PENGEMBANGAN MODEL PjBL-NoS DALAM PROGRAM PERKULIAHAN SUMBER ENERGI TERBARUKAN UNTUK MENINGKATKAN LITERASI ENERGI DAN KETERAMPILAN BERPIKIR KREATIF

DISERTASI

Diajukan untuk Memenuhi Sebagian dari Syarat untuk Memperoleh Gelar Doktor Pendidikan Ilmu Pengetahuan Alam

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PERNYATAAN KEASLIAN DISERTASI

Dengan ini saya menyatakan bahwa disertasi yang berjudul "**Pengembangan Model PjBL-NoS Dalam Program Perkuliahan Energi Terbarukan Untuk Meningkatkan Literasi Energi Dan Keterampilan Berpikir Kreatif**" beserta seluruh isinya adalah benar-benar karya saya sendiri. Saya tidak melakukan penjiplakan atau pengutipan dengan cara-cara yang tidak sesuai dengan etika ilmu yang berlaku dalam masyrakata keilmuan. Atas pernyataan ini, saya siap menanggung resiko/sanksi yang dijatuhkan kepada saya apabila dikemudian hari ditemukan adanya pelanggaran etika keilmuan dalam karya saya ini, atau ada klaim dari pihak lain terhadap keaslian karya saya ini.

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KATA PENGANTAR

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Program perkuliahan yang dikembangkan dalam penelitian ini menggunakan model Project-Based Learning (PjBL) yang dikombinasikan dengan *Nature of Science* (NoS). Pendekatan ini dirancang untuk meningkatkan literasi energi mahasiswa sekaligus mengasah keterampilan berpikir kreatif, sehingga mereka tidak hanya memahami konsep sumber energi terbarukan secara teori, tetapi juga mampu menerapkannya dalam konteks nyata. Harapan saya, hasil penelitian ini dapat memberikan kontribusi bermakna bagi dunia pendidikan, khususnya dalam menyiapkan generasi yang mampu menghadapi dan memberikan solusi terhadap permasalahan energi yang kian kompleks.

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PENGEMBANGAN MODEL PjBL-NoS DALAM PROGRAM PERKULIAHAN SUMBER ENERGI TERBARUKAN UNTUK MENINGKATKAN LITERASI ENERGI DAN KETERAMPILAN BERPIKIR KREATIF

ABSTRAK

Penelitian ini bertujuan mengembangkan model pembelajaran Project-Based Learning yang dikombinasikan dengan pendekatan *Nature of Science* (PjBL-NoS) dalam program perkuliahan sumber energi terbarukan. Model ini dirancang untuk meningkatkan literasi energi serta meningkatkan keterampilan berpikir kreatif mahasiswa. Salah satu proyek utama dalam program ini adalah pemanfaatan limbah kulit durian yang melimpah dan tidak pernah habis di daerah lingkungan mahasiswa. Penanganan limbah kulit durian sangat penting di lingkungan mahasiswa penelitian karena limbah ini jika tidak dikelola dengan baik dapat menjadi sumber pencemaran lingkungan yang signifikan. Selain itu, pengembangan teknologi pemanfaatan limbah kulit durian sebagai bahan untuk briket, sel volta, sel elektrolisis dan sumber energi terbarukan lainnya dapat memberikan solusi inovatif yang mendukung keberlanjutan energi sekaligus mengurangi beban limbah organik di lingkungan. Pengembangan model menggunakan model ADDIE kemudian untuk implementasi model menggunakan desain *mixed methods*. Instrumen pengumpul data yang digunakan diantaranya tes literasi energi, tes keterampilan berpikir kreatif, rubrik produk kreatif (non-tes), dan kuisioner respon mahasiswa (non-tes). Karakteristik model PjBL-NoS sebagai berikut: (a) setiap tahap sintaks PjBL disusun secara eksplisit untuk mengintegrasikan aspek NoS, seperti penguatan bukti empiris, kreativitas ilmiah, dan nilai sosial sains; (b) proyek yang dirancang berbasis pemanfaatan limbah kulit durian sebagai sumber energi biomassa, sehingga mendorong keterlibatan langsung mahasiswa dalam isu energi terbarukan berbasis kearifan lokal; (c) penggunaan skenario dan pertanyaan pemicu di setiap fase pembelajaran yang mendorong eksplorasi ilmiah dan diskusi reflektif; serta (d) penilaian tidak hanya menilai produk proyek, tetapi juga proses berpikir kreatif dan literasi energi. Ada peningkatan literasi energi mahasiswa pada aspek sikap dan perilaku, sedangkan pada aspek kognitif berada pada kategori sedang. Terdapat peningkatan juga pada keterampilan berpikir kreatif mahasiswa pada kategori sedang. Aspek peningkatan tertinggi pada aspek mengevaluasi dan memperbaiki ide, sedangkan terendah pada aspek menghasilkan ide-ide yang beragam. Produk kreatif yang dihasilkan mahasiswa berada pada kategori sangat baik. Program perkuliahan sumber energi terbarukan menggunakan model PjBL-NoS yang dikembangkan memiliki keunggulan dalam beberapa hal yaitu: program perkuliahan memberikan pengalaman praktis dan menarik (pemanfaatan limbah kulit durian); meningkatkan minat dan motivasi belajar mahasiswa; memperluas wawasan tentang sumber energi terbarukan; mendorong kreativitas dan inovasi; meningkatkan keterampilan kerja sama dan tanggung jawab kelompok; dan memperbaiki literasi energi dan keterampilan berpikir kreatif. Di samping itu, program perkuliahan sumber energi terbarukan menggunakan model PjBL-NoS yang dikembangkan juga memiliki keterbatasan dalam hal: memerlukan daya

dukung instrumen laboratorium yang lebih lengkap; eksplorasi uji produk yang dilakukan oleh mahasiswa masih terbatas; aspek teknis pelaksanaan harus disempurnakan; dan perlu adaptasi model agar sesuai dengan karakter beragam mahasiswa.

Kata kunci: literasi energi, keterampilan berpikir kreatif, model PjBL-NoS, limbah kulit durian

DEVELOPMENT OF THE PjBL-NoS MODEL IN THE RENEWABLE ENERGY COURSE PROGRAM TO IMPROVE ENERGY LITERACY AND CREATIVE THINKING SKILLS

ABSTRACT

This research aims to develop a Project-Based Learning model combined with the Nature of Science (PjBL-NoS) approach in a renewable energy course. This model is designed to enhance energy literacy and improve students' creative thinking skills. One of the main projects in this program is the utilization of abundant and never-ending durian skin waste in the research area. Handling durian skin waste is very important in the research student environment because this waste if not managed properly can be a significant source of environmental pollution. In addition, the development of durian skin waste utilization technology as a material for briquettes, voltaic cells, electrolysis cells and other renewable energy can provide innovative solutions that support energy sustainability while reducing the burden of organic waste in the environment. The model development used the ADDIE model, then for the implementation of the model using a mixed methods design. The data collection instruments used included an energy literacy test, a creative thinking skills test, a creative product rubric (non-test), and a student response questionnaire (non-test). The characteristics of the PjBL-NoS model are as follows: (a) each stage of the PjBL syntax is explicitly structured to integrate NoS aspects, such as strengthening empirical evidence, scientific creativity, and the social value of science; (b) the project is designed based on the utilization of durian peel waste as a biomass energy source, thus encouraging direct student involvement in renewable energy issues based on local wisdom; (c) the use of scenarios and trigger questions in each learning phase that encourage scientific exploration and reflective discussion; and (d) the assessment not only assesses the project product, but also the creative thinking process and energy literacy. There was an increase in students' energy literacy in the aspects of attitude and behavior, while in the cognitive aspect it was in the moderate category. There was also an increase in students' creative thinking skills in the moderate category. The highest aspect of improvement was in the aspect of evaluating and improving ideas, while the lowest was in the aspect of generating diverse ideas. The creative products produced by students were in the very good category. The renewable energy lecture program using the PjBL-NoS model developed has several advantages, namely: the lecture program provides practical and interesting experiences (utilization of durian skin waste); increases students' interest and motivation to learn; broadens insights about renewable energy; encourages creativity and innovation; improves teamwork and group responsibility skills; and improves energy literacy and creative thinking skills. In addition, the renewable energy lecture program using the PjBL-NoS model developed also has limitations in terms of: requiring more complete laboratory instrument support; product test exploration carried out by students is still limited; technical aspects of implementation must be refined; and the model needs to be adapted to suit the diverse characters of students.

Keywords: energy literacy, creative thinking skills, PjBL-NoS model, durian skin waste

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