

## ABSTRAK

**Sri Ratna Lestari, NIM 8236174004 (2025). Pengembangan Penuntun Praktikum Biologi Molekuler Dasar Berbasis PjBL untuk Meningkatkan Penguasaan Konsep dan Keterampilan Proses Sains Siswa di SMKS Galang Insan Mandiri Binjai.**

Penelitian ini bertujuan untuk mengembangkan penuntun praktikum biologi molekuler dasar berbasis *Project-Based Learning* (PjBL) guna meningkatkan penguasaan konsep dan keterampilan proses sains siswa pada mata pelajaran Projek Ilmu Pengetahuan Alam dan Sosial (PIPAS), khususnya aspek makhluk hidup dan lingkungannya. Penelitian ini menggunakan model pengembangan ADDIE (*Analysis, Design, Development, Implementation, Evaluation*). Subjek penelitian adalah siswa kelas X Program Keahlian Kesehatan dan Pekerjaan Sosial di SMKS Galang Insan Mandiri Binjai. Instrumen pengumpulan data meliputi angket analisis kebutuhan, lembar validasi ahli, angket respon siswa, dan tes penguasaan konsep serta keterampilan proses sains siswa. Penuntun praktikum dikembangkan melalui tiga kegiatan utama: isolasi DNA sederhana, simulasi PCR *in silico*, dan elektroforesis sederhana, yang dirancang sesuai sintaks PjBL. Hasil validasi oleh para ahli menunjukkan tingkat kelayakan sangat baik: ahli materi (92,53%), ahli desain pembelajaran (98,08%), dan ahli desain layout (94,81%). Efektivitas penuntun diuji melalui uji-t dua pihak yang menunjukkan adanya peningkatan signifikan antara kelas eksperimen dan kontrol, baik dalam penguasaan konsep ( $t = 9,299$ ;  $p = 0,000$ ) maupun keterampilan proses sains ( $t = 8,800$ ;  $p = 0,000$ ). Temuan ini membuktikan bahwa penuntun praktikum yang dikembangkan efektif dalam meningkatkan kualitas pembelajaran biologi molekuler serta mampu memfasilitasi siswa dalam menerapkan keterampilan ilmiah yang kontekstual dan kolaboratif. Penelitian ini merekomendasikan implementasi PjBL dalam kegiatan praktikum sebagai strategi pembelajaran vokasi yang relevan dengan kebutuhan abad ke-21.

**Kata Kunci:** Project-based learning, penuntun praktikum, biologi molekuler, penguasaan konsep, keterampilan proses sains

## ABSTRACT

**Sri Ratna Lestari, NIM 8236174004 (2025). The Development of a Project-Based Learning-Oriented Basic Molecular Biology Practicum Guide to Enhance Students' Conceptual Understanding and Science Process Skills at SMKS Galang Insan Mandiri Binjai.**

This study aimed to develop a Project-Based Learning (PjBL)-oriented practicum guide for basic molecular biology to enhance students' concept mastery and science process skills in the Natural and Social Sciences Project, particularly on the topic of living organisms and their environment. The development model used was ADDIE (Analysis, Design, Development, Implementation, Evaluation). The research subjects were grade X students from the Health and Social Work Expertise Program at SMKS Galang Insan Mandiri Binjai. Data were collected through needs analysis questionnaires, expert validation sheets, student response questionnaires, and tests of cognitive understanding and science process skills. The practicum guide consisted of three core activities: simple DNA isolation, *in silico* PCR simulation, and basic electrophoresis, all designed in alignment with PjBL syntax. Expert validation results indicated a high level of feasibility: content expert (92.53%), instructional design expert (98.08%), and layout expert (94.81%). The guide's effectiveness was evaluated through an independent sample t-test, showing significant differences between experimental and control groups in both concept mastery ( $t = 9.299$ ;  $p = 0.000$ ) and science process skills ( $t = 8.800$ ;  $p = 0.000$ ). These findings demonstrate the practicum guide's effectiveness in improving the quality of molecular biology instruction and fostering students' ability to apply scientific processes in a contextual and collaborative manner. The study recommends adopting PjBL-based practicum guides as a relevant instructional strategy for vocational education in the 21st century.

**Keywords:** Project-based learning, practicum guide, molecular biology, concept mastery, science process skills