PENGEMBANGAN PROGRAM PEMBELAJARAN EKOLOGI BERBASIS *CITIZEN SCIENCE PROJECT* TENTANG PENCEMARAN LIMBAH TAMBANG EMAS DI DAERAH ALIRAN SUNGAI UNTUK MENINGKATKAN KETERAMPILAN PEMECAHAN MASALAH DAN LITERASI LINGKUNGAN CALON GURU BIOLOGI SERTA LITERASI KEBERLANJUTAN MASYARAKAT

DISERTASI

Diajukan untuk Memenuhi Sebagian dari Syarat Memperoleh Gelar Doktor

Pendidikan Program Studi Pendidikan IPA

Oleh

SUSBIYANTO

NIM.2002786

PROGRAM STUDI
PENDIDIKAN ILMU PENGETAHUAN ALAM
FAKULTAS MATEMATIKA DAN ILMU PENGETAHUAN ALAM
UNIVERSITAS PENDIDIKAN INDONESIA
2025

PENGEMBANGAN PROGRAM PEMBELAJARAN EKOLOGI BERBASIS *CITIZEN SCIENCE PROJECT* TENTANG PENCEMARAN LIMBAH TAMBANG EMAS DI DAERAH ALIRAN SUNGAI UNTUK MENINGKATKAN KETERAMPILAN PEMECAHAN MASALAH DAN LITERASI LINGKUNGAN CALON GURU BIOLOGI SERTA LITERASI KEBERLANJUTAN MASYARAKAT

Oleh

SUSBIYANTO

S.Pd., Universitas Jambi, 2010

M.Pd., Universitas Negeri Yogyakarta, 2014

Sebuah Disertasi yang diajukan untuk memenuhi salah satu syarat memperoleh gelar Doktor Pendidikan IPA (Dr.) pada Fakultas Pendidikan Matematika dan Ilmu Pengetahuan Alam

Universitas Pendidikan Indonesia

Juli 2025

SUSBIYANTO

PENGEMBANGAN PROGRAM PEMBELAJARAN EKOLOGI BERBASIS *CITIZEN SCIENCE PROJECT* TENTANG PENCEMARAN LIMBAH TAMBANG EMAS DI DAERAH ALIRAN SUNGAI UNTUK MENINGKATKAN KETERAMPILAN PEMECAHAN MASALAH DAN LITERASI LINGKUNGAN CALON GURU BIOLOGI SERTA LITERASI KEBERLANJUTAN MASYARAKAT

Disetujui dan disahkan oleh panitia disertasi,

Promotor,

Prof. Topik Hidayat, S.Pd., M.Si., Ph.D.
NIP. 197004101997021001

Ko-Promotor,

Prof. Hj. RR. Hertien Koosbandiah Surtikanti, MSc.ES., PhD.
NIP. 196104191985032001

Anggota,

Prof. Dr. H. Riandi, M.Si.
NIP. 196305011988031002

Ketua Program Studi Pendidikan Ilmu Pengetahuan Alam
Fakultas Pendidikan Matematika dan Ilmu Pengetahuan Alam
Universitas Pendidikan Indonesia

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

PERNYATAAN

Dengan ini saya menyatakan bahwa disertasi dengan judul "Pengembangan Program Pembelajaran Ekologi Berbasis *Citizen Science Project* tentang Pencemaran Limbah Tambang Emas Di Daerah Aliran Sungai untuk Meningkatkan Keterampilan Pemecahan Masalah dan Literasi Lingkungan Calon Guru Biologi serta Literasi Keberlanjutan Masyarakat" ini beserta seluruh isinya adalah benar-benar karya saya sendiri, dan saya tidak melakukan penjiplakan atau pengutipan dengan cara-cara yang tidak sesuai dengan etika keilmuan yang berlaku dalam masyarakat ilmiah. Atas pernyataan ini, saya siap menanggung resiko/sanksi yang dijatuhkan kepada saya apabila kemudian ditemukan adanya pelanggaran terhadap etika keilmuan dalam karya saya ini, atau ada klaim dari pihak lain terhadap keaslian karya saya ini.

Bandung, 3 Juli 2025

Yang membuat pernyataan

Susbiyanto

KATA PENGANTAR

Alhamdulillahi robbil ‘alamin, segala puji dan syukur penulis panjatkan ke hadirat Allah SWT atas rahmat, taufik, dan hidayah-Nya sehingga penulis dapat menyelesaikan penelitian dan penyusunan disertasi ini. Judul karya tulis ini adalah ”Pengembangan Program Pembelajaran Ekologi Berbasis *Citizen Science Project* tentang Pencemaran Limbah Tambang Emas di Daerah Aliran Sungai untuk Meningkatkan Keterampilan Pemecahan Masalah dan Literasi Lingkungan Calon Guru Biologi serta Literasi Keberlanjutan Masyarakat”. Penulisan disertasi ini merupakan salah satu syarat untuk memperoleh gelar Doktor Pendidikan dalam bidang Pendidikan Ilmu Pengetahuan Alam

Penelitian ini dilatarbelakangi oleh urgensi untuk mengatasi permasalahan lingkungan, khususnya pencemaran limbah tambang emas di daerah aliran sungai, serta kebutuhan untuk meningkatkan keterampilan pemecahan masalah, literasi lingkungan, dan literasi keberlanjutan. Melalui pendekatan *Citizen Science project*, program pembelajaran ekologi ini dirancang tidak hanya untuk membekali calon guru biologi dengan kemampuan analitis dan praktis dalam menyelesaikan masalah lingkungan, tetapi juga untuk memberdayakan masyarakat dalam memahami dan berpartisipasi aktif dalam upaya pelestarian lingkungan.

Disertasi ini memaparkan proses pengembangan program pembelajaran, implementasi, serta hasil uji efektivitasnya dalam meningkatkan keterampilan pemecahan masalah dan literasi lingkungan calon guru biologi, serta literasi keberlanjutan masyarakat di wilayah yang terdampak limbah tambang emas. Harapan penulis, hasil penelitian ini dapat memberikan kontribusi signifikan, baik secara teoretis maupun praktis, dalam bidang pendidikan biologi dan pengelolaan lingkungan berkelanjutan.

Penulis menyadari bahwa disertasi ini masih jauh dari sempurna dan mungkin terdapat kekurangan di dalamnya. Oleh karena itu, penulis dengan rendah hati menerima kritik dan saran yang membangun dari para pembaca demi penyempurnaan karya ini. Semoga disertasi ini dapat menjadi amal saleh dan memberikan manfaat bagi pengembangan ilmu pendidikan biologi, peningkatan kesadaran lingkungan, serta upaya pelestarian alam di masa depan. Aamiin yaa robbal ‘alamin.

Bandung, Juli 2025

Penulis

UCAPAN TERIMA KASIH

Penulis menyadari bahwa penyelesaian disertasi ini tidak terlepas dari bantuan, bimbingan, dan dukungan dari berbagai pihak. Oleh karena itu, pada kesempatan kali ini, penulis ingin menyampaikan ucapan terima kasih yang tulus serta penghargaan yang setinggi-tingginya kepada yang terhormat:

1. Bapak Prof. Topik Hidayat, S.Pd., M.Si., Ph.D., selaku promotor atas waktu dan kesempatan, arahan dan bimbingan, serta motivasi yang telah diberikan kepada penulis selama penulis menyusun disertasi ini.
2. Ibu Prof. Dr. Hj. RR. Hertien Koosbandiah S., M.Sc., selaku ko-promotor atas waktu dan kesempatan, petunjuk dan koreksi serta dorongan yang telah diberikan kepada penulis selama penulis menyusun disertasi ini.
3. Bapak Prof. Dr. H. Riandi, M.Si., selaku anggota promotor yang dalam kesibukannya selalu memberikan bimbingan, tuntunan dan nasihat kepada penulis dalam penyelesaian disertasi ini.
4. Bapak Prof. Dr. rer. nat. Adi Rahmat, M.Si. selaku Dekan Fakultas Pendidikan Matematika dan Ilmu Pengetahuan Alam (FPMIPA) Universitas Pendidikan Indonesia atas segala fasilitas dan kebijakan yang diberikan selama penulis menempuh pendidikan Doktor.
5. Bapak Prof. Prof. Dr. Phil. Ari Widodo, M.Ed. selaku Ketua Program Studi S3 Pendidikan IPA FPMIPA UPI, beserta staf akademik yang telah memberikan dorongan, kemudahan, dan bantuan dalam menyelasaikan disertasi ini.
6. Seluruh staf dosen, karyawan, dan segenap civitas akademika Prodi S3 Pendidikan IPA FPMIPA UPI yang telah memberikan dukungan secara langsung maupun tidak langsung kepada penulis untuk menggali pengetahuan, pengalaman, dan wawasan sehingga dapat menyelesaikan studi ini dengan baik.
7. Teman-teman seperjuangan S3 Pendidikan IPA FPMIPA UPI angkatan 2020 DAN 2021 yang telah mendukung dan memotivasi penulis selama studi.

Semoga segala amal kebaikan yang telah diperbuat dalam membantu dan mendukung penulis dalam menyelesaikan penelitian dan penyusunan disertasi ini mendapatkan balasan yang setimpal dari Allah SWT, Aamiiin.

Bandung, Juli 2025

Susbiyanto

DEVELOPMENT OF ECOLOGY LEARNING PROGRAM BASED ON A CITIZEN SCIENCE PROJECT ON ARTISANAL GOLD MINING WASTE POLLUTION IN RIVER TO ENHANCE PROBLEM-SOLVING SKILLS AND ENVIRONMENTAL LITERACY AMONG PROSPECTIVE BIOLOGY TEACHERS ALONG WITH COMMUNITY SUSTAINABILITY LITERACY

ABSTRACT

This study developed an ecology learning program grounded in a citizen science project addressing gold mining waste pollution in river basin areas, with the goal of enhancing problem-solving skills and environmental literacy among pre-service biology teachers, as well as promoting sustainability literacy within local communities. The research introduces a contextualized citizen science-based model with dual impacts educational and community empowerment targeted at environmentally degraded mining areas. Employing a mixed methods approach with an exploratory sequential design (QUAN emphasized). The study involved two participant groups, the first group consisted of 30 students from the Biology Education Study Program at a University in Merangin Regency. The second group consists of communities living near gold mining activities, not far from the Batanghari River. Instruments included open-ended problem-solving tests, multiple-choice environmental literacy tests, and sustainability literacy questionnaires. Data were analyzed using the Rasch model. Results indicated a substantial improvement in students' problem-solving abilities, with 70% reaching a very high category and 26.7% classified as high. Only 3.3% remained in the low category. Environmental literacy outcomes were similarly positive, with 66.7% in the very high category and 3.3% high, while no students were categorized as low. In terms of community sustainability literacy, 20.75% of respondents demonstrated very high levels, 32.08% high, 28.30% moderate, and 18.87% low. The findings underscore the effectiveness of citizen science-based ecological education in strengthening problem-solving competencies, fostering environmental literacy among future educators, and promoting sustainability awareness in mining-affected communities. This study highlights the relevance of integrating citizen science into higher education curricula to support eco-pedagogical innovation and participatory environmental stewardship.

Keywords: citizen science project-based ecology learning, gold mining waste pollution, river basins

PENGEMBANGAN PROGRAM PEMBELAJARAN EKOLOGI BERBASIS *CITIZEN SCIENCE PROJECT* TENTANG PENCEMARAN LIMBAH TAMBANG EMAS DI DAERAH ALIRAN SUNGAI UNTUK MENINGKATKAN KETERAMPILAN PEMECAHAN MASALAH DAN LITERASI LINGKUNGAN CALON GURU BIOLOGI SERTA LITERASI KEBERLANJUTAN MASYARAKAT

ABSTRAK

Penelitian ini bertujuan menghasilkan program pembelajaran ekologi berbasis *citizen science project* tentang pencemaran limbah tambang emas di daerah aliran sungai yang dapat digunakan untuk meningkatkan keterampilan pemecahan masalah dan literasi lingkungan calon guru biologi serta literasi keberlanjutan masyarakat. Kebaharuan penelitian diperoleh dalam bentuk program pembelajaran ekologi berbasis *citizen science* yang kontekstual, serta memiliki dampak ganda pada pendidikan dan pemberdayaan masyarakat di wilayah sekitar penambangan emas. Penelitian ini dirancang menggunakan metode *mixed methods* dengan tipe *exploratory sequential design* (*quan emphasized*). Subyek penelitian terdiri dari dua kelompok yang berbeda. Kelompok pertama adalah mahasiswa Program Studi Pendidikan Biologi dari salah satu perguruan tinggi di Kabupaten Merangin, dengan jumlah 30 mahasiswa. Kelompok kedua adalah masyarakat yang tinggal disekitar kegiatan penambangan emas dengan lokasi yang tidak jauh dari Sungai Batanghari. Instrumen keterampilan pemecahan masalah dalam penelitian ini berbentuk soal tes keterampilan pemecahan masalah, terdiri dari 5 soal uraian. Pengukuran literasi lingkungan, dengan menggunakan dua instrument yang berbeda. Instrumen literasi lingkungan dalam penelitian ini disusun dalam bentuk soal tes pilihan ganda dan angket. Instrumen literasi keberlanjutan masyarakat dalam penelitian ini, digunakan dalam bentuk angket. Analisis data dilakukan dengan menggunakan metode analisis Rasch. Hasil penelitian menunjukkan bahwa setelah intrevensi keterampilan pemecahan masalah mahasiswa mengalami peningkatan dimana 70% mahasiswa mencapai kategori kemampuan sangat tinggi, dan 26,7% berada dalam kategori kemampuan tinggi. Hanya 3,3% mahasiswa yang tetap berada dalam kategori kemampuan rendah, dan tidak ada mahasiswa yang berada dalam kategori sangat rendah. Sementara itu, literasi lingkungan mahasiswa menunjukkan peningkatan yang mencolok. Sebanyak 66,7% mahasiswa berhasil mencapai kategori pemahaman sangat tinggi, 3,3% mahasiswa berada pada kategori tinggi dan 30% mahasiswa yang berada kategori rendah serta tidak ada mahasiswa yang berada pada kategori sangat rendah. Di sisi lain, pada litersi keberlanjutan masyarakat terdapat 20,75% responden yang memberikan persetujuan sangat tinggi, 32,08% responden yang memberikan persetujuan tinggi, 28,30% responden yang memberikan persetujuan moderat, dan 18,87% responden yang memberikan persetujuan rendah. Program pembelajaran ekologi berbasis *citizen science project* tentang pencemaran limbah tambang emas di daerah aliran sungai efektif meningkatkan keterampilan pemecahan masalah dan literasi lingkungan calon guru biologi, serta literasi keberlanjutan masyarakat. Temuan ini memberikan implikasi bahwa program berbasis *citizen science* relevan diterapkan dalam perkuliahan ekologi untuk memperkuat kompetensi ekopedagogik dan konservasi berbasis komunitas.

Kata kunci: pembelajaran ekologi berbasis *citizen science project*, pencemaran limbah tambang emas, daerah aliran sungai

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