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Engineering Design Process (EDP)-Based Learning to Enhance High School Students' Creativity in Alternative Energy Topics

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Abstract: The energy issue is one of the 17 Sustainable Development Goals (SDGs), which is a global development agenda that all countries, including Indonesia, must follow. The curriculum plays a crucial role in enhancing students' energy literacy. It is expected that with the energy literacy possessed by students, they will have a good understanding of energy, which will encourage them to use energy wisely. Additionally, it is hoped that creative ideas from students will emerge to address energy-related problems. Based on this background, this research aims to enhance students' creativity in addressing energy issues. The research method employed is a quantitative research method with a Pretest-Posttest Nonequivalent Control Group Design, which is a form of Quasi Experimental Design. The subjects in this study are twelfth-grade science students (XII MIPA) selected through purposive sampling and divided into two groups, namely the control group and the experimental group. The control group uses a project-based learning model, while the experimental group uses project-based learning based on the engineering design process. The number of samples for the experimental group is 33 students, and for the control group, it is 34 students, making a total of 67 research subjects. The creative thinking skills of students are measured using a descriptive test that includes indicators of creative thinking skills, while student creativity in their products is measured using an assessment sheet for creative products based on presentations and testing of creative products carried out at the end of the learning process. The data analysis results show that there is an improvement in students' creative thinking skills, as indicated by the average N-Gain achievement of 53.3%, falling into the moderate category. Additionally, the creativity of student products in all creative product indicators is rated as highly creative, with an average score of 89. The Mann Whitney U Test results indicate a significant difference in the improvement of creative thinking skills and student creativity in their products

Keywords: Creative thinking skills; Engineering design process; Student's creativity

Introduction

Education in the current era faces demands to provide relevant and contextual learning experiences, especially in the context of developing 21st century skills. Jama (2018) states that the 21st century is marked by the very rapid development of information technology, automation, and many jobs that are routine or repetitive work have begun to be replaced by machines, both production machines and computer machines or robots (Indarta et al., 2021). In 21st Century Partnership Learning Framework, there are a number of 21st century skills that must be developed in students in today's learning, namely (1) critical thinking skills and problem solving (2) communication and collaboration skills (3) creativity and innovation skills, (4) information and communication technology literacy, (5) contextual learning skills, and (6) information and media literacy skills (BNSP, 2010).

In the list of several 21st-century skills mentioned above, one of the crucial skills for students to possess and develop is creativity. Creativity is the ability to

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create something new, either really a new thing or a new idea that is obtained by connecting several existing things and making it something new. Leen et al. (2014) states creative thinking skills (creativity) is the ability to find new ideas that are original and unique in solving a problem (Maysyaroh et al., 2021).

Creativity is important in life because it can make people more productive. Apart from that, creativity also improves the quality of life and can make it easier to find a way out of a problem. Torrance (1963) defines that creativity is a person's process when having problems, difficulties, inability in knowledge, becomes someone who is able to identify difficulties, seek modified solutions to problems, and in the end is able to communicate the results of the solution. Munandar (2012) states that creativity is the ability to generate new combinations based on existing data, information, or elements (Anshori et al., 2019).

Based on Sopan (2015) suggests there are 4 indicators of student Creativity, namely Fluency or the ability to express many ideas. Flexibility is the ability to suggest various solutions or approaches to problems. Originality is the ability to spark ideas in ways that are original, not cliche. Elaboration is the ability to describe something in detail (Dinantika et al., 2019).

Creative products are anything offered to the market for consumption or use to satisfy the needs and desires of consumers. The term "product" goes beyond just commercial items but encompasses a variety of objects or ideas, such as new concepts of creativity (Nurkhoerudin et al., 2019). Creative products resulting from a creative process can take the form of ideas, solutions, and performances. Creative products can be tangible (physical) or intangible (conceptual). Tangible products are real and "touchable," like inventions or marketable products. Intangible creative products can include learning and personal development, the development of new services, improvements, social technologies, or the design of new processes or methodologies (Mayasari et al., 2014).

This research focuses on the application of EDP-based project learning in the context of alternative energy materials at the Senior High School (SMA) level. The choice of focus on creativity as the main skill in this project learning is based on the understanding that creativity plays a central role in preparing students to face increasingly complex future challenges.

The engineering design process is one learning approach that can be used to increase student creativity (Syukri et al., 2017). According to Han et al. (2019), the DIGIER model, which is a development of the approach Engineering Design Process, can be a very effective teaching and learning strategy to enhance the scientific creativity and collaboration abilities of scientifically gifted students who will play an important role in the future society (Han et al., 2019) and The Engineering Design Process (EDP) is a new trend in science education reform and many science teachers are poorly informed about the use of EDP in science learning (Winarno et al., 2020).

Alternative energy material was chosen as the content framework because it is not only globally relevant, but also provides great opportunities for creative exploration. Project learning allows students to be directly involved in problem solving and developing innovative ideas related to alternative energy. Through this approach, it is hoped that students will not only gain knowledge about alternative energy, but also increase their creativity in facing problems and creating sustainable solutions.

Based on the national energy balance analysis data, out of the total primary energy supply in Indonesia in 2021, the largest supply comes from coal at 37.6%, followed by oil at 33.4%, and gas at 16.8%. The remaining 12.2% is provided by Renewable Energy Sources, including hydropower, geothermal, solar, wind, and bioenergy (Sekretariat Jenderal Dewan Energi Nasional, 2022). This data shows that the national energy supply still relies heavily on fossil energy sources, which are non-renewable and could threaten national energy security if not balanced with new and renewable energy sources. From the available data, the production of crude oil over the past 10 years (from 2012 to 2021) has shown a declining trend. The same trend is observed in natural gas production. Therefore, efforts are needed to reduce dependence on fossil energy sources. One of the efforts that can be made in the field of education is to enhance students' energy literacy (Yusup, 2017).

The curriculum plays a crucial role in enhancing students' energy literacy. It is expected that with energy literacy, students will have a good understanding of energy, which will encourage them to use energy wisely. Additionally, it is hoped that creative ideas from students will emerge to address energy-related problems, such as creating creative energy-producing products.

In the high school physics curriculum, specific basic competencies related to renewable energy only appeared in the 2013 curriculum revision of 2016. This material is taught to twelfth-grade high school students. However, in the emergency curriculum implemented in 2020, renewable energy topics were among the materials removed. This is problematic because the lack of available curriculum for alternative energy education in schools can lead to a lack of awareness, motivation, and interest among students in the concept of renewable energy (Hoque et al., 2022). Based on data from one study, it is stated that students' scientific literacy skills

are still low when it comes to the topics of effort and energy (Triwibowo et al., 2021).

Thus, this research aims to investigate the extent to which the application of EDP-based project learning can increase high school students' creativity in understanding and overcoming challenges related to alternative energy, making a positive contribution to the development of their 21st century skills.

Method

The type of research used in this research is Quasi Experiments. The research design used is Pretest-Posttest Nonequivalent Control Group Design which is one form of Quasi Experimental Design. On Nonequivalent Control Group Design in this case, researchers used control and experimental groups but group selection was not done randomly (Creswell, 2003). This design is almost the same as pretest-posttest control group design, only in this design the experimental group and control group are not selected randomly (Soegiyono, 2013).

In this study, researchers used 2 groups consisting of 1 experimental group and 1 control group. The learning model in the experimental class is EDP-based project learning, while in the control class the project-based learning model is used. The diagram of the Pretest-Posttest Nonequivalent Control Group Design used in this study can be seen in Table 1.

Table 1. Pretest-Posttest Nonequivalent Control Group Design

Group	Pretest	Treatment	Posttest
Experiment	O_1	X	O_2
Control	O_3	-	O_4

Information:

X = Treatment in the experimental class with EDP-based project learning
O_1 = Pretest experimental class before treatment
O_2 = Posttest experimental class after treatment
O_3 = Pretest control class
O_4 = Posttest control class

The population in this study were students of class XII MIPA SMAS Kosgoro Bogor City, which consisted of 5 classes, namely class XII MIPA 1 to class XII MIPA 5, each class consisting of 27-36 students. Sampling was carried out directly to determine 1 control class and 1 experimental class. In this study class XII MIPA 2 as the control class and class XII MIPA 5 as the experimental class. Each class is divided into 6 groups.

The steps taken in the research were divided into three stages. (1) Preparation Stage. At this stage, researchers prepare research instruments and determine the classes that will be used as research samples. (2) Implementation Stage. At this stage, researchers implemented EDP-based project learning in the experimental class and project based learning in the control class. (3) Analysis and reporting stage. In this stage, the researcher collects and processes data from the test results of students' creative thinking skills and their creativity in creative products from both the experimental and control classes. Conclusions are drawn, and a research report is prepared.

The research instruments used in this study include: Lesson plans with the EDP-based project learning. These lesson plans serve as a reference for teachers during the teaching process. Test questions in the form of open-ended questions consisting of 5 items used to measure students' creative thinking skills. These questions cover various aspects of creative thinking, such as fluency, flexibility, originality, and elaboration. Assessment sheets for students' creative products. These sheets are used to evaluate the creativity of student products based on three indicators: novelty, resolution, and elaboration. These indicators are adapted from Besemer et al. (1981) and are assessed through presentations of the products created by students. Before using these instruments on the sample group, they were subjected to validity and reliability testing using the assistance of the SPSS program. The data obtained from the research, in the form of creative thinking skills test results (pre-test and post-test), are analyzed to calculate N-Gain values to determine the improvement in students' creative thinking skills.

The N-Gain index analysis is conducted to answer the research hypothesis, which aims to determine whether the improvement in students' creativity is better with the implementation of EDP-based project learning compared to students who learn using the Project-Based Learning model alone. The N-Gain index is calculated using the formula developed by Meltzer (Langngan et al., 2021).

N-Gain can be calculated using the following formula:

$$N - Gain\ Score = \frac{posttest - pretest\ score}{maximum\ score - pretest\ score} \quad (1)$$

Where:

- Post-test score is the average score of students on the post-test.
- Pre-test score is the average score of students on the pre-test.
- Max score is the maximum possible score on the test.

Interpretation of N-Gain index results using the N-Gain criteria according to Hake in the Table 2.

Table 2. The Criteria for N-Gain Index

N-Gain Score	Criteria
g < 0.3	Low
0.30 ≤ g ≤ 0.70	Moderate
g > 0.7	High

The assessment of student creative products is done by using a creative product assessment sheet, where each indicator is rated using a scale of 1-5. Scores for each indicator are then summed and converted into a scale of 100 using the following formula:

$$Score = \frac{Obtained\ score}{Maximum\ score} x100\% \quad (2)$$

The scores obtained from student creative products are then interpreted to determine the criteria for student creativity, as presented in Table 3.

Table 3. Criteria on the Value Range of Creative Products (Aini et al., 2023)

Value range (%)	Category
81 – 100	Excelent
61 – 80	Good
41 – 60	Fair
21 – 40	Less
0 – 20	Poor

The data analysis technique for the preliminary test involves testing for normality using the Shapiro-Wilk test when the sample size (N) is less than 100. If the data does not meet the assumption of normality, nonparametric statistics, such as the Mann-Whitney U Test, are used for further analysis. This approach is common when dealing with data that may not follow a normal distribution.

Result and Discussion

The learning carried out in this research is EDP-based project learning on alternative energy materials. The EDP stages that students go through consist of define the problem, research, imagine, plan, create, test and evaluate, redesign, and communicate (Jolly, 2016). Learning is carried out for 4 weeks in accordance with the lesson plan that has been made. Based on the results of observations, in general the entire learning process included in the lesson plan has been implemented.

The goal of this research is to identify student creativity after implementing EDP-based project learning in the context of alternative energy topics. The creativity of students in this context refers to their ability for creative thinking and the creativity of the products they create.

Activities in EDP-based project learning is presented in Figure 1.

Figure 1. Activities in project-based learning based on the engineering design process

Creative Thinking Skills

Students' creative thinking skills are measured using a test consisting of 5 open-ended questions covering 4 indicators of students' creative thinking. The analysis of pre-test and post-test answers from students in the control and experimental groups is presented in Table 4.

Table 4. Pretest, Posttest, and N-Gain Scores

Class	Pretest	Posttest	Score N-Gain (%)
Control	52.24	74.00	44.25
Experimental	49.21	79.76	59.25

Based on the Table 4, it can be observed that the average pretest scores for both the control group and the experimental group are relatively similar, at 52.2 and 49.2, respectively. After implementing EDP-based project learning, there is an improvement in the scores of students' creative thinking skills in both the control and experimental groups. In the control group, the score increases to 74.0 with an N-Gain of 44.3%, while in the experimental group, it reaches 79.8 with an N-Gain of 59.3%, and both fall into the moderate category. The figure shows that the increase in students' creative thinking skills in the experimental class is higher compared to the control class.

The results of the pretest and posttest for each indicator of students' creative thinking skills in both the control and experimental groups are presented in Table 5. Based on the data in Table 5, it can be concluded that EDP-based project learning is capable of improving students' creativity, especially in the elaboration indicator. This is evident from the N-Gain score, where the experimental group shows the highest value compared to the other indicators.

Table 5. The Average N-Gain Values for Each Indicator of Students' Creative Thinking Skills

Indicators of creative thingking	Control Class		Experimental Class	
	N-Gain Score (%)	Category	N-Gain Score (%)	Category
Fluency	0.50	Moderate	0.61	Moderate
Flexibility	0.22	Low	0.46	Moderate
Elaboration	0.55	Moderate	0.68	Moderate
Originality	0.50	Moderate	0.62	Moderate

Fluency is assessed based on participants' ability to generate logical ideas that reflect understanding, not just recalling what has been learned. This research highlights that participants' knowledge insights are a key factor influencing fluency. Flexibility is assessed by the extent to which participants can articulate diverse ideas and demonstrate the ability to view a problem from various different perspectives. In the context of this study, flexibility is influenced by a high level of experience and curiosity.

Elaboration is assessed based on how well participants can describe details of an object or event with the aim of understanding and solving existing problems. Meanwhile, originality is assessed based on participants' ability to create their own work and demonstrate uniqueness in solving a problem. Through efforts to enhance creative thinking with the implementation of project-based EDP learning, this research successfully developed various aspects of students' creative thinking skills. This is evident from the increase in the average pretest and posttest scores for all indicators, with assessment criteria at a moderate level. This is in line with the research conducted by Siew (2016), which states that the EDP approach can be applied as a means to foster creativity, problem-solving skills, and critical thinking skills in students (Siew et al., 2016).

The pretest and posttest results are then used to perform tests for normality and homogeneity to determine the significance of the learning outcomes in the control and experimental groups. Since the sample data is less than 50, the Shapiro-Wilk test is used to determine data normality. The results of the normality test serve as a requirement for subsequent tests. The data from the normality test results are presented in Table 6.

Table 6. Data from the Normality Test Results

Data	Class	Sig.	Data distribution
Pretest	Control	0.776	data is normally distributed
	Experimental	0.110	data is normally distributed
Posttest	Control	0.008	the data is not normally distributed
	Experimental	0.045	the data is not normally distributed

Based on the data in Table 6, it is apparent that the posttest scores for both the control and experimental groups do not follow a normal distribution. Therefore, for the subsequent statistical test, a non-parametric test using the Mann-Whitney U Test is employed. This test is conducted to determine whether EDP-based project learning can improve students' creative thinking skills.

The results of the Mann-Whitney U Test for the posttest yield a p-value (sig.) of 0.038. Since sig = 0.038 < 0.05, it indicates a significant difference in the creative thinking skills of students between the control group and the experimental group.

Creative Products

The assessment of students' creative products is based on presentations and testing of the creative products conducted at the end of the learning process. The results of the assessment of students' creative products are presented in Table 7.

Table 7. Results of the Assessment of Students' Creative Products for Each Indicator

Indicators of creative products	Control Class		Experimental Class	
	Score	Category	Score	Category
Novelty	61.76	Good	85.15	Excelent
Resolution	76.67	Good	88.48	Excelent
Elaboration	78.53	Good	93.33	Excelent
Average	72.32	Good	88.99	Excelent

Based on the Table 7, it is evident that the average score for creative products in the control group is 72.32, categorized as good (creative), while in the experimental group, it is 89.99, categorized as excelent (very creative).

The results of the Mann-Whitney U Test for the scores of students' creative products yield a p-value (sig.) of 0.000. Since sig = 0.000 < 0.05, it indicates a significant difference in the creativity of student products between the control group and the experimental group.

Based on the Table 5 and Table 7, it can be said that EDP-based learning can increase students' creativity, both their creative thinking skills and their creative products. The increase in students' creative thinking skills after implementing EDP-based learning is in line with the results of previous research, such as the results of research by Syukri et al which states that the integration of EDP in learning can increase students' scientific creativity (Syukri et al., 2017). And also the results of Ayaz's research which states that physics learning that integrates EDP is more effective in developing students' creativity skills compared to traditional physics learning methods (et al., 2019).

Conclusion

The implementation of EDP-based project learning on alternative energy materials is able to improve students' creative thinking skills which are needed to be built due to the demands of globalization and the fulfillment of 21st century skills. This is shown from the results of the pretest and posttest conducted before and after learning which show a significant difference between classes control and experimental class.

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Author Contributions

Conceptualization, U.S., D.A. and A.P.; methodology, U.S., and D.A.; validation, D.A., and A.P.; formal analysis, U.S.; investigation, U.S.; resources, U.S.; writing-original draft preparation, U.S.; writing-review and editing, D.A., and A.P.; All authors have read and agreed to the published version of the manuscript.

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Conflicts of Interest

The authors declare no conflict of interest regarding the publication of this paper.

References

Aini, M., & Aini, M. (2023). Enhancing Creative Thinking And Communication Skills Through Engineering Design Process (EDP) Learning Model: A Case Study. *Bioedukasi*, *21*(1), 21. https://doi.org/10.19184/bioedu.v21i1.38022

Anshori, I. Al, Rokhmat, J., & Gunada, I. W. (2019). Penerapan Model Pembelajaran Kausalitik Dalam Meningkatkan Kreativitas Peserta Didik. *Jurnal Pendidikan Fisika Dan Teknologi*, *5*(2), 205–212. https://doi.org/10.29303/jpft.v5i2.1215

Ayaz, E., & Sarıkaya, R. (2019). The Effect of Engineering Design-Based Science Teaching on The Perceptions of Classroom Teacher Candidates Towards STEM Disciplines. *International Journal of Progressive Education*, *15*(3), 13–27. https://doi.org/10.29329/ijpe.2019.193.2

Besemer, S. P., & Treffinger, D. J. (1981). Analysis of Creative Products: Review and Synthesis. *The Journal of Creative Behavior*, *15*(3), 158–178. https://doi.org/10.1002/j.2162-6057.1981.tb00287.x

BNSP. (2010). *Paradigma Pendidikan Nasional Abad XXI* (V. 1.0 (ed.)).

Creswell, J. (2003). *Research Mthods_Qual_Quant Mixed Methods Approaches*.

Dinantika, H. K., Suyanto, E., & Nyeneng, I. D. P. (2019). Pengaruh Penerapan Model Pembelajaran Project Based Learning Terhadap Kreativitas Siswa Pada Materi Energi Terbarukan. *Titian Ilmu: Jurnal Ilmiah Multi Sciences*, *11*(2), 73–80. https://doi.org/10.30599/jti.v11i2.473

Han, H. J., & Shim, K. C. (2019). Development of an engineering design process-based teaching and learning model for scientifically gifted students at the Science Education Institute for the Gifted in South Korea. *Asia-Pacific Science Education*, *5*(1). https://doi.org/10.1186/s41029-019-0047-6

Hoque, F., Yasin, R. M., & Sopian, K. (2022). Revisiting Education for Sustainable Development: Methods to Inspire Secondary School Students toward Renewable Energy. *Sustainability (Switzerland)*, *14*(14), 1–18. https://doi.org/10.3390/su14148296

Indarta, Y., Jalinus, N., Abdullah, R., & Samala, A. D. (2021). 21st Century Skills: TVET dan Tantangan Abad 21. *Edukatif: Jurnal Ilmu Pendidikan*, *3*(6), 4340–4348. https://doi.org/10.31004/edukatif.v3i6.1458

Jolly, A. (2016). STEM by design: Strategies and activities for grades 4-8. *STEM by Design: Strategies and Activities for Grades 4-8*, 1–168.

https://doi.org/10.4324/9781315679976

Langngan, V. B., Tulandi, D. A., & Mandang, T. (2021). Efektivitas Laboratorium Virtual Sebagai Media Pembelajaran Pada Eksperimen Viskositas. *Charm Sains: Jurnal Pendidikan Fisika*, *2*(2), 88–93. https://doi.org/10.53682/charmsains.v2i2.112

Mayasari, T., Kadarohman, R. A., & Rusdiana, D. (2014). Eksplorasi Dimensi Kreativitas Untuk Pengembangan Produk Kreatif Energi Baru Dan Terbarukan. *Jurnal Pengajaran Matematika Dan Ilmu Pengetahuan Alam*, *18*(2), 221. https://doi.org/10.18269/jpmipa.v18i2.54

Maysyaroh, S., & Dwikoranto, D. (2021). Kajian Pengaruh Model Project Based Learning Terhadap Keterampilan Berpikir Kreatif Peserta Didik Pada Pembelajaran Fisika. *ORBITA: Jurnal Kajian, Inovasi Dan Aplikasi Pendidikan Fisika*, *7*(1), 44. https://doi.org/10.31764/orbita.v7i1.4433

Nurkhoerudin, D., Edie, S. S., & Hartono, H. (2019). Unnes Physics Education Journal Kreativitas Mahasiswa Fisika dalam Mendesain Produk Materi Medan dan Gaya. *Unnes Physics Education Journal*, *8*(3). https://doi.org/10.15294/upej.v8i3.35628

Sekretariat Jenderal Dewan Energi Nasional. (2022). *Laporan Analisis Nerasa Energi Nasional*. Sekretariat Jenderal Dewan Energi Nasional.

Siew, N. M., Goh, H., & Sulaiman, F. (2016). Integrating stem in an engineering design process: The learning experience of rural secondary school students in an outreach challenge program. *Journal of Baltic Science Education*, *15*(4), 477–493. https://doi.org/10.33225/jbse/16.15.477

Soegiyono. (2013). *Metode Penelitian Kuantitatif, Kualitatif dan R&D* (19th ed.). Alfabeta.

Syukri, M., Halim, L., & Mohtar, L. E. (2017). Engineering Design Process: Cultivating Creativity Skills through Development of Science Technical Product Muhammad. *Jurnal Fizik Malaysia*, *38*(1), 10055–10065. Retrieved from https://rb.gy/t4cmld

Triwibowo, S., Parno, P., & Latifah, E. (2021). Kemampuan Literasi Sains Siswa SMA Topik Usaha dan Energi. *Jurnal Pendidikan: Teori, Penelitian, Dan Pengembangan*, *6*(11), 1787. https://doi.org/10.17977/jptpp.v6i11.15146

Winarno, N., Rusdiana, D., Samsudin, A., Susilowati, E., Ahmad, N. J., & Afifah, R. M. A. (2020). The Steps of the Engineering Design Process (EDP) in Science Education: A Meta-Analysis. *Journal for the Education of Gifted Young Scientists*, *8*(4), 1345–1360. https://doi.org/10.17478/jegys.766201

Yusup, M. (2017). Analisis Kurikulum Fisika Sma Dalam Perspektif Literasi Energi. *Jurnal Inovasi Dan Pembelajaran Fisika*, 48–53. Retrieved from http://fkip.unsri.ac.id/index.php/menu/104