RANCANG BANGUN *VIRTUAL LAB* FISIKA SERTA IMPLEMENTASINYA DALAM MODEL *INQUIRY LABORATORY* DAN *PHYSICS MEANING ORIENTED LABORATORY* UNTUK MENINGKATKAN LITERASI INKUIRI SAINS DAN EKSPLANASI ILMIAH

DISERTASI

Diajukan untuk Memenuhi Sebagian dari Syarat untuk Memperoleh Gelar Doktor Pendidikan IPA

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Sebuah Disertasi yang diajukan untuk memenuhi salah satu syarat memperoleh gelar Doktor Pendidikan IPA (Dr.) pada Program Studi Pendidikan IPA

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Yang membuat pernyataan,

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Penelitian ini diangkat sebagai upaya untuk meningkatkan literasi inkuiri sains dan eksplanasi ilmiah makasiswa dengan cara mengembangan *Virtual Lab*. Disertasi ini berjudul "Rancang Bangun *Virtual Lab* Fisika serta Implementasinya dalam *Model Inquiry Laboratory* dan *Physics Meaning Oriented Laboratory* untuk Meningkatkan Literasi Inkuiri Sains dan Eksplanasi Ilmiah*"*. Disertasi ini memaparkan bagaimana karakteristik *Virtual Lab* yang dikembangkan untuk pembelajaran fisika. Pengaruh *Virtual Lab* untuk meningkatkan literasi inkuiri sains dan eksplanasi ilmiah mahasiswa menjadi tujuan dari peneliti. Selain itu penelitian ini juga melihat bagaimana tanggapan mahasiswa terhadap *Virtual Lab* yang dikembangkan. Selanjutnya penelitian ini juga membahas kelebihan dan keterbatasan *Virtual Lab* yang dikembangkan di dalam pembelajaran fisika.

Disertasi ini diharapkan dapat memberi bahan masukan kepada dosen dan pendidik dalam upaya meningkatkan dan memperbaiki praktik pembelajaran di lembaganya masing-masing. Sehubungan dengan rendahnya literasi inkuiri sains dan eksplanasi ilmiah sehingga dilakukan sebuah inovasi untuk memperbaikinya. Salah satu jalannya dengan *Virtual Lab* yang dikembangkan dalam pembelajaran fisika.

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Rancang Bangun *Virtual Lab* Fisika serta Implementasinya dalam *Model Inquiry Laboratory* dan *Physics Meaning Oriented Laboratory* untuk Meningkatkan Literasi Inkuiri Sains dan Eksplanasi Ilmiah

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Abstrak

Penelitian ini bertujuan untuk menghasilkan produk *Virtual Lab* (*VL*) yang berkualitas dan teruji dalam mendukung implementasi model-model praktikum fisika inovatif. Metode penelitian yang digunakan adalah DDR. Subjek penelitian adalah 143 mahasiswa fisika yang terdiri dari 4 kelas yang dipilih secara acak. Uji implementasi *VL* dilakukan pada 2 kelas eksperimen dan 2 kelas kontrol. Penelitian ini menghasilkan *VL* dengan karakteristik dapat diakses melalui perangkat *personal computer* maupun laptop, dijalankan dalam *mode offline* maupun *online*, dilengkapi dengan tombol-tombol navigasi yang sederhana, dikembangkan dengan menggunakan software *adobe animate*, dilengkapi dengan alat-alat ukur virtual hasil rekayasa, menghasilkan data akurat, direkomendasikan untuk mendukung kegiatan praktikum yang beorientasi konstruksi pemahaman konten dan pelatihan berbagai keterampilan sains. Kualitas *VL* yang dikembangkan berdasarkan hasil validasi ahli berada pada kategori valid. Usabilitas *VL* memberikan rerata hasil tanggapan pada kategori persetujuan bahwa *VL* mudah digunakan. Implementasi *VL* di dalam *virtual inquiry laboratory* menunjukkan peningkatan LIS mahasiswa dibandingkan dengan kelas kontrol. Implementasi *VL* di dalam model praktikum *virtual PMO laboratory* menunjukkan peningkatan eksplanasi ilmiah pada setiap materi, level eksplanasi, dan tipe eksplanasi dibandingkan dengan kelas kontrol. Hasil uji hipotesis memberikan informasi bahwa terdapat perbedaan yang signifikan diantara kelas eksperimen dan kontrol, sehingga penerapan *virtual inquiry laboratory* secara signifikan dapat lebih meningkatkan LIS dan *virtual PMO laboratory* secara signifikan dapat lebih meningkatkan eksplanasi ilmiah mahasiswa dibandingkan dengan pembelajaran *virtual verification laboratory*. Produk *VL* hasil pengembangan direkomendasikan untuk digunakan untuk mendukung kegiatan praktikum fisika terutama untuk materi-materi yang sulit dipraktikumkan karena keterbatasan alat ukur maupun penciptaan kondisi ideal pengukuran besaran fisis.

Kata Kunci: *Virtual Lab, Inquiry Laboratory, Physics Meaning Oriented Laboratory,* Literasi Inkuiri Sains, Eksplanasi Ilmiah.

Design and Construction of Virtual Physics Laboratory and Its Implementation in Inquiry Laboratory Model and Physics Meaning Oriented Laboratory to Improve Science Inquiry Literacy and Scientific Explanation

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Abstract

This study aims to produce a quality and tested *Virtual Lab* (VL) product in supporting the implementation of innovative physics practicum models. The research method used is DDR. The subjects of the study were 143 physics students consisting of 4 classes selected randomly. The VL implementation test was conducted on 2 experimental classes and 2 control classes. This study produced a VL with characteristics that can be accessed via personal computers or laptops, run in offline or online mode, equipped with simple navigation buttons, developed using Adobe Animate software, equipped with virtual measuring instruments from engineering, producing accurate data, recommended to support practicum activities that are oriented towards the construction of understanding content and training various science skills. The quality of the VL developed based on the results of expert validation is in the valid category. The usability of the VL provides an average response result in the agreement category that the VL is easy to use. The implementation of VL in the virtual inquiry laboratory shows an increase in students' LIS compared to the control class. The implementation of VL in the PMO laboratory virtual practicum model shows an increase in scientific explanations for each material, explanation level, and explanation type compared to the control class. The results of the hypothesis test provide information that there is a significant difference between the experimental and control classes, so that the implementation of the virtual inquiry laboratory can significantly improve LIS and the virtual PMO laboratory can significantly improve students' scientific explanations compared to virtual verification laboratory learning. The VL product developed is recommended for use to support physics practicum activities, especially for materials that are difficult to practice due to limited measuring instruments or the creation of ideal conditions for measuring physical quantities.

Keywords: *Virtual Lab, Model Inquiry Laboratory, Physics Meaning Oriented Laboratory, Science Inquiry Literacy, Scientific Explanation.*

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