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Enhancing Physiology Learning and Practical Experimentation through Task-based Modules and PowerLab Integration in Undergraduate Medical Education: Indonesia

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Abstract

Introduction: Anatomy, histology, biochemistry, and physiology are essential for clinical practice. Task-based learning (TBL) offers an innovative, active learning strategy that aligns with these foundational subjects. Meanwhile, the use of computer-aided data acquisition (data acquisition; DAQ) systems like PowerLab has significantly transformed physiology education through simulation-based experimentation. This study aimed to evaluate the effectiveness of combining TBL and PowerLab in enhancing undergraduate medical students' understanding of physiology.

Methods: This quasi-experimental study included 180 undergraduate medical students from the Faculty of Medicine and Health Sciences at Unismuh. Participants were selected using convenience sampling. A survey consisting of 12 validated Likert-scale questions (Cronbach's alpha=0.84) was conducted to gather students' insights into how PowerLab can be utilized to perform and educate physiology experiments. A task-based module was used in this study, implemented over five sessions, each lasting 120 minutes, and covering topics such as cardiovascular, respiratory, and neuromuscular physiology. Students' cognitive abilities were measured using a pre-post-test consisting of 25 validated multiple-choice questions, a practicum exam, and the final mark of the biomedical course. Data were

analyzed using SPSS version 26.0 and Microsoft Excel. Frequency and summary statistics were analyzed using descriptive statistics.
Results: During experiments with PowerLab, 74.4% of the students demonstrated a good to excellent understanding of physiological concepts. The pre-post-test scores elicited a statistically significant median increase compared to the pre-test score ($p<0.001$). There was also a statistically significant correlation (Spearman's rho=0.82, $p<0.001$) between the practicum exam results and average test scores (Spearman's rho=0.54, $p<0.001$) with the final marks in the biomedical course. However, 30 students (16.7%) showed decreased scores, indicating variability in response to the intervention, requiring further exploration. Additionally, students reported discrepancies between satisfaction (67% excellent) and perceived comprehension (40% average), suggesting gaps between enjoyment and conceptual understanding.
Conclusion: Integrating PowerLab technology with task-based modules enhances understanding and performance in physiology education. These strategies create an engaging, hands-on learning environment that fosters critical thinking and prepares students for clinical practice applications. However, further studies are needed to investigate the reasons behind variability in students' responses, especially those whose scores decreased, and to address observed discrepancies between students' satisfaction and actual comprehension of the physiological concepts.