

## Evaluation of medical parasitology learning activity in undergraduate medical and nursing students at Universitas Padjadjaran

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### ABSTRACT

As a tropical country, the incidence of infectious diseases caused by parasites in Indonesia is still high. Therefore, local medical and nursing students need to be equipped with adequate knowledge of medical parasitology. Considering that education is affected by several variables, summative evaluation at the final examination seems unable to demonstrate the clear effect of learning experiences on the level of students' comprehension. Consequently, a study was conducted using pre- and post-test scores to determine the degree of comprehension after learning medical parasitology of undergraduate medical and nursing students at the faculty of medicine and nursing, respectively, at the Universitas Padjadjaran. A cross-sectional design was used focusing on secondary data, which included 1,271 samples from pre- and post-test scores from medical parasitology lectures and laboratory activities at the university. A paired *t*-test and an alternative Wilcoxon signed-rank test were used to analyze the data. The comparison analysis of post-test and pre-test scores in laboratory activities showed a significantly increase in the classes of 2015 (40.70 vs. 85.78;  $p < 0.001$ ), 2016 (46.11 vs. 88.17;  $p < 0.001$ ), 2017 (50.00 vs. 92.86;  $p < 0.001$ ), and 2018 (39.13 vs. 90.48;  $p < 0.001$ ). Similarly, following a lecture on nematode and cestode, the scores increased significantly in the classes of 2017 (14.29 vs. 52.38;  $p < 0.001$ ) and 2018 (33.33 vs. 90.48;  $p < 0.001$ ). Furthermore, there was a significant score increase after the protozoa lecture in the 2018 class (26.67 vs. 86.67;  $p < 0.001$ ). This study found that both lectures and laboratory activities at the Universitas Padjadjaran improved the students' understanding of medical parasitology.

**Keywords:** learning evaluation, medical parasitology, pre-test, post-test, understanding level



## 1. INTRODUCTION

Tropical infectious diseases remain a major problem in Indonesia, which is located in a tropical climate zone. In 2013, the incidence of dengue fever was recorded at 35–40 cases per 100,000 populations in Indonesia. In addition, Indonesia still has other neglected tropical infectious diseases such as lymphatic filariasis (11,912 cases in 2013) (Wibawa *et al.*, 2016; Haryanto, 2018). Therefore, medical and nursing students in Indonesia must be well-versed in the causes of infection, especially parasites. Therefore, the teaching method is critical to develop competent health workers, while an evaluation of the effectiveness of the learning is needed to meet the needs of Indonesia.

The students' level of understanding is routinely evaluated at the end of a semester through examinations (Kirkpatrick *et al.*, 2008). The results of the summative assessment, however, does not show the direct impact of the learning method on the level of students' understanding because it might be influenced by various factors (Spurlock, 2018). Furthermore, several courses have implemented pre- and post-test quizzes as formative assessment to assess the level of students' understanding, such as in the medical parasitology course.

Therefore, to determine the level of students' knowledge on medical parasitology courses in the medical and nursing undergraduate programs of the Faculty of Medicine and Faculty of Nursing, respectively, at the Universitas Padjadjaran, this study was conducted through analysis of pre-test and post-test scores.

## 2. METHODS

### Study design

This research was an analytical study and conducted from August to November 2019 at the Faculty of Medicine, Universitas Padjadjaran, Indonesia.

### Sampling

The study evaluated secondary data taken retrospectively from online pre-test and post-test assessments in medical parasitology learning in medical and nursing undergraduate programs at the Universitas Padjadjaran. A total sampling technique was adopted. The inclusion criteria included active students who registered in the academic year when the medical parasitology course was offered, participated in general lecture learning or laboratory activities, and participated in pre-test and post-test evaluations. The exclusion criteria were students who already participated in medical parasitology courses in the previous academic year. The total score data obtained were 1,309 students. However, 25 samples did not meet the inclusion criteria and 13 were excluded because they were repeating the medical parasitology courses. The final sample size analyzed was 1,271 samples (97%).

### Research data

The research data were the scores of all pre- and post-tests from lecture or laboratory activities. Each learning method had different types and weights of pre-test and post-test questions. The sample size for laboratory activities with the topic of helminth in 2018 was 278 students. The sample sizes in laboratory activities with the topic of zoonoses in the 2017, 2016, and 2015 classes were 275, 248, and 171 students, respectively. The sample sizes in general lecture activities with the topic of nematodes and cestodes in the 2018 and 2017 batches were 150 and 149 students. The sample size in general protozoa lectures in the 2018 class was 139 samples. Students of the Nursing Undergraduate Program who took part in general lectures on the topic of nematodes & cestodes in class 2017 were divided into 2 learning sessions, namely morning and afternoon sessions. Students who took part in general lecture on nematodes and cestodes and protozoa topics in the 2018 class only had 1 learning session. Mean while, medical undergraduate students who took part in laboratory activities in the 2016, 2017, and 2018 batches were divided into six learning sessions, namely Monday morning and afternoon, Wednesday morning and afternoon, and Friday morning and afternoon. Medicine Undergraduate students who took part in laboratory activities in batch 2015 were divided into four learning sessions, namely Wednesday morning and afternoon, Thursday morning and afternoon.

### Data analysis

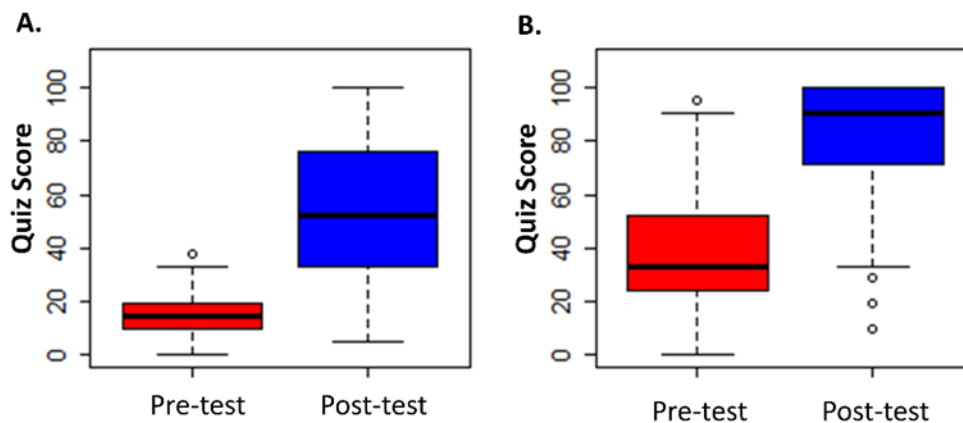
Students' score data was expressed as a percentage (acquired score/total score × 100%) then analyzed using the paired *t*-test with the alternative Wilcoxon signed rank test using R 3.6.0 for Windows. The results of data analysis using paired *t*-test was displayed in an error bar graph and data analysis using the Wilcoxon signed rank test which was displayed in the form of a boxplot graph. Graphs of the results of data analysis were grouped according to their batch and learning methods. All statistical tests were carried out at the significance level ( $\alpha$ ) of 0.05.

### Ethical clearance

This study has been reviewed by the research ethics committee Universitas Padjadjaran and obtained ethical exemption (NO. 1346/UN6.KEP/EC/2019)

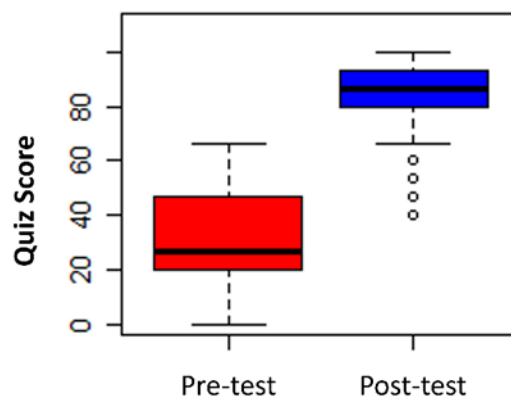
### 3. RESULTS

In the nematodes and cestodes lecture, students of the nursing undergraduate program class of 2017 and 2018 had higher post-test scores compared to the pre-test ones. The median scores of the 2017 and 2018 batches of post-test increased significantly compared to the pre-test (14.29 vs. 52.38;  $p < 0.001$ ) and (33.33 vs. 90.48;  $p < 0.001$ ). The difference between median post- and pre-test for general lectures in 2017 and 2018 were 41.48 and 42.86, respectively. However, there were 8 students who scored very low (Figure 1).



**Figure 1** Comparison of the pre- and post-test scores in the general lecture activities for nematodes and cestodes for undergraduate nursing program students (A) batch 2017 and (B) 2018. Data were presented as median  $\pm$  interquartile range. Statistical analysis between two groups was tested using Wilcoxon signed rank test; (A)  $p < 0.01$ , (B)  $p < 0.01$ .

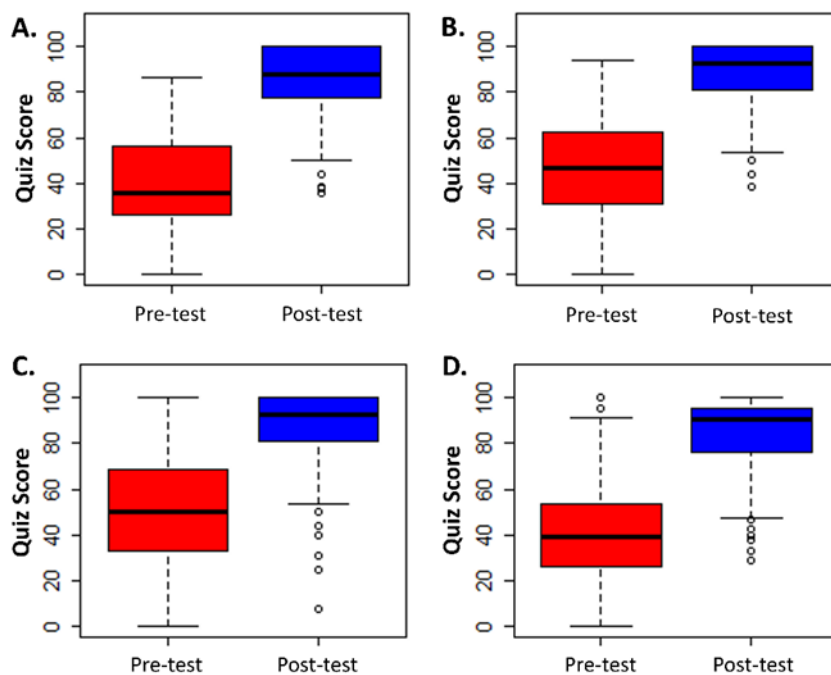
In the general protozoa lectures, students of the 2018 batch from the nursing undergraduate program had a higher post-test score compared to the pre-test ones. The median of both tests increased significantly (26.67 vs. 86.67;  $p < 0.001$ ). The difference in median post-test and pre-test for general lectures was 50.00. However, there were 11 students who scored very low (Figure 2).



**Figure 2** Comparison of the pre-test and post-test scores from the lecture activities on the protozoa lectures among 2018 undergraduate nursing students. Data were presented as median  $\pm$  interquartile range. Statistical analysis of two groups was evaluated using Wilcoxon signed rank test;  $p < 0.01$ .

From the laboratory activities, the medical undergraduate students of the 2017 and 2018 class had higher post-test scores compared to pre-test ones. The 2017 and 2018 post-test median compared to the pre-test increased significantly (50.00 vs. 92.86;

$p < 0.001$  for 2017 and 39.13 vs. 90.48;  $p < 0.001$  for 2018). The difference of post-test medians and pre-test laboratory activities in the 2017 and 2018 class were 37.50 and 44.74, respectively. From the laboratory activities, the students in the 2015 and 2016 classes had higher post-test scores compared to pre-test ones. The mean post-test value in 2016 compared to pre-test increased significantly (40.70 vs. 85.78;  $p < 0.001$ ) and (46.11 vs. 88.17;  $p < 0.001$ ). The difference between the mean post-test and pre-test laboratory activities in the 2015 and 2016 batches were 45.07 and 42.06, respectively. However, there were 39 students who have extreme low scores (Figure 3).



**Figure 3** Comparison of the pre-test and post-test scores from laboratory activities on Zoonosis for (A) 2015, (B) 2016, and (C) 2017 students, and on helminthology for (D) 2018 undergraduate medical students. Data were presented as median  $\pm$  interquartile range. Statistical analysis between the 2015 and 2016 classes were tested using paired t-test, (A)  $p < 0.01$ , (B)  $p < 0.01$ ; differences between the 2017 and 2018 classes were tested using Wilcoxon signed rank test, (C)  $p < 0.01$ , (D)  $p < 0.01$ .

The median value from general nematodes and cestodes lectures for students of the 2017 and 2018 undergraduate nursing program increased by 266.55% and 171.47%. The median from general lectures on protozoa among 2018 undergraduate nursing students were increased by 224.97%. The median values from laboratory activities on zoonoses among undergraduate medical students of 2017 were increased by 85.72%. The median values from laboratory activities on helminthology among undergraduate medical students of the 2017 class were increased by 131.23%. Lastly, the average value from laboratory activities on zoonosis for 2015 and 2016 medical students are increased by 145.03% and 98.97%.

#### 4. DISCUSSION

The low scores were outside the range of quartiles 1 and 3 in the distribution of the pre- or post-test score data. Extreme low values occurred due to various factors, including the low capability of students to learn. Therefore, the level of understanding on medical parasitology from general lectures or laboratory activities did not increase significantly. In addition, extreme scores included pre-test and post-test from students with previous topic-related learning, hence the pre-test and post-test scores obtained did not match the level of knowledge obtained from the learning activities (Semkins *et al.*, 2000). Pre-testing was an initial diagnostic tool to measure the level of understanding before the start of the lectures, while the post-test was a formative assessment tool to measure the level of understanding after the lectures. The increase in the post-test score compared to the pre-test shows that there was an increase in student understanding after the lecture (Sun *et al.*, 2013; Shivaraju *et al.*, 2017; Madeni *et al.*, 2011). A study conducted by Shivaraju in 2017 stated that assessing the level of understanding using pre-test and post-test was an effective way to assess actual learning (Shivaraju *et al.*, 2017).

The median pre-test and post-test scores of student's from general lecture activities were lower than those from laboratory activities. This might have occurred due to the student population who participated in different learning activities, causing bias in the data analysis. The significant difference in the scores achieved from general lectures compared to laboratory activities did not appear to be influenced by the much larger number of students in general lectures, confirming Mahlo's research on the total ratio of teachers to students and the lack of significant influence on learning comprehension (Mahlo, 2015). Lower scores from general lectures may be related to a lack of maintained attention during the lecture as revealed by Wilson et al., (2007). They discovered that the research that underpins this estimation offers little support for the belief that students' interest begins to wane after 10 to 15 min. The research, however, failed to consider individual variations in focus. The results suggest that when lecturing, teachers should account for individual variations in student attention and assess if students are documenting the appropriate content of the lecture in their notes (Wilson *et al.*, 2007).

Laboratory learning activities tend to produce higher knowledge retention rates compared to conventional learning activities such as general lectures. Learning in the laboratory may reflect various ways, including observation of a phenomenon, hands-on practical experience, and experimentation. The primary goal of organizing laboratory activities is to acquire learning and improve functional knowledge, which is often beyond their field of expertise. Laboratory learning allows students to apply and reinforce the theory learned from lectures. It also aims to achieve a variety of learning outcomes, including experiential learning (Ka Yuk Chan, 2012; Franco Valdez *et al.*, 2018).

Based on the findings in this study, the following recommendations are proposed. Confounding variables in learning activities and quiz questions must be considered more thoroughly so that the post-test outcomes improve as a result of learning activities. Students with extremely low values need extra consideration in order to receive appropriate treatment during the learning process, allowing the goals to be met optimally for all the students. The sample in the study should be derived from the same population to reduce bias in the study.

## 5. CONCLUSION

Both general lectures and laboratory activities can significantly increase post-test scores from medical parasitology learning at the Universitas Padjadjaran. Learning activities had an impact on increasing understanding. Post-test scores from laboratory activities produce higher scores than learning solely from general lectures. However, some students with low scores need more attention after the learning activities evaluated.

### Conflict of interests

Authors declare no conflict of interests in this study.

### Acknowledgement

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### Data and materials availability

All data associated with this study are present in the paper.

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