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Research Article

Development of Electronic LKPD to Support PJBL Environmental Change Materials to Improve Creative Thinking Skills and Environmental Literacy of Phase E Students in Independent Learning

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Abstract: This study aims to determine the feasibility, practicality, and effectiveness of Electronic LKPD Supporting on PjBL on in improving creative thinking skills and environmental literacy of students at SMAN 1 Tarakan. This type of research is research and development (Research and Development) with the ADDIE model (analyze, design, development, implement, evaluate). The analyze stage includes initial analysis, competency analysis, constructional analysis, and content analysis. The design stage includes compiling an electronic LKPD outline and designing learning content in the LKPD. The development stage includes developing data collection instruments. The data collection instruments in this study were a feasibility sheet for expert lecturers, a practicality sheet for biology teachers, a student readability sheet, and pretest and posttest questions for creative thinking skills and environmental literacy. This instrument was developed based on the review of the supervisor, assessment of expert lecturers, biology teachers, and trials on students. The implement stage includes the application of electronic LKPD that has been developed on class X students of SMAN 1 Tarakan. The experimental design used is the pretest-posttest control group design. The evaluate stage includes the form of evaluation carried out at each stage of ADDIE. The data analysis technique uses the manova test. The results of the study show: (1) The electronic LKPD supporting PjBL that was developed meets the criteria of being very valid for use in learning activities with an average value according to media experts of 3.55, material experts of 3.89 and learning experts of 3.96. (2) Practicality with a very practical category for use based on the results of student and teacher responses. (3) Effectiveness based on the Multivariate Analysis of Variance test with a significance level of 5% shows that there is an influence on students' creative thinking skills and environmental literacy after treatment using electronic LKPD supporting PjBL.

Keywords: Creative Thinking Skills; Environmental Literacy; Electronic LKPD; Project Based Learning; ADDIE model.

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1. Introduction

The rapid development of technology in the era of the industrial revolution 4.0 demands innovation in the world of education, including the use of digital learning media. However, the education system in Indonesia has not been fully able to maximize the potential of technology in learning, especially due to limited infrastructure and user adaptation (Kahar et al., 2021). These changes also require teachers to have 21st century competencies in order to form an innovative generation and be able to face global challenges. On the other hand, the results of the national assessment show that students' creative thinking skills and environmental literacy are still low, as seen in 27% of students who have not reached completeness and the tendency to copy answers without understanding concepts. This is in

line with research by Anggraini & Nazip (2022) and Al-Hilmiyah & Suhartini (2024) which found that students' environmental literacy skills are still in the medium category.

The low level of creativity and environmental awareness shows the need for learning that stimulates thinking skills and concern for ecological issues. Based on these conditions, this research is focused on developing an Electronic Student Worksheet (LKPD) based on Project Based Learning (PjBL) on environmental change materials for Phase E students in the Independent Curriculum. This research is limited to the development of interactive learning products based on digital technology that contain the syntax of PjBL and is oriented towards improving creative thinking skills and environmental literacy.

Several previous studies have provided a relevant basis for the development of Project-Based Learning (PjBL)-based electronic LKPD in biology learning, especially on the topic of environmental change. Student environmental literacy is still in the medium category, so learning needs to be directed to direct activities in the field so that students are more concerned and responsible for the environment. Meanwhile, research by Al-Hilmiyah and Suhartini (2024) conducted at Adiwiyata Mandiri schools revealed that the environmental literacy abilities of students in the MIPA and social studies programs differed significantly, but were not influenced by grade level (Anggraini & Nazip, 2022). This research also confirms that the implementation of the Adiwiyata program is going quite well and has a positive impact on the environmental awareness of students. Both studies emphasize the importance of implementing project-based and environment-based learning to improve students' literacy and environmental awareness (Al-Hilmiyah & Suhartini, 2024).

The main goal is to produce electronic LKPD that is valid, practical, and effective in improving students' abilities. The product developed has specifications in the form of an interactive display with access via a smartphone or computer, containing instructions for use, learning outcomes and objectives, project activities, and evaluation based on environmental context (Ariyana et al., 2018).

2. Literature Review

Research Development

Development research is a scientific approach that aims to produce new products that are suitable for use in the field of education through a process of testing, revision, and repeated evaluation. Different from educational research that focuses on theoretical findings, development research focuses on creating practical solutions based on field test results (Rayanto, 2020). According to Sugiyono in Lestari et al. (2022), this research produced a product and tested its effectiveness. One of the widely used models is the ADDIE (Analysis, Design, Development, Implementation, Evaluation) model, because it is systematic and adaptive to learning problems. This model is considered effective in creating an interesting learning experience and according to the needs of 21st century education. Each stage, from needs analysis, strategy design, instrument development, product application to evaluation, has an important role to ensure that learning outcomes are in accordance with the set goals (Fadhila et al., 2022).

LKPD Electronics

The Electronic Student Worksheet (Electronic LKPD) is an interactive learning medium that utilizes digital technology to facilitate more interesting and flexible learning activities (Sujanem et al., 2022). This LKPD functions to help students understand the material through activity guides, practice questions, and interactions that foster independence and motivation to learn (Audry et al., 2022). Its main advantages are high accessibility, the use of environmentally friendly digital devices, and the ability to adapt to the needs of the 21st century (Sujanem et al., 2022). The main goal is to increase students' understanding and involvement by encouraging critical thinking and problem-solving (Wahyuni et al., 2021). The Electronic LKPD generally includes important components such as activity names, objectives, supporting theories, tools and materials, work steps, observation results, and reflective questions that support active learning (Sari et al., 2023).

Project Based Learning (PjBL) Learning Model

The Project Based Learning (PjBL) learning model is an innovative student-centered approach with the principle of learning through projects that emphasizes contextual and

authentic problem-solving (Abdul Latip & Supriatna, 2017). This model enhances students' critical thinking, communication, collaboration, and creativity skills through a real project-based learning experience. PjBL is also proven to foster motivation to learn and maintain long-term knowledge because students play an active role in the process. In the context of biology learning, the application of PjBL helps students relate scientific concepts to real environmental problems, foster scientific attitudes, and improve high-level thinking skills. The PjBL syntax includes five to six core stages, ranging from determining fundamental questions to evaluating learning experiences (Widoretno et al., 2023).

Environmental Change Material

The environment is a system consisting of biotic and abiotic components that interact with each other to maintain ecological balance. Based on Law No. 32 of 2009, the environment includes the unity of space with all elements that affect life. Environmental changes occur when the balance of the ecosystem is disturbed due to natural factors and human activities. Natural resource exploitation activities, such as oil drilling in Tarakan City, can cause soil, water, and air pollution, which impacts the lives of surrounding organisms. Understanding environmental changes is important for students to be able to identify, analyze, and provide solutions to real environmental problems faced by the community (Noor, 2017).

Creative Thinking Skills

Creative thinking skills are the ability to generate original and useful ideas through divergent, flexible, and fluid thinking processes. In the context of learning biology, this skill is important to encourage students to find alternative solutions to scientific problems. Creative thinking includes aspects of fluency, flexibility, originality, and elaboration. Learning involving PjBL has been proven to improve these abilities because it encourages students to actively innovate and explore new ideas (Mulyani et al., 2023). Thus, creative thinking is not only results-oriented, but also on cognitive processes that foster curiosity and problem-solving abilities.

Environmental Literacy

Environmental literacy is the ability to understand, assess, and act on environmental issues scientifically and responsibly. This literacy includes three domains, namely knowledge, attitudes, and competencies that encourage a person to care and participate in environmental conservation. The results of the study show that the level of environmental literacy of students in Indonesia is still low, especially in the aspect of analysis and implementation of environmental solutions (Al-Hilmiyah & Suhartini, 2024). Therefore, environmental education must emphasize direct engagement with the local context so that students are able to develop ecological awareness and environmentally friendly behaviors in a sustainable manner (Widiyastuti et al., 2024).

Freedom of Learning

The Independent Learning Policy emphasizes the freedom of teachers and students in designing contextual, creative, and student-centered learning (Ministry of Education and Culture, 2019). This concept aims to create a learning environment that is adaptive to the needs and potential of students in order to achieve a Pancasila student profile that is critical, independent, and creative. In the context of biology, Merdeka Belajar provides space for the application of a project-based approach that fosters high-level thinking skills and scientific literacy. The PjBL model in the framework of Independent Learning allows learners to integrate theory and practice through real learning experiences that are relevant to daily life (Chong et al., 2023).

Phase E

Phase E in the Independent Curriculum includes high school students in grades X–XII who are at the stage of developing formal and reflective thinking. In this phase, students are expected to be able to analyze, evaluate, and create based on the knowledge they already have. Learning in Phase E emphasizes scientific and project-based approaches to foster critical, collaborative, and caring for environmental issues. The integration of PjBL-based Electronic LKPD is very relevant to be applied in this phase because it can increase learning

independence, creative thinking skills, and environmental literacy in line with the principles of Independent Learning (Al-Hilmiyah & Suhartini, 2024).

3. Materials and Method

This research is a type of research and development (R&D) that uses the ADDIE (Analyze, Design, Development, Implementation, Evaluation) model as developed by Dick and Carey (1996) and refined by Branch (2009). This model was chosen because it has systematic stages in designing, developing, and evaluating learning media. The ADDIE model is considered more comprehensive than other development models such as 4D (Umami et al., 2022).

The product developed is in the form of an electronic LKPD based on Project Based Learning (PjBL) on environmental change materials to improve the creative thinking skills and environmental literacy of phase E students in the framework of *Independent Learning*. This LKPD is designed using *a liveworksheet* that can be accessed through digital devices such as smartphones or laptops.

The development stage begins with an analysis that aims to identify learning needs and problems faced by students. The analysis was carried out through observation and interviews with biology teachers and students at SMA Negeri 1 Tarakan. The data collected included the curriculum, learning approaches, school facilities, and the level of readiness of students for the use of technology in learning.

The design stage includes the preparation of an electronic LKPD design that is simple and easy to operate. Product design includes content structure, learning activity flow, and the preparation of validation instruments by material, media, and learning experts. At the development stage, the LKPD is prepared based on the design results and validated by experts. The validated product is then tested for readability by students and revised according to input.

The implementation stage is carried out by applying electronic LKPD to biology learning in class X of SMA Negeri 1 Tarakan. The experimental design used is a pretest-posttest control group design, where the experimental class uses an electronic LKPD and the control class uses a conventional LKPD. The implementation aims to assess the effectiveness of LKPD in improving creative thinking skills and environmental literacy.

The evaluation stage is carried out continuously in each phase of development, including evaluation from supervisors, expert validators, teachers, and students. The goal is to improve the LKPD so that it is suitable for use in project-based biology learning.

Data is collected through several techniques, namely interviews, questionnaires, and tests. Interviews were used to obtain preliminary information related to the conditions of biology learning and its supporting facilities. The questionnaire serves to analyze the needs of students, assess the feasibility of the product by experts, and measure user responses to the LKPD. The test was used to assess the effectiveness of LKPD in improving creative thinking skills (using description questions) and environmental literacy (using multiple-choice questions, descriptions, and questionnaires).

The instruments used include interview guides, student needs questionnaires, expert validation sheets, and creative thinking skills and environmental literacy test instruments that have been validated and tested for reliability.

Data analysis was carried out with qualitative and quantitative approaches. Qualitative data from the results of interviews and needs questionnaires were analyzed descriptively to understand the learning context. Meanwhile, quantitative data from the results of validation and product trials were analyzed using the N-Gain test (Hake, 1998) to determine the improvement of students' creative thinking skills and environmental literacy. In addition, the MANOVA test was used to assess the significance of the difference in learning outcomes between the experimental and control classes (Huang, 2020).

4. Results and Discussion

Initial Product Development Results

The initial product development was carried out using the ADDIE (Analyze, Design, Development, Implement, Evaluate) model which is systematic and oriented towards increasing learning effectiveness. At the analysis stage, the researcher identified needs through observation and interviews with biology teachers as well as the distribution of questionnaires to students at SMAN 1 Tarakan. The results show that biology learning is still conventional, dominated by memorization and teacher-centered. Students tend to be passive and less motivated because learning media such as textbooks are still monotonous and lack interesting visualization. This analysis emphasizes the need for interactive project-based learning media innovation in order to develop creative thinking skills and environmental literacy (Maydiantoro, 2020).

Furthermore, at the planning stage, the researcher designed *an electronic LKPD to support project-based learning* by paying attention to the learning outcomes and objectives of phase E. LKPD is designed to be simple, easy to understand, and can be accessed via *a smartphone* or computer through a link or *barcode*. The structure of the LKPD includes key components such as instructions for use, learning outcomes, project activities, assessments, and evaluations. In addition, validation instruments are also prepared for media, material, and learning experts to ensure clarity of content and ease of use.

At the development stage, the LKPD design was realized using *a liveworksheet* application so that students could interact digitally. The resulting product is then validated by experts and biology teachers to assess the aspects of validity, practicality, and readability. Validation includes improvements in terms of appearance, clarity of instructions, and suitability of the material for learning objectives. A readability test was also carried out on students to assess the ease of use of electronic LKPD.

Next, the implementation stage was carried out through the implementation of electronic LKPD in two classes at SMAN 1 Tarakan. The experimental class used the developed LKPD product, while the control class used conventional teaching materials. The implementation process aims to observe the effectiveness of products in improving creative thinking skills and environmental literacy. This implementation is systematically designed to be in accordance with the principles of project-based learning and pay attention to the readiness of teachers and students.

The last stage, namely evaluation, is carried out to review the effectiveness, practicality, and validity of the LKPD after it is implemented. This evaluation involves input from experts, teachers, and students to improve product weaknesses. The results of the evaluation show that the ADDIE model allows for continuous improvement of learning products, as each stage is interconnected and generates feedback that reinforces the quality of instructional design.

Product Trial Results

The product trial was conducted to determine the effectiveness of the electronic LKPD supporting Project Based Learning (PjBL) on environmental change materials in improving students' creative thinking skills and environmental literacy. The trial process involves an experimental class and a control class at SMAN 1 Tarakan with a pretest-posttest control group design. The test results showed that the use of electronic LKPD had a significant effect on improving students' creative thinking skills and environmental literacy. This is shown through the results of Manova's analysis which shows that there is a significant difference between the two classes with a significance level of 5%. Students in the experimental class obtained a higher average posttest score than the control class. These findings reinforce the view that project-based learning encourages students' activities in critical, collaborative, and creative thinking in accordance with the characteristics of 21st century learning. In addition, the results of the questionnaire of teacher and student responses showed that electronic LKPD was considered very practical to be used in learning activities. Teachers assessed that this device facilitates the implementation of project-based learning, while students feel that the appearance is attractive, easy to access, and helps to understand biological concepts contextually. Overall, PjBL-based electronic LKPD is declared valid, practical, and effective for use in learning biology on environmental change materials (Rayanto, 2020).

Product Revision

Product revisions are carried out to improve the electronic LKPD based on the results of the trial, input from validators, teachers, and students. This revision is carried out through two stages so that the products produced are really suitable for use in learning.

The first phase of revision is carried out after validation by media experts, material experts, learning experts, and biology teachers. The improvements are focused on improving the technical aspects and appearance of the electronic LKPD to make it more attractive and easy to use. Revisions include adjusting the background color to better contrast with the text, resizing fonts to improve readability, fixing non-working interactive links, and adding instructions for teachers and students. In addition, some parts of the material were revised to be more concise, systematic, and in accordance with the learning outcomes of the Independent Curriculum. Revisions were also made to the project section to be more contextual with local environmental issues in Tarakan City. This improvement effort aims to make the electronic LKPD more user-friendly and support the active involvement of students in the learning process (Meihami & Malmir, 2024).

The second phase of revision was carried out after the readability test was limited to six students in class X. Based on the results of the questionnaire and observations, students gave suggestions to make the LKPD display more attractive and easy to read on smartphone screens. Therefore, improvements are focused on text size, spacing adjustments between paragraphs, and color combinations so as not to cause visual fatigue. Some of the instructions on the project activities were also simplified to make it easier for students to understand. In addition, the interface navigation system has been improved to make interpage links accessible faster. After the second phase of revision is completed, the product is declared ready for re-testing and use in project-based learning activities in the classroom (Sujanem et al., 2022).

Final Product Review

The final product developed is in the form of an electronic LKPD based on Project Based Learning (PjBL) on *Environmental Change* material for class X Phase E of the Independent Curriculum. This LKPD was prepared by paying attention *to learning outcomes* and relevant *learning objectives*, as well as raising real environmental issues in Tarakan City. Through the project approach, students are invited to find solutions to environmental problems by following the stages of PjBL syntax, namely formulating essential questions, preparing project plans and schedules, monitoring progress, assessing results, and reflecting on learning experiences. In addition, assessment instruments were developed to measure two main abilities, namely creative thinking skills and environmental literacy. The aspect of creative thinking is measured through eight description questions, while environmental literacy includes three domains, namely *competencies* with five description questions, *disposition* through ten Likert scale questionnaires, and *knowledge* with fifteen multiple-choice questions.

The validity of the product was tested by two expert lecturers and one biology teacher by assessing aspects of media, materials, and learning. The validation results show that this PjBL-based electronic LKPD is very good and suitable for use in learning activities after going through revisions according to the suggestions of the validators. The instrument for measuring creative thinking skills and environmental literacy is also declared valid and can be used as a measuring tool in accordance with the research variables. Overall, the validation results showed that this product met the criteria for content quality, media appearance, and expected learning effectiveness

5. Conclusion

Based on the results of research and development, it was concluded that the electronic LKPD based on *project-based learning* (PjBL) developed is suitable for use as a learning medium. Validation from material experts, media experts, and learning experts shows that the category is very good, so this product is declared valid in terms of content and appearance. The electronic LKPD is also considered practical to be used in the biology learning process in high school because it is easily accessible and in accordance with the needs of students. In addition, the results of the effectiveness test showed that PjBL-based electronic LKPD was able to significantly improve students' creative thinking skills and environmental literacy.

Based on the results of the implementation, it is recommended that this electronic LKPD be used by high school/MA biology teachers, especially class X, as supporting teaching materials in learning using the PjBL model on the topic of environmental change. This

product can also be used as a reference for other teachers who want to develop similar teaching materials on different topics. In its implementation, the availability of an internet network or Wi-Fi needs to be ensured so that the learning process runs smoothly. In addition, follow-up research is expected to involve more systematic observation to assist teachers in analyzing students' activities and performance while using electronic LKPD.

The research products have been disseminated on a limited basis at SMAN 1 Tarakan and received positive responses from teachers and students. For follow-up, development can be carried out by expanding the trial to other schools that have similar characteristics in order to obtain more comprehensive data related to the effectiveness and feasibility of PjBL-based electronic LKPD in improving creative thinking skills and environmental literacy.

References

Adela Fitria Audry, Hardiansyah, H., & Amalia Rezeki. (2022). Pengembangan E-LKPD pendukung problem based learning pada materi sistem gerak kelas XI. JUPEIS: Jurnal Pendidikan dan Ilmu Sosial, 1(3), 128–139. https://doi.org/10.55784/jupeis.vol1.iss3.158

Al-Hilmiyah, N. A.-A., & Suhartini, S. (2024). Analisis kemampuan literasi lingkungan peserta didik Sekolah Adiwiyata Mandiri. Jurnal Edukasi Biologi, 10(1), 57–72. https://doi.org/10.21831/edubio.v10i1.20358

Anggraini, N., & Nazip, K. (2022). Kemampuan literasi lingkungan mahapeserta didik pendidikan biologi menggunakan skor NELA. Journal of Education Action Research, 6(4), 552–557. https://doi.org/10.23887/jear.v6i4.46975

Ariyana, Y., Pudjiastuti, A., Bestary, R., & Zamroni. (2018). Buku pegangan pembelajaran keterampilan berpikir tingkat tinggi pendukung zonasi. Buku Pegangan Pembelajaran Berorientasi pada Keterampilan Berpikir Tingkat Tinggi, 1–87.

Asep Dudin Abdul Latip, & Asep Supriatna, M. P. (2017). Strategi project based learning (PjBL). Widina Media Utama.

Branch, R. M. (2009). Instructional design: The ADDIE approach. Department of Educational Psychology and Instructional Technology, University of Georgia.

Chong, M.-T., Puah, C.-H., Teh, C.-S., & Affendy bin Arip, M. (2023). Digital connectivity in Making Indonesia 4.0: A priority for digital transformation. Review of Economics and Finance, 21(May 2022), 430–437.

Fadhila, N. A., Setyaningsih, N. W., Gatta, R. R., & Handziko, R. C. (2022). Pengembangan bahan ajar menggunakan model ADDIE pada materi struktur dan fungsi jaringan tumbuhan SMA Kurikulum 2013. BIOEDUKASI (Jurnal Pendidikan Biologi), 13(1), 1. https://doi.org/10.24127/bioedukasi.v13i1.5298

Hake, R. R. (1998). Interactive-engagement versus traditional methods: A six-thousand-student survey of mechanics test data for introductory physics courses. American Journal of Physics, 66(1), 64–74. https://doi.org/10.1119/1.18809

Huang, F. L. (2020). MANOVA: A procedure whose time has passed? Gifted Child Quarterly, 64(1), 56–60. https://doi.org/10.1177/0016986219887200

Kahar, M. I., Cika, H., Nur Afni, & Nur Eka Wahyuningsih. (2021). Pendidikan era revolusi industri 4.0 menuju era society 5.0 di masa pandemi COVID-19. Moderasi: Jurnal Studi Ilmu Pengetahuan Sosial, 2(1), 58–78. https://doi.org/10.24239/moderasi.vol2.iss1.40

Kemendikbud. (2019). Merdeka belajar 11. Kementerian Pendidikan dan Kebudayaan. https://www.kemdikbud.go.id/main/blog/2019/12/empat-pokok-kebijakan-merdeka-belajar

Lestari, D., Erika, F., & Hartati, Y. (2022). Development of learning tools GOAL (Graphic Organizer-Based Argumentation Learning) model to improve students' argumentation skills. Journal of Educational Chemistry (JEC), 4(2), 109–116. https://doi.org/10.21580/jec.2022.4.2.12191

Maydiantoro, A. (2020). Model penelitian pengembangan. Chemistry Education Review (CER), 3(2), 185.

Mayu, D., & Widoretno, S. A. (2024). Kota Tarakan dalam angka: Tarakan municipality in figures 2024. BPS-Statistics of Tarakan Municipality.

Mulyani, A. S. N. D., Syamsiah, S., & L., H. (2023). Keefektifan model project-based learning terhadap kemampuan berpikir kreatif peserta didik SMA pada materi keanekaragaman hayati. Jurnal Jeumpa, 10(1), 176–183. https://doi.org/10.33059/jj.v10i1.7410

Rayanto, Y. H. (2020). Penelitian pengembangan model ADDIE dan R2D2: Teori & praktek. Lembaga Academic & Research Institute.

Sari, D. N., Ningsih, K., & Wahyuni, E. S. (2023). Kelayakan LKPD pendukung inkuiri terbimbing untuk melatihkan keterampilan proses sains pada materi sistem organisasi kehidupan. Bioscientist: Jurnal Ilmiah Biologi, 11(2), 1385. https://doi.org/10.33394/bioscientist.v11i2.9286

Sriwindari, W., Asih, T., & Noor, R. (2022). Pengembangan e-modul pendukung PjBL (Project Based Learning) materi daur ulang limbah untuk mengembangkan berpikir kreatif peserta didik kelas X SMA. Prosiding Seminar Nasional Pendidikan IPA, 12–20.

Sujanem, R., Suwindra, N. P., & Suswandi, I. (2022). Jurnal Pendidikan Fisika Undiksha, 12(1), 154–163.

Umami, F., Wijoyo, S. H., & Rokhmawati, R. I. (2022). Pengembangan e-modul pendukung flipbook menggunakan model pengembangan ADDIE pada peserta didik kelas XI mata pelajaran desain grafis percetakan di SMKN 02 Singosari. Jurnal Pengembangan Teknologi dan Ilmu Komputer, 6(3), 1247–1252.

Wahyuni, R., Siregar, A., Salwa, G., Hillary, G., Napitupulu, J., Siregar, M., Indah, N., & Harahap, S. (2021). Penerapan E-LKPD pendukung project based learning (PjBL) untuk meningkatkan motivasi dan hasil belajar peserta didik. Journal of Natural Sciences, 2(2), 62–71. https://doi.org/10.34007/jonas.v2i2.99

Widiyastuti, D. A., Nurtamara, L., & Ulimaz, A. (2024). Analisis kesadaran dan literasi lingkungan pada mahapeserta didik pendidikan biologi. Jurnal Pendidikan dan Ilmu Biologi, 6(4), 18987–18997.