ENGINEERING DESIGN PROCESS-BASED STEM ON WIND TURBINE PROJECT TO STRENGTHEN RENEWABLE ENERGY AWARENESS AND CRITICAL THINKING SKILLS

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Arranged by:

Hilda Oktapiani

NIM 2109638

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ENGINEERING DESIGN PROCESS-BASED STEM ON WIND TURBINE PROJECT TO STRENGTHEN RENEWABLE ENERGY AWARENESS AND CRITICAL THINKING SKILLS

Oleh

Hilda Oktapiani

Sebuah skripsi yang diajukan untuk memenuhi salah satu syarat memperoleh gelar Sarjana Pendidikan pada Fakultas Pendidikan Matematika dan Ilmu Pengetahuan Alam

Universitas Pendidikan Indonesia

Agustus 2025

APPROVAL SHEET

HILDA OKTAPIANI

ENGINEERING DESIGN PROCESS-BASED STEM-PjBL ON WIND TURBINE PROJECT TO STRENGTHEN RENEWABLE ENERGY AWARENESS AND CRITICAL THINKING SKILLS

Approved and confirmed by

Supervisor I

Dr. Eka Cahya Prima, S.Pd., M.T.
NIP 199006262014041001

Supervisor II

Dr. Nanang Winarno, S.Si., S.Pd., M.Pd.
NIP 198403212014041001

Received by,

Head of Science Education Study Program

Prof. Dr. Phil. Ari Widodo, M.Ed.
NIP. 196705271992031001

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I, the undersigned:

Name	:	Hilda Oktapiani
Student ID	:	2109638
Major	:	International Program on Science Education
Title	:	Engineering Design Process-Based STEM-PjBL on Wind Turbine Project to Strengthen Renewable Energy Awareness and Critical Thinking Skills

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2109638

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ENGINEERING DESIGN PROCESS-BASED STEM ON WIND TURBINE PROJECT TO STRENGTHEN RENEWABLE ENERGY AWARENESS AND CRITICAL THINKING SKILLS

Hilda Oktapiani
International Program on Science Education
Universitas Pendidikan Indonesia
hildaoktapiani@upi.edu

ABSTRACT

This study investigated the effectiveness of integrating the Engineering Design Process (EDP) into STEM learning model to enhance middle school students' renewable energy awareness and critical thinking through wind turbine projects. A quasi-experimental non-equivalent pretest–posttest design was employed with a total of 62 participants: 31 students in the experimental class, which implemented STEM with EDP, and 31 students in the control class, which applied STEM without EDP. Data were collected using awareness questionnaires and critical thinking tests, while student performance was assessed to examine its correlation with the main variables. The data were analyzed using Wilcoxon, Mann–Whitney, t-tests, N-Gain, and correlation analyses. The findings indicated that the STEM-EDP model significantly improved renewable energy awareness, particularly in awareness and knowledge, environmental impact, and attitudes and opinions. Students' critical thinking skills also increased substantially, especially in inferring, evaluating statements, identifying assumptions, and observation, with a large effect size ($\eta^2 = .412$). Although student performance was generally higher in the experimental group, no significant correlation was found between student performance and either awareness or critical thinking. Overall, integrating EDP into STEM proved effective in strengthening students' cognitive skills, with further refinement needed to support affective engagement, reflection, and time management.

Keywords: Critical Thinking Skills, Engineering Design Process, Renewable Energy Awareness, STEM Learning Model

ENGINEERING DESIGN PROCESS BERBASIS STEM PADA PROYEK TURBIN ANGIN UNTUK MEMPERKUAT KESADARAN ENERGI TERBARUKAN DAN KETERAMPILAN BERPIKIR KRITIS SISWA

Hilda Oktapiani
International Program on Science Education
Universitas Pendidikan Indonesia
hildaoktapiani@upi.edu

ABSTRAK

Penelitian ini mengkaji efektivitas integrasi *Engineering Design Process* (EDP) ke dalam model pembelajaran STEM untuk meningkatkan kesadaran energi terbarukan dan kemampuan berpikir kritis siswa SMP melalui proyek turbin angin. Desain penelitian yang digunakan adalah *quasi-experimental non-equivalent pretest–posttest* dengan total 62 partisipan: 31 siswa di kelas eksperimen yang menerapkan STEM dengan EDP, dan 31 siswa di kelas kontrol yang menerapkan STEM tanpa EDP. Data dikumpulkan melalui angket kesadaran dan tes berpikir kritis, sementara kinerja siswa juga dinilai untuk melihat korelasinya dengan variabel utama. Analisis data dilakukan menggunakan uji Wilcoxon, Mann–Whitney, t-test, N-Gain, dan analisis korelasi. Hasil penelitian menunjukkan bahwa model STEM-EDP secara signifikan meningkatkan kesadaran energi terbarukan, terutama pada aspek pengetahuan dan kesadaran, dampak lingkungan, serta sikap dan opini. Kemampuan berpikir kritis siswa juga meningkat secara substansial, khususnya pada keterampilan menyimpulkan, mengevaluasi pernyataan, mengidentifikasi asumsi, dan melakukan observasi, dengan ukuran efek yang besar ($\eta^2 = .412$). Meskipun kinerja siswa secara umum lebih tinggi pada kelompok eksperimen, tidak ditemukan korelasi yang signifikan antara kinerja siswa dengan kesadaran maupun berpikir kritis. Secara keseluruhan, integrasi EDP dalam STEM terbukti efektif dalam memperkuat keterampilan kognitif siswa, dengan kebutuhan perbaikan lebih lanjut pada aspek keterlibatan afektif, refleksi, dan manajemen waktu.

Kata Kunci: *Engineering Design Process*, Kesadaran Energi Terbarukan, Keterampilan Berpikir Kritis, Model Pembelajaran STEM

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