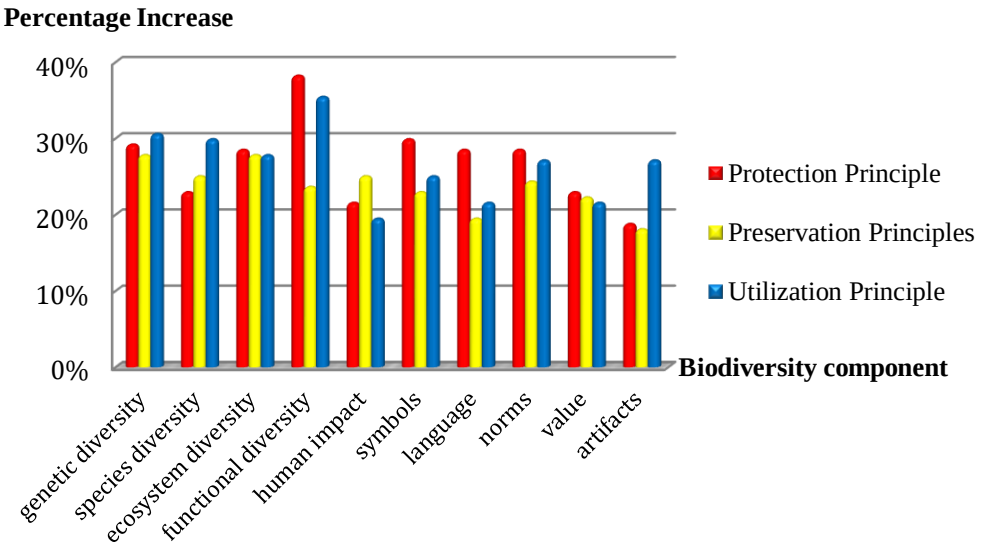

Figure 4. Increasing Students' Biodiversity Conservation Awareness based on Indicators of Each Principle

Based on the results of the reflective essay work, students' opinions regarding phytoplankton can be grouped into 4 themes, namely awareness of the existence of phytoplankton, perceptions of the role of phytoplankton, awareness of phytoplankton conservation, and interest in conserving phytoplankton:

Awareness of the existence of phytoplankton is the trigger for students to know the true meaning of phytoplankton microorganisms. According to the 10th grade students, they just discovered that zooplankton and phytoplankton are different.

*"Before, I had heard about plankton organisms, but I just found out that plankton is divided into 2 types, namely phytoplankton and zooplankton. I just found out about the role of phytoplankton, namely as primary producers in the ocean, while zooplankton are the first consumers that connect with biota at a higher trophic level."*Acha

Further more, students who already know the existence of phytoplankton in the ocean, have perceptions of the role of phytoplankton. These perceptions can be classified into 2, namely positive and negative perceptions. As many as 22% of students said that the presence of phytoplankton had many important roles for ecosystems and humans.

"The presence of phytoplankton in the aquatic environment has many ecological functions such as providing oxygen in the waters and as an indicator of water quality, both fresh and seawater. In addition, the amount of oxygen produced is also the most on earth, and another important role of phytoplankton is to carry out biocalcification which is very important in the carbon cycle. Janeta.

On the other hand, negative perceptions can be interpreted from students' negative appreciation of the existence of phytoplankton. This form of appreciation can be seen from the opinions of students who mentioned the existence of phytoplankton which is detrimental to the surrounding ecosystem.

"The existence of several types of phytoplankton such as Coscinodiscus sp. can cause the death of thousands of ocean fish. This is due to the population explosion of this type of phytoplankton whose existence requires a lot of oxygen levels as well, causing dissolved oxygen levels to deplete and affecting the presence of fish in these waters." Sivana.

After students have perceptions about the role of phytoplankton, both positive and negative, students become aware of the importance of phytoplankton conservation. This is shown from the opinion of students who say that it is necessary to do phytoplankton conservation. The students' opinions can be grouped into three principles of conservation awareness, namely the principles of protection, preservation and utilization. On the principle of protection, students argue that this group of phytoplankton species needs to be protected on the grounds that the existence of phytoplankton has many important roles in the life cycle of ecosystems.

"The existence of phytoplankton in aquatic ecosystems has many important roles for other living things on earth. This role is to produce the most oxygen on earth, perform biocalcification, and many other things. Therefore, phytoplankton must be protected for the balance of the ecosystem. Trisna.

On the other hand, there are students who think that phytoplankton also needs to be conserved because of its importance for aquatic and terrestrial ecosystems.

"The occurrence of an explosion in the phytoplankton population can cause thousands of fish to die because of population density which results in reduced oxygen. However, the decline in the population of phytoplankton has also caused oxygen levels on earth to decrease and the balance of the ecosystem to be disrupted, so the preservation of phytoplankton is needed so that it can balance the ecosystem again." Pinka

The opinion of other students said that the existence of phytoplankton needs to be utilized because it has many ecological functions for both aquatic and terrestrial ecosystems.

"The many ecological functions of phytoplankton can be utilized for the continuation of the life cycle on earth. For example, the function of phytoplankton is as a biocalcification agent that creates calcification on coral reefs and sedimentary rocks which can later be used by humans in their daily lives, such as souvenirs and construction that requires limestone." Viki

After gaining conservation awareness related to phytoplankton, it turns out that there are students who have thoughts of doing phytoplankton conservation in the future. For example, one of the students, let's call him Naswa, had the thought of conserving phytoplankton because it relates to his daily life.

"After knowing that phytoplankton is very important on earth, I want to do phytoplankton conservation because it is very related to my own life. I want to apply the conservation effort that I can do at this time, namely disseminating information related to phytoplankton through social media. That way, the public can get to know the phytoplankton even further." Naswa.

In line with research (Goswami, et al., 2017), that functional diversity is a variety of ecological roles that are owned by a species and affect several aspects of other functions in the ecosystem. The existence of this role makes students aware of the importance of conserving phytoplankton by protecting it and students become interested in doing conservation. This is supported by the student's opinions in working on their reflective essays which say the role of this very large amount of phytoplankton must be properly protected so that the ecosystem balance is maintained. This student's opinion shows that a new conservation perception has arisen within the students regarding the group of phytoplankton species.

In line with research (Sulastri, 2019), the presence of high motivation to learn can foster a new perception in student psychology. Technology and engineering-based learning can increase students' motivation and interest in learning. This is because in this lesson students are given the freedom to find sources from anywhere (Lathif, et al., 2019). In addition, students can also grow their creativity according to the guidelines of this lesson. Thus the application of advanced technology and engineering in biology learning model for SDGs is quite effective in changing students' perceptions of conservation.

4. CONCLUSION

The conclusion of the research that has been carried out show that the application of advanced technology and engineering in biology learning models for SDGs is quite effective in changing students' perceptions of conservation with a percentage of 70% on biodiversity material and 62% on environmental change material. This change in the perception of conservation is based on the factor of functional diversity on the principle of protection which creates a new perception for conservation. Based on the students' opinion, said that the protection of phytoplankton is very necessary to fulfill the needs of the life cycle on earth.

5. ACKNOWLEDGEMENT

As a writer, I realize that this article can be completed thanks to the help and motivation from various parties. On this occasion, allow the author to express respect and gratitude to The author's parents always provide support and motivation in compiling this article, Prof. Dr. Hadi Suwono, M.Sc., and Rifka Fachrunnisa, S.Pd., M.Ed. as a supervisor, Mrs. Idayati and Mrs. Lukie Pamularsih are accompanying tutors who always provide direction, motivation, and evaluation in data collection at SMAN 1 Turen, Class X students who have taken their time to help the writer fill out a questionnaire for the preparation of articles.

6. REFERENCES

Arisandi, A., Tamam, B., & Fauzan, A. (2018). Profil Terumbu Karang Pulau Kangean, Kabupaten Sumenep, Indonesia. *Jurnal Ilmiah Perikanan Dan Kelautan*, *10*(2), 76–83. https://doi.org/10.20473/jipk.v10i2.10516

Arsyad, A. M. (2017). Identifikasi Kesadaran Masyarakat Terhadap Konservasi Dan Rehabilitasi Burung. *SOSIO-DIDAKTIKA: Social Science Education Journal*, *4*(1), 81–91. https://doi.org/10.15408/sd.v4i1.4393

Dawadi, S., Shrestha, S., & Giri, R. A. (2021). Mixed-Methods Research: A Discussion on its Types, Challenges, and Criticisms. *Journal of Practical Studies in Education*, *2*(2), 25–36. https://doi.org/10.46809/jpse.v2i2.20

Dista, D. X., & Marta, R. (2022). Peningkatan Kemandirian Belajar Siswa dengan Menerapkan Pembelajaran STEAM di Sekolah Dasar. *Jurnal Ilmiah Ilmu Kependidikan*, *6*(1), 16–26.

Firdaus, M. R., & Wijayanti, L. A. . (2019). Fitoplankton dan Siklus Karbon Global. *Oseana*, *44*(2), 35–48. https://oseana.lipi.go.id/oseana/article/view/39

Habibi, F., Eviyuliwati, I., & Kartowisastro, S. (2018). The Effect of Reflective Journal Writing on Studentsr Writing Ability of Narrative Text. *Advances in Social Science, Education and Humanities Research*, *115*(Icems 2017), 16–20. https://doi.org/10.2991/icems-17.2018.4

Handarini, O. I., & Wulandari, S. S. (2020). Pembelajaran Daring Sebagai Upaya Study from Home (SFH). *Jurnal Pendidikan Administrasi Perkantoran (JPAP)*, *8*(3), 465–503. file:///C:/Users/win10/Downloads/8503-Article Text-27609-1-10-20200629 (1).pdf

Hasanah, Sembiring, & Afni. (2022). Sosialisasi kurikulum merdeka merdeka belajar untuk meningkatkan pengetahuan para guru di SD Swasta Muhamaddiyah 04 Binjai. *Ruang Cendikia: Jurnal Pengabdian Kepada Masyarakat*, *1*(3), 235–238.

Junaid, I. (2016). Analisis Data Kualitatif dalam Penelitian Pariwisata. *Nurnal Keprawisataan*, *10*(01), 65–66. https://jurnal.uin-antasari.ac.id/index.php/alhadharah/article/view/2374

Nisa, F., Gede Agung, A. A., & Tegeh, I. M. (2021). Model Pembelajaran Berbasis Karakter Konservasi untuk Anak Usia Dini. *Jurnal Pendidikan Anak Usia Dini Undiksha*, *9*(1), 17. https://doi.org/10.23887/paud.v9i1.33633

Pratiwi, T. I., Istirahayu, I., & Mariana, D. (2022). Kemandirian Belajar Siswa SMA Pada Masa Pandemi Covid-19. *Coution: Journal of Counseling and Education*, *3*(1), 41. https://doi.org/10.47453/coution.v3i1.606

Qodriyatun, S. N. (2019). Peran dan Partisipasi Masyarakat dalam Pengelolaan Kawasan Konservasi secara Kolaboratif. *Kajian*, *24*(1), 43–56. https://huma.or.id/home/pusat-

Rasyid, H. Al, Purnama, D., & Kusuma, A. B. (2018). Pemanfaatan Fitoplankton Sebagai Bioindikator Kualitas Air Di Perairan Muara Sungai Hitam Kabupaten Bengkulu Tengah Provinsi Bengkulu. *Jurnal Enggano*, *3*(1), 39–51. https://doi.org/10.31186/jenggano.3.1.39-51

Ridona, O. (2015). Efektifitas Indonesia Untuk Menjaga Keanekaragaman Hayati Laut Dalam Coral Triangle Iniatiative on Coral Reefs, Fisheries and Food Security (Cti-Cff). *Jom Fisip*, *2*(2), 1.

Rosdianto, H., Murdani, E., & H. (2017). the Implementation of Poe (Predict Observe Explain) Model to Improve Student'S Concept Understanding on Newton'S Law. *Jurnal Pendidikan Fisika*, *6*(1), 55. https://doi.org/10.22611/jpf.v6i1.6899

Rusch, G. M., Bartlett, J., Kyrkjeeide, M. O., Lein, U., Nordén, J., Sandvik, H., & Stokland, H. (2022). A joint climate and nature cure: A transformative change perspective. *Ambio*, *51*(6), 1459–1473. https://doi.org/10.1007/s13280-021-01679-8

Suriyana, S., & Novianti, M. (2021). Efektifitas Pembelajaran Berbasis STEAM (Science, Technology, Engineering, Art, and Mathematic) terhadap Hasil Belajar pada Meteri Dimensi Tiga SMK. *Edukatif: Jurnal Ilmu Pendidikan*, *3*(6), 4049–4056. https://doi.org/10.31004/edukatif.v3i6.1199

Suwono, H., Fachrunnisa, R., Yuenyong, C., & Hapsari, L. (2019). Indonesian Students' Attitude and Interest in STEM: An Outlook on the Gender Stereotypes in the STEM Field. *Journal of Physics: Conference Series*, *1340*(1). https://doi.org/10.1088/1742-6596/1340/1/012079

Taylor, P. C. (2013). Research As Transformative Learning for Meaning-Centered Professional Development. In *Meaning-Centered Education: International Perspectives and Explorations in Higher Education* (Issue January 2013). https://doi.org/10.4324/9780203115084

Vallina, S. M., Cermeno, P., Dutkiewicz, S., Loreau, M., & Montoya, J. M. (2017). Phytoplankton functional diversity increases ecosystem productivity and stability. *Ecological Modelling*, *361*, 184–196. https://doi.org/10.1016/j.ecolmodel.2017.06.020

Vebrianto, R., Thahir, M., Putriani, Z., Mahartika, I., Ilhami, A., & Diniya. (2020). Mixed Methods Research: Trends and Issues in Research Methodology. *Bedelau: Journal of Education and Learning*, *1*(2), 63–73. https://doi.org/10.55748/bjel.v1i2.35

Wahyuningrum, S. R., Putri, A. P., & Jamaluddin, M. (2021). Pre-Experimental Design Bimbingan Kelompok dengan Teknik Assertive Training dalam Peningkatan Keterampilan Komunikasi Siswa di SMK Kesehatan Nusantara. *Jurnal Penelitian Ilmu Sosial Dan Keagamaan Islam*, *18*(1), 14–28.

Westermann, J., & von Oheimb, G. (2021). Species-based or process-based conservation? Dealing with neophytes in the core areas of German national parks. *Journal for Nature Conservation*, *59*(October 2020), 125924. https://doi.org/10.1016/j.jnc.2020.125924