

Correlation of Basic Medical Laboratory Activities Performance with Grade Point Average of First-Year Medical Students: Insights from New Medical School in Bekasi

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ABSTRACT

Introduction: The surge in medical schools in Indonesia necessitates continuous quality improvement, particularly in curriculum and assessment. This study examines the correlation between first-year medical students' performance in basic medical science laboratory activities and their Grade Point Average (GPA).

Methods: A retrospective observational study was conducted using secondary data from a new Medical School in Bekasi, Indonesia. Student performance was reflected through the average final laboratory scores in the first year, while the GPA encompasses both medical and non-medical courses, totaling 21 credit hours. Data were collected from the university's information system database. Pearson's correlation test was used for normally distributed data, while Spearman's test was applied for non-normally distributed data.

Results: The study included 27 first-year medical students with complete laboratory activity scores and GPA from the first two semesters. Significant positive correlations were found between laboratory performance in all subjects and GPA: Anatomy ($R = 0.789$, $p < 0.0001$), Histology ($R = 0.7810$, $p < 0.0001$), Microbiology ($R = 0.6781$, $p = 0.0001$), and Anatomical Pathology ($R = 0.7024$, $p < 0.0001$). These results highlight a strong correlation between laboratory performance and GPA in new medical school in Bekasi.

Conclusion: This study emphasizes the importance of laboratory-based experiential learning in enhancing academic achievement among first-year medical students. Despite some limitations of this study, future research should explore the additional factors and include more medical schools to better understand the impact of laboratory performance on academic success.

Keywords: basic medical science; grade point average; laboratory; medical school; student performance

INTRODUCTION

Indonesia, a rapidly developing nation in Southeast Asia, has witnessed a significant surge in the establishment of medical schools in recent years, following the government's decision to lift the longstanding moratorium on the creation of new medical institutions. This expansion is driven by several factors, including the country's growing population, the need to address persistent healthcare disparities, and the government's commitment to improving the quality and accessibility of medical education.

The continuous quality improvement of medical schools in Indonesia should be maintained periodically throughout their existence. The development and implementation of a robust curriculum,

coupled with effective assessment and quality assurance processes, are essential components of ensuring continuous quality improvement in medical schools^{1,2}. Medical education plays a pivotal role in shaping the future of healthcare, and the success of this endeavor hinges on the implementation of effective learning delivery methods³. Problem-based Learning (PBL) is based on principles of adult learning theory, including the student's motivation, encouragement to set goals, and critical thinking about decision-making in day-to-day operations⁴. The medical education curriculum is often implemented through a variety of delivery methods, such as tutorial discussions, laboratory activities, and clinical skill laboratories, to provide comprehensive training for medical students⁵.

One crucial aspect of this curriculum is the role of basic medical science laboratory activities, which serve as the foundation for the subsequent stages of medical education. Basic medical science laboratory activities play a pivotal role in equipping medical students with the necessary knowledge and skills to navigate the complexities of clinical practice. Another challenge in biomedical science education is the inherent complexity and the requirement for detailed understanding. This necessitates that students develop a deep comprehension of biomedical concepts⁶. These hands-on experiences allow students to apply the theoretical concepts learned in the tutorial class, fostering a deeper understanding of the subject matter⁷. Furthermore, research has shown that the performance of medical students in these laboratory activities can have a direct correlation with their overall academic achievement, as measured by their grade point average⁸.

The development of educational curricula is by nature driven by the discipline itself, and medical educators must be held accountable for the outcomes of their interventions, especially in new medical schools. The implementation of basic medical science laboratory sessions for first-year students should be evaluated to determine whether it supports student understanding of medical science and correlates with Grade Point Average (GPA). This study aims to analyze the correlation between students' performance in laboratory sessions and their GPA in the first year. The findings of this research are expected to assist first-year students in formulating plans and strategies to improve their GPA.

METHOD

Study Design

The research design is a retrospective observational study employing secondary data conducted at the Faculty of Medicine in Cikarang, Indonesia. The study population consists of first-year medical students. The inclusion criteria for study subjects are as follows: Officially registered as first-year students within the Faculty of Medicine, Have scores of laboratory activity final examination from each block, Have grade point average from first-two semesters. Exclusion criteria apply to subjects who: lack of scores from laboratory activity examinations.

Sampling Technique

A census incorporating all first-year medical students at President University who meet the specified inclusion and exclusion criteria was conducted.

Data Collection

The necessary data will be collected using a structured approach. This will involve using secondary data available from the database maintained by the Faculty of Medicine at President University. Secondary data collected was from institution's information system database containing Grade Point Average and laboratory activity grades of first-year medical students. The final grades reflected student's performance in basic medical laboratory activities including anatomy, histology, microbiology, and anatomical pathology.

The laboratory activities are conducted through several consistent stages. First, the practical session begins with a pre-test, followed by a brief introductory lecture, a case study as a trigger, the

main practical procedure, discussion, and reflection, and concludes with a post-test. The introductory lecture explains the learning objectives that students must achieve, presents the case study as a trigger, and provides an explanation of the practical procedure steps. Students were asked to do some assignments from anatomy and microbiology laboratories. The final grades were concluded from the post-test, assignment, and final examination of laboratory activities.

The Grade Point Average (GPA) of first-year students is derived from 21 credit hours of subjects and blocks. Nine credit hours are from general compulsory university courses, and 12 credit hours are from medical subjects or blocks.

Statistical Analysis

For data analysis, correlation methods are selected based on data distribution. Pearson's correlation test is used for normally distributed data, whereas Spearman's correlation test is required for non-normally distributed data. The strength of the relationship between variables is measured from very weak (0.0 to less than 0.2) to very strong (0.8 to 1.00), according to Dahlan's classification in 2014. A result is deemed significant if the p-value is less than 0.05. This analysis is frequently performed using GraphPad Prism version 9, which facilitates statistical data processing.

Ethical Approval

This study has received ethical approval from the ethics committee of Universitas Indonesia with the number: KET-788/UN2.F1/ETIK/PPM.00.02/2024. Several measures are taken to safeguard the confidentiality and security of the secondary data in this research, including data anonymization, limited access permission, non-disclosure agreements, data deletion after completion of the research, and removal of personal identification data following anonymization.

RESULT

Characteristics of Study Participants

Among 31 students, four students did not have a complete final grade of laboratory activity. Therefore, 27 students were included in this study. The baseline characteristic of 27 students is exhibited in Table 1. The majority of participants come from A-accredited high schools and are female.

Table 1. Baseline characteristics of study participants

Characteristics	All participants (n= 27)
Gender	
Male	5
Female	22
Grade point average (mean)	3.39 ± 0.33
Final scores of lab activity examination	
Anatomy (mean)	62.40 ± 9.373
Histology (mean)	61.46 ± 21.62
Microbiology (mean)	64.53 ± 21.48
Anatomical Pathology (median)	70
Senior high-school accreditation	
A	24
B	1
Not accredited	2

Student's Lab Activity Performance Correlates with Grade Point Averages

The performance of laboratory activities across all first-year basic medical science laboratories shows a significant correlation with the GPA of medical students (Table 2). Specifically, the Pearson correlation analysis indicates strong positive correlations between GPA and Anatomy Laboratory, GPA

and Histology Laboratory, and GPA and Anatomical Pathology Laboratory. Similarly, a substantial positive correlation is observed between GPA and the Microbiology Laboratory.

Table 2. Correlation of basic medical science laboratory performances with student's GPA

Variables	R	P value	95% CI
Anatomy Laboratory and GPA	0.789	<0.0001	0.5841 to 0.8994
Histology Laboratory and GPA	0.7810	<0.0001	0.5702 to 0.8953
Microbiology laboratory and GPA	0.6781	0.0001	0.4016 to 0.8413
Anatomical Pathology Laboratory and GPA	0.7024	<0.0001	0.4301 to 0.8575

The strength of the correlation between GPA and the Anatomy Laboratory performance falls within the 'strong' category, reflecting a high degree of association between these variables. Likewise, the correlation between GPA and Histology Laboratory performance is also categorized as 'strong,' indicating a robust relationship. The association between GPA and Microbiology Laboratory performance, while slightly lower, still represents a 'moderate to strong' correlation, signifying a substantial link between these variables.

Lastly, the correlation between GPA and Anatomical Pathology Laboratory performance, despite the non-normal distribution of the Anatomical Pathology scores, is classified as 'strong.' This consistent pattern of strong correlations across different laboratory subjects underscores the importance of laboratory performance in influencing overall academic success in medical education.

The Kolmogorov-Smirnov test results indicate that only the Anatomical Pathology scores significantly deviate from a normal distribution, with a p-value of 0.0077. All other datasets, including GPA, Anatomy, Histology, and Microbiology, follow a normal distribution (Supplementary 1). Consequently, Pearson correlation analysis was employed for these normally distributed datasets

DISCUSSION

The Role of Laboratory Activities Performance in Grade Point Averages

The data demonstrates that first-year medical students' performance in basic medical science laboratories is significantly associated with their GPA, with all analyzed variables exhibiting moderate to strong positive correlations. Medical schools have recognized the importance of providing students with hands-on experience in laboratory settings to complement their theoretical knowledge. This approach aligns with the growing emphasis on active learning strategies, which have been shown to enhance student engagement and knowledge retention⁹.

While traditional lecture-based instruction remains a cornerstone of medical education, medical schools have also incorporated innovative pedagogical approaches, such as basic science workshops, to facilitate the application of fundamental scientific concepts to clinical case studies and scenarios¹⁰. These activities not only reinforce the theoretical underpinnings of medical science but also foster critical thinking and problem-solving skills, which are essential for future clinical practice⁹.

The academic performance of medical students is a critical concern for medical educators, as it directly impacts the quality of future healthcare professionals. Recent studies have investigated the relationship between various factors and academic achievement in medical education. One such factor is the performance of medical students in basic medical laboratory courses, such as anatomy, histology, pathology, and microbiology. Research has shown that students' scores in these foundational courses can be an early indicator of their overall academic performance throughout medical school⁸.

One potential factor that has received limited attention is the impact of laboratory activities on student GPA. Laboratory activities, which offer students the opportunity to engage in hands-on experiential learning, may have a significant influence on the academic performance of students, particularly those who have demonstrated a strong aptitude for academic achievement as indicated by their GPA¹¹. Previous studies show that students who experience hands-on laboratory work achieve

higher academic performance than those who participate in virtual labs. These studies also indicate that hands-on lab activities enhance students' self-perceptions regarding their persistence in the sciences.¹² Maintaining a high-grade point average is a crucial aspect of academic success, and understanding the factors that contribute to strong academic performance is essential for educational institutions¹³.

As a new medical school, the assessment methods were designed to measure all aspects of student's abilities, such as cognitive, psychomotor, and attitude. The assessment of student performance in our setting was performed through the final block, objective-structured clinical examination, general compulsory university course assignments, and examinations that require critical thinking and problem-solving skills. Laboratory activities reinforced student's engagement, so they could conduct more active learning.

These findings suggest that excelling in laboratory activities is crucial for achieving higher academic performance in medical school. In this context, laboratory activities may offer students the opportunity to develop a deeper understanding of course content, improve their critical thinking and problem-solving skills, and foster a sense of engagement and self-confidence, all of which could contribute to enhanced academic performance¹⁴. These findings indicate that the laboratory activities conducted align with other teaching methods. Alignment in teaching methods within medical education is a crucial factor in student achievement¹⁵.

These findings suggest that early assessment of students' performance in basic medical laboratory courses could be a useful tool for identifying those who may require additional support or intervention to ensure their academic success^{16,17}. Medical educators should consider incorporating strategies to strengthen students' foundational knowledge in these critical subject areas, as this may have a significant impact on their overall academic trajectory. This result encourages the stakeholders to support the facilities, infrastructure, and instruments of the basic medical science laboratories in the Faculty of Medicine. Another study reported that the development of physical facilities at public schools in Pakistan influences student academic achievement. Proper laboratory facilities and equipment can provide students with the necessary resources and tools to effectively apply theoretical knowledge in practical settings, gain hands-on experience, and develop critical thinking and problem-solving skills essential for their future medical practice¹⁸.

Study limitations

Several variables that might affect GPA were not examined in this study. An existing research suggests that various factors, such as sleep patterns, self-confidence, and study habits, can influence academic performance in college¹⁹⁻²¹. Additionally, research has shown that students' personality traits, personal status, lifestyle behaviors, and learning behaviors can all impact their academic achievement²². Future research should consider investigating these variables and should also include more students to comprehensively assess the impact of laboratory activity performance to academic achievement in first-year medical students in the new medical school settings.

CONCLUSION

This study highlights the significant correlation between first-year medical students' performance in basic medical science laboratory activities and their GPA. The findings underscore the importance of laboratory-based experiential learning in enhancing academic achievement, so the resources to develop excellent basic medical science laboratories for undergraduate medical students need to be considered. However, the study's limitations, including the exclusion of non-medical course grades and unexamined variables such as motivation, sleep patterns, self-confidence, and study habits, suggest the need for further research. Future studies should explore these factors and include additional medical schools and more medical students to provide a more comprehensive understanding of the impact of laboratory activities on academic success.

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CONFLICT OF INTEREST

The authors declare that no conflict of interest exists in this study

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