

**ESD-STEM SOLID WASTE MANAGEMENT PROJECT TO ENHANCE
STUDENTS' ENGINEERING DESIGN SKILL AND SUSTAINABILITY
ACTION IN LEARNING ENVIRONMENTAL POLLUTION**

RESEARCH PAPER

Submitted as Requirement to Obtain Degree of *Sarjana Pendidikan* in
International Program on Science Education (IPSE) Study Program



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**SCIENCE EDUCATION STUDY PROGRAM
FACULTY OF MATHEMATICS AND SCIENCE EDUCATION
UNIVERSITAS PENDIDIKAN INDONESIA
2025**

ESD-STEM SOLID WASTE MANAGEMENT PROJECT TO ENHANCE STUDENTS' ENGINEERING DESIGN SKILL AND SUSTAINABILITY ACTION IN LEARNING ENVIRONMENTAL POLLUTION

Oleh
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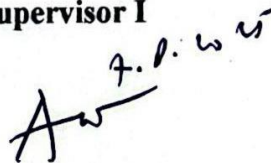
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ESD-STEM SOLID WASTE MANAGEMENT PROJECT TO ENHANCE STUDENTS' ENGINEERING DESIGN SKILL AND SUSTAINABILITY ACTION IN LEARNING ENVIRONMENTAL POLLUTION

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ABSTRACT

Poor solid waste management can lead to significant environmental pollution, and the younger generation needs to be involved in finding solutions. The purpose of this study is to investigate the impact of involving students in ESD-STEM learning through solid waste management projects on improving engineering design skills and sustainability actions. This research used a quasi-experimental design with a convenience sampling, which involved an experimental and a control class. The instruments used included a validated and reliable sustainability action questionnaire and an assessment rubric. The questionnaire to measure changes in student actions was adapted from the Environmental Citizenship Questionnaire (ECQ) and ESD learning goals. The Performance-Based Evaluation Rubric for Assessing and Enhancing Engineering Design Skills (PBER) was used to assess students' engineering design process. The results showed that students' engineering design skills were relatively good, with an average score of 76.5%. Additionally, the results showed a significant difference in the sustainability actions of students in the experimental and control classes after the learning process but with an increase in student action in the experimental class which was still low with an average N-gain score of 0.25. This shows that student involvement through the ESD-STEM solid waste management project has a significant influence on student sustainability actions, although the increase is still relatively low. These results prove that ESD-STEM learning is able to foster students' engineering design skills and sustainability action on environmental issues, but more optimal habituation and assistance are needed for more sustainable impact.

Keywords: Engineering Design Skill, ESD-STEM Project, Solid Waste Management, Sustainability Action

**PROYEK PENGELOLAAN SAMPAH PADAT BERBASIS ESD-STEM
UNTUK MENINGKATKAN KETERAMPILAN REKAYASA DAN AKSI
KEBERLANJUTAN SISWA DALAM PEMBELAJARAN PENCEMARAN
LINGKUNGAN**

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ABSTRAK

Pengelolaan sampah padat yang kurang optimal dapat menyebabkan pencemaran lingkungan yang serius dan membutuhkan keterlibatan generasi muda dalam menemukan solusinya. Penelitian ini bertujuan untuk mengkaji pengaruh keterlibatan siswa dalam pembelajaran ESD-STEM melalui proyek pengelolaan sampah padat terhadap peningkatan keterampilan rekayasa dan aksi keberlanjutan siswa. Penelitian ini menggunakan kuasi-eksperimental dengan *convenience sampling*, yang melibatkan kelas eksperimen dan kontrol. Instrumen yang digunakan meliputi kuesioner aksi keberlanjutan dan rubrik penilaian yang telah dinyatakan valid dan reliabel. Kuesioner untuk mengukur perubahan aksi siswa diadaptasi dari *Environmental Citizenship Questionnaire* (ECQ) dan *ESD learning goals* serta *Performance-Based Evaluation Rubric* (PBER) untuk menilai keterampilan desain rekayasa. Hasil penelitian menunjukkan bahwa keterampilan rekayasa siswa tergolong baik dengan rata-rata skor sebesar 76.5%. Selain itu, hasil menunjukkan adanya perbedaan yang signifikan terhadap aksi keberlanjutan siswa di kelas eksperimen dan kontrol setelah proses pembelajaran dilakukan namun dengan peningkatan aksi siswa di kelas eksperimen yang masih rendah dengan hasil rata-rata N-gain skor sebesar 0.25. Hal ini menunjukkan bahwa keterlibatan siswa melalui ESD-STEM solid waste management project memiliki pengaruh yang signifikan terhadap aksi keberlanjutan siswa, meskipun peningkatannya masih tergolong rendah. Hasil ini membuktikan bahwa pembelajaran ESD-STEM mampu menumbuhkan keterampilan rekayasa dan aksi keberlanjutan siswa terhadap isu lingkungan, namun diperlukan pembiasaan dan pendampingan yang lebih optimal untuk dampak yang lebih berkelanjutan.

Kata Kunci: Aksi Keberlanjutan, Keterampilan Rekayasa, Pengelolaan Sampah Padat, Proyek ESD-STEM

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