# Performance Analysis of an Anatomy Course between the Students of Second-degree Bachelor of Science in Nursing and School of Nursing

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**Purpose:** The social demand for second-degree Bachelor of Science in Nursing (BSN) has become increasingly significant in addition to the demand for the School of Nursing (SN). Previous studies showed that BSN students displayed better academic performance than SN students and that biological sciences were fundamental in nursing. However, research that investigates the academic performance of BSN and SN students in Taiwan is lacking. Thus, the present study aims to compare the academic performance between BSN and SN students in anatomy. Specifically, the study analyzes whether or not students who underwent biology classes displayed better performance in anatomy. **Methods:** Grades of 29 BSN and 37 SN students were collected. However, two BSN students did not provide information about completion of a biology course. The collected scores included midterm lecture, midterm laboratory, final lecture, and final laboratory. Scores in anatomy were first compared to give a background of the academic performance of the BSN and SN students. Students were divided into two groups, namely, took-biology-class and no-biology-class. Then, t-test was conducted to analyze whether the took-biology-class students performed better than the no-biology-class students in anatomy. **Results:** No significant difference was observed between the BSN and SN students in terms of academic performance in anatomy, which indicates a similar level of performance between the two groups. However, the mean of the less-than-median and greater-than or equal-to-median scores of the took-biology-class students was significantly higher than those of the no-biology-class students in the final laboratory exam. This result suggests that students who took a biology class performed better in the laboratory exam for anatomy. **Conclusions:** Results could eliminate the concern about the quality of the BSN course. Moreover, the study proposes that biology class could be used as one of the screening factors for admission selection. Although this research is a pioneering study related to BSN programs in Taiwan, further studies are required to monitor academic performance and evaluate teaching methods to enhance student success in BSN.

**Key words: second-degree Bachelor of Science in Nursing, School of Nursing, anatomy course, biology class**

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## INTRODUCTION

Nurses play an active and important role in the field of healthcare. The nursing workforce is critical to the provision of optimal population health outcomes and effectiveness of any health care system because nurses deliver the highest proportion of preventive and curative patient care.[1,2] However, the nursing profession at the global level is facing shortages, high turnover, and inequitable distribution of the workforce.[3]

Second-degree Bachelor of Science in Nursing (BSN) programs or accelerated baccalaureate nursing programs are being offered to students with a bachelor's degree from non-nursing majors. Such programs have existed in the United States since 1971 and have been proliferated in addition to the traditional School of Nursing (SN).[4] Thus, BSN programs have been expanded to positively influence the number of nurses entering the profession and solve the shortage crisis.[5]

The BSN program is intense and requires students to attend on a full-time basis.[4] Many reports have indicated that BSN students may face the challenge of rigorous curricula and fast-paced nursing profession and are subject to high overall pressures related to balancing between family and school, psychological, and environmental issues.[6-8] However, several studies have described BSN students as highly motivated,[7] with better academic performance,[5,9-11] and obtaining high passing rates in the National Council Licensure Examination for registered nurses (NCLEX-RN).[7] However, whether or not these positive traits are the same for BSN students in Taiwan remains clear.

Identifying students with the potential to successfully complete the BSN program is critical to recruitment and retention. Reports have suggested that student performance in terms of pre-nursing grade point average (GPA) and pre-requisite nursing courses can predict the successful completion of the BSN course.[12,13] In addition, previous studies have found that students' GPA in the first semester is the most sustainable predictor of success in completing nursing programs and passing the NCLEX exam.[14,15] Therefore, understanding student performance in the previous bachelor's degree and academic performance of the first semester in the current course is crucial for the recruitment and retention of BSN students.

According to the World Health Organization and Taiwan National Development Council, Taiwan has become an aging society since 1993 and entered an era of aged society in 2018. It is estimated that by 2026, Taiwan will grow into a super-aged society. Therefore, the demand for long-term care is increasing. As a result, the nursing workforce is imperative. Since 2016, BSN programs in Taiwan have been designed to accommodate long-term care policies and address the shortage of nurses. However, research that investigates differences in the academic performance between BSN and SN students in Taiwan is scarce. Understanding the differences in behavior between BSN and SN students will help design recruitment and retention projects for each group. In addition, course grades for anatomy and physiology were related to the GPA of the first semester.[16] Previous studies suggested that a strong foundation in biological sciences is fundamental to nursing and reported that students who passed NCLEX had significantly high GPAs in biology.[5,17,18] Therefore, the present study aims to compare the performance between BSN and SN students in anatomy (the main course of the first semester in BSN) for one semester. Furthermore, it examines whether or not students who previously took biology classes displayed better performance.

## METHODS

Data of academic records in anatomy for this study were collected from the Department of Anatomy and Cell Biology, National Taiwan University (NTU). A total of 29 BSN students and 37 SN students agreed to participate in the study. Two BSN students did not provide regarding completion of a biology class. Informed consent for data collection was obtained from all participants. The study was approved by the Research Ethics Committee of NTU and did not use identifying information to protect anonymity.

The academic year of the NTU is divided into two semesters, namely, September to January and February to June. The recruited BSN and SN students were introduced to the same anatomy course from September 2018 to January 2019. They were taught by the same faculty members and provided with the same syllabus, equal access to the same resources, and underwent the same examinations throughout the semester. The course included 13 lectures and 2 laboratory sessions for one semester. Four examinations, namely, midterm lecture, midterm laboratory, final lecture, and final laboratory were delivered throughout the semester. The examinations were co-designed by faculty members who set questions according to the topics taught. Laboratory examinations were conducted through PowerPoints, and the time allocated to answer each question was 1 min. At the end of the semester, academic records in anatomy and biology class information were collected and analyzed. The criteria for data collection were as follows: completion of the four exams during the semester and no one was excluded. Performance in anatomy was measured by the score of the four examinations. T-test was used to analyze the collected data and compare the performance between BSN and SN students. Then, the students were divided into two groups, took-biology-class and no-biology-class. The scores for each group were also analyzed by t-test to understand whether or not students who took biology classes displayed better performance in anatomy. Moreover, distribution analysis was conducted using R program.

## RESULTS

Figure 1A depicts the comparison of average scores for the midterm and final exams of the lecture and laboratory in anatomy. No significant difference in the average scores of the BSN and SN students in the lecture and laboratory exams was noted. These results indicate that the performance of BSN students is similar to that of SN students.

According to previous studies, BSN students displayed better academic performance than SN students.[5,9-11] Therefore, to further elucidate the lecture and laboratory performance between BSN and SN students, we compared the midterm and final exam scores for the lecture (Figure 1B) and laboratory (Figure 1C). The scorers were plotted, and the average of the two groups were compared. No significant differences were observed in the lecture and laboratory performances between BSN and SN students (Figures 1B and 1C). In the laboratory tests, BSN and SN students had lower final exam scores than the mid-term exams, but no significant difference was found (Figure 1C). These results indicate that BSN and SN students obtained a similar performance in anatomy.

The study further analyzed whether or not BSN students who took biology classes performed better in anatomy than those who did not take biology class because previous studies suggested that the foundation in biological sciences is important in nursing.[5,17] No differences between

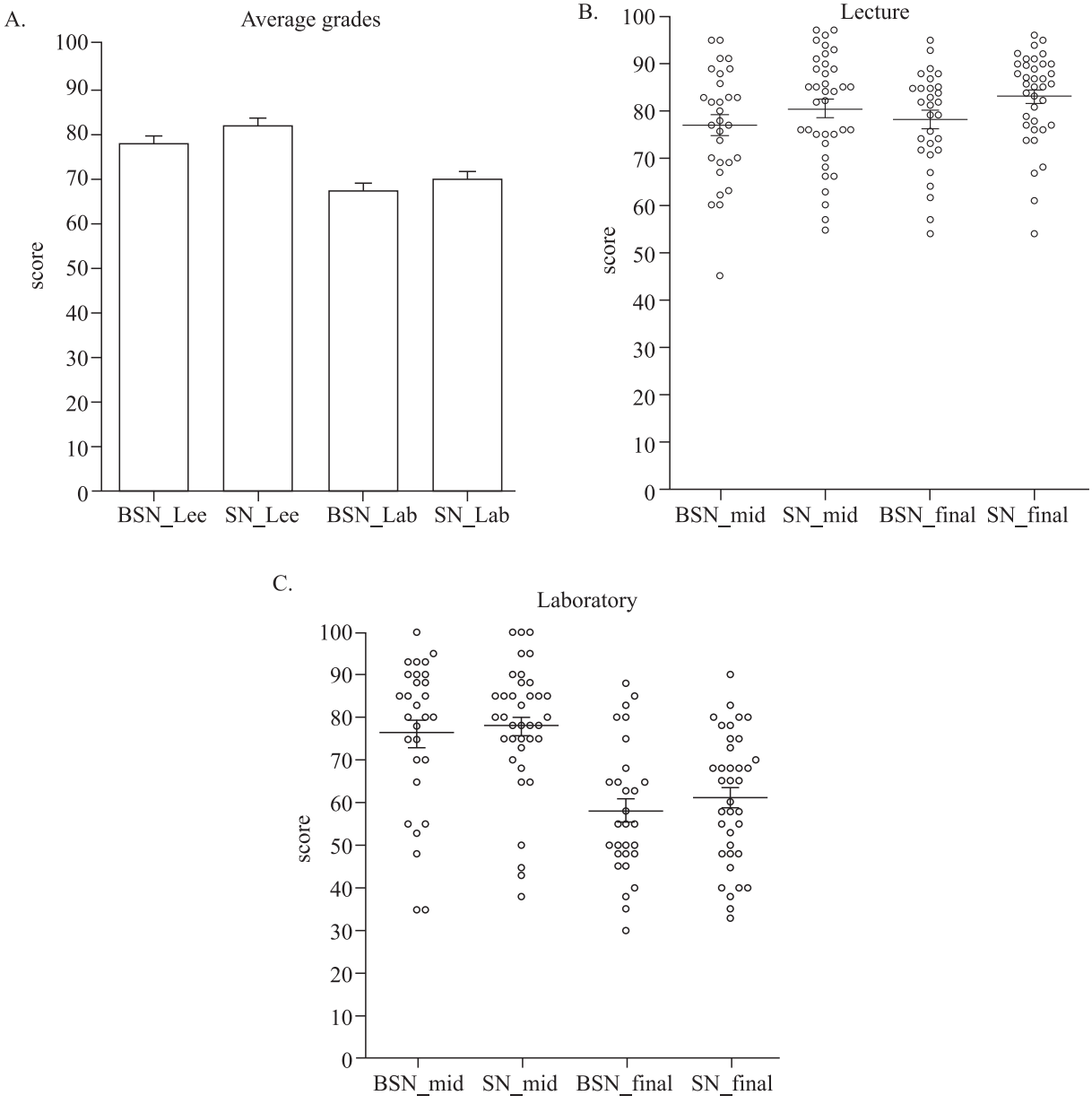
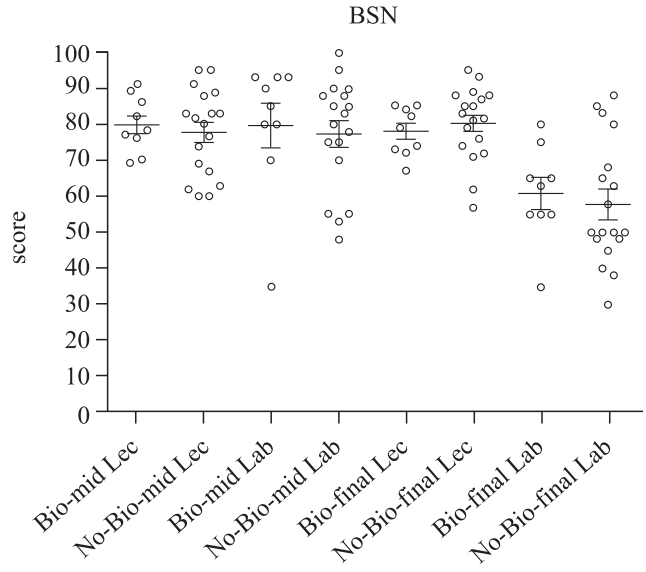



**Figure 1.** Comparison of average grades, lecture performance, and laboratory performance obtained by BSN and SN students. (A) Lecture (Lec) and laboratory (Lab) scores for the midterm and final examinations were averaged separately. No significance was found between BSN and SN students in terms of average grades for lecture and laboratory performance. (B) Lecture scores obtained by BSN and SN students on the midterm and final examinations were plotted. No significance in the lecture performance between BSN and SN students. (C) Laboratory scores obtained by BSN and SN students for the midterm and final examinations were plotted. No significance in the laboratory performance was noted for the BSN and SN students.

A.




B.

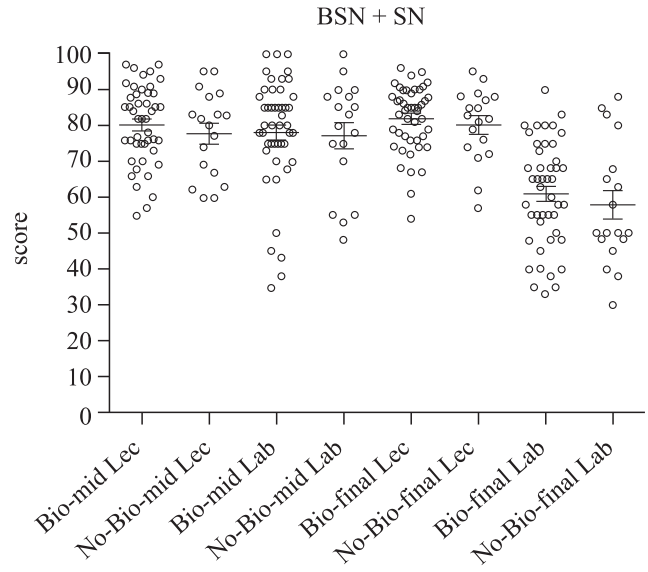
| Groups | Took-biology-class | No-biology-class |
|---|---|---|
| Number of values | 9 | 18 |
| Mean ± SEM of mid-term lecture | 79.8 ± 2.6 | 77.8 ± 2.8 |
| Mean ± SEM of mid-term laboratory | 79.9 ± 6.2 | 77.4 ± 3.6 |
| Mean ± SEM of final lecture | 77.9 ± 2.2 | 80.4 ± 2.4 |
| Mean ± SEM of final laboratory | 60.9 ± 4.4 | 57.7 ± 4.1 |

**Figure 2.** Comparison of average grades obtained between the took-biology-class and no-biology-class groups of BSN students. (A) Lecture (Lec) and laboratory (Lab) scores for the midterm (mid) and final (final) examinations were averaged separately for the took-biology-class and no-biology-class groups of BSN students. No significance was noted between the two groups in terms of lecture and laboratory performances for the midterm and final examinations. (B) Summary of the average grades obtained by the took-biology-class and no-biology-class groups of BSN students.

the took-biology-class (n = 9) and no-biology-class (n = 18) BSN students were noted in the average scores for the lecture and laboratory in the midterm and final exams (Figure 2). We further grouped the BSN and SN student into the took-biology-class group (n = 46) and no-biology-class group (n = 18) because of the small number of took-biology-class BSN students. The analysis aims to compare whether or not taking the biology class will influence the performance of the students in anatomy. No significance was found between two groups in terms of average scores for lecture and laboratory performances in the midterm and final exams (Figure 3).

Although the average scores of the lecture and laboratory performances for the midterm and final exams was non-significantly different between the took-biology-class and no-biology-class

A.




B.

| Groups | Took-biology-class | No-biology-class |
|---|---|---|
| Number of values | 46 | 18 |
| Mean ± SEM of mid-term lecture | 80.3 ± 1.6 | 77.8 ± 2.8 |
| Median of mid-term lecture | 82 | 81 |
| Mean ± SEM of mid-term laboratory | 78.3 ± 2.3 | 77.4 ± 3.6 |
| Median of mid-term laboratory | 80 | 81.5 |
| Mean ± SEM of final lecture | 82.0 ± 1.4 | 80.4 ± 2.4 |
| Median of final lecture | 84.5 | 82.5 |
| Mean ± SEM of final laboratory | 61.0 ± 2.2 | 57.7 ± 4.1 |
| Median of final laboratory | 64 | 50 |

**Figure 3.** Comparison of average grades obtained by BSN and SN students between the took-biology-class and no-biology-class groups. (A) Lecture (Lec) and laboratory (Lab) scores for the midterm (mid) and final (final) examinations were averaged separately for the took-biology-class and no-biology-class groups of BSN and SN students. No significance was found between the two groups in terms of lecture and laboratory performances for the midterm and final examinations. (B) Summary of average and median grades obtained by the took-biology-class and no-biology-class groups of BSN and SN students.

groups, we observed that the mean and median scores of the took-biology-class group in the final laboratory exam (61.0 ± 2.2; 64) was higher, although non-significant, than those of the no-biology-class group (57.7 ± 4.1; 50) (Figure 3B). Moreover, distribution analysis revealed a non-normal distribution for the midterm laboratory and final lecture scores of the took-biology-class group (Table 1). Therefore, student scores were further subdivided into less-than-median and greater-than

**Table 1.** Summary of distribution analysis of grades obtained by the took-biology-class and no-biology-class groups of BSN and SN students.

| Groups | Took-biology-class | No-biology-class |
|---|---|---|
| Number of values | 46 | 18 |
| p-value of mid-term lecture | 0.1347 | 0.1662 |
| p-value of mid-term laboratory | 0.0003* | 0.0924 |
| p-value of final lecture | 0.0211* | 0.3027 |
| p-value of final laboratory | 0.2464 | 0.1733 |

*$p < 0.05$; non-normal distribution

or equal-to-median. The average grades of the took-biology-class group was significantly higher than those of the no-biology-class students in the final laboratory exam in the less-than-median range (Figure 4A and 4B) and in the greater-than or equal-to-median (Figure 4C and 4D). Results suggest that students who took biology classes performed better in the laboratory exam for anatomy.

## DISCUSSION

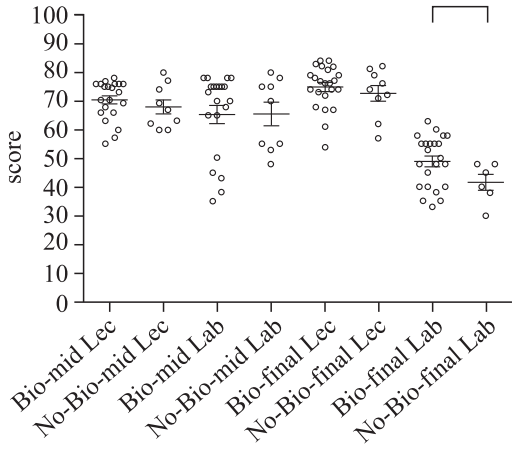
The study showed a similar performance between BSN and SN students in anatomy, which is one of the major courses of the semester. Clearly, the present study showed different patterns of academic performance compared with previous studies, which showed that BSN students displayed better academic performance than SN students.[5,9-11] However, previous studies used the overall grades of examinations or GPA to represent the academic performance of students. Thus, the present study agrees that BSN students may perform better in courses other than anatomy.

The results of the current study may be related to the rigor of the BSN program. BSN students have encountered the challenges of a new and fast-paced curriculum and suffered higher levels of stress.[6-8,19] Moreover, other findings reported that students struggled in the transition from a competent adult life to student life, whereas other students found that the BSN program was intense, required much work, and left little time for study.[16] Therefore, enabling BSN students to adapt to the intense curriculum and perform better will be a critical issue for educators.

Another consideration for learning outcomes may be related to the experience of BSN students. A survey showed that BSN students hold certain preferences for teaching methods. For example, BSN students cited that the aspect of teachers knowing them by name is important. Others preferred to learn entirely online or web-enhanced courses and had higher expectations for classroom structure, faculty guidance, and obtaining high grades in related courses.[20] In this regard, teachers can modify teaching strategies and incorporate the preferences, such as web-based courses, into the classroom to effectively adapt to these more experienced and educated students.

BSN students come from diverse backgrounds. Therefore, the selection of students may be one of the reasons for the difference. In the admission criteria of the BSN program in NTU, the application documents accounted for 30% and interview accounted for 70% of the selection rating. Seldomridge and DiBartolo suggested that schools could consider the GPA in science courses, rather than overall GPA, for admission to nursing programs.[17] Similarly, other scholars proposed

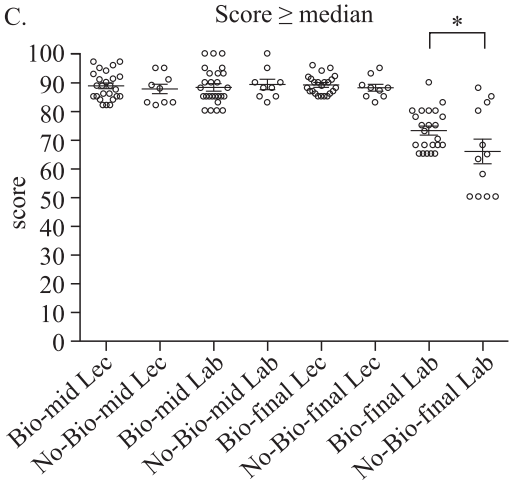
A.




B.

| Groups | Took-biology-class | No-biology-class | |
|---|---|---|---|
| Number of values<br>Mean ± SEM of mid-term lecture | 21<br>70.3 ± 1.5 | 9<br>68 ± 2.5 | |
| Number of values<br>Mean ± SEM of mid-term laboratory | 20<br>65.5 ± 3.3 | 9<br>65.4 ± 4.2 | |
| Number of values<br>Mean ± SEM of final lecture | 23<br>74.9 ± 1.6 | 9<br>72.7 ± 2.8 | |
| Number of values<br>Mean ± SEM of final laboratory | 23<br>48.9 ± 1.89 | 6<br>41.5 ± 2.8 | * |

C.




D.

| Groups | Took-biology-class | No-biology-class | |
|---|---|---|---|
| Number of values<br>Mean ± SEM of mid-term lecture | 25<br>88.7 ± 1.0 | 9<br>87.7 ± 1.7 | |
| Number of values<br>Mean ± SEM of mid-term laboratory | 26<br>88.2 ± 1.3 | 9<br>89.3 ± 1.8 | |
| Number of values<br>Mean ± SEM of final lecture | 23<br>89.0 ± 0.7 | 9<br>88.1 ± 1.3 | |
| Number of values<br>Mean ± SEM of final laboratory | 23<br>73.1 ± 1.5 | 12<br>65.8 ± 4.3 | * |

**Figure 4.** Comparison of average grades of less-than-median and greater-than or equal-to-median scores between the took-biology-class and no-biology-class groups of BSN and SN students. Lecture (Lec) and laboratory (Lab) scores for the midterm (mid) and final (final) examinations obtained by the BSN and SN students were divided into less-than-median and greater-than or equal-to-median. The average grades of the less-than-median students (A and B) and greater-than or equal-to-median students (C and D) are shown and compared between the took-biology-class and no-biology-class groups. The took-biology-class students performed significantly better than the no-biology-class students in the final laboratory exam for the less-than-median students and greater-than or equal-to-median students. *$p < 0.05$

that prerequisite science course performance is a reliable predictor of academic performance within the nursing field.[21,22] Moreover, the present study showed that students who took biology classes may perform better in the laboratory exam for anatomy (Figure 4). Based on the abovementioned studies, the study suggests that the admission criteria for the BSN program could consider the applicant's

performance in previous science courses, such as biology, to achieve better academic performance and retention.

Figure 1C depicts a trend in which laboratory scores were lower in the final exam compared with the midterm exam for BSN and SN students, although no significant difference was observed between laboratory scores in the midterm and final exams. The reason for this result may be the different ranges of examination. In the midterm exam, the examination covered the skeletal and muscular systems, which were easier to identify. In contrast, the final examination included the nervous, cardiovascular, and other systems, which were difficult for students to identify within short time. This result implied that students may have difficulty in recognizing the abovementioned systems, and teachers can reinforce laboratory classes or provide on-line laboratory resources to help students improve performance in this aspect.

A previous study showed that students who passed NCLEX had significantly high GPAs in biology.[18] Although the study did not scrutinize the performance of the took-biology-class group, it demonstrated that the took-biology-class students significantly performed better in the laboratory exam for anatomy. This finding indicates that biology may provide the basic knowledge for anatomy and help students perform better in nursing courses. Therefore, biology classes could be taken into consideration during the admission selection of BSN students or when identifying students who might be unsuccessful in nursing.

The study has several limitations. First, the BSN program in NTU began in 2018. At the time of the study, only one cohort was recruited. Therefore, data may only reflect the program's first cohort. Thus, follow-up studies are necessary to monitor the academic performance of BSN students. Second, the study only included grades in anatomy for the first semester. Further studies investigating the details of each course and overall academic performance in the first semester of BSN students are strongly recommended. Finally, the sample size was small; thus, a big sample size is ideal. Further research can deeply elucidate the academic performances between the two nursing programs and assess the teaching strategies that are effective for BSN students.

## CONCLUSIONS

In summary, no significant difference was found for the learning performance in anatomy between BSN students and traditional SN students. In addition, the took-biology-class group significantly performed better for the laboratory exam in anatomy. The result indicating that BSN and traditional SN students displayed a similar performance could eliminate the concern about the quality of anatomy teaching in the BSN program. Although the study is preliminary, it is the first to shed light on the BSN programs in Taiwan. In essence, the success of BSN programs is based on the number of students that complete the program and become registered nurses. Successful BSN programs begin with the screening process and monitoring of student achievement. The study proposes that completion of biology courses could be used as a screening factor during admission selection. After understanding the academic performance of students, the teachers can help and provide remedies for students at risk of dropping out, such that they can successfully pass the licensure exam and begin their nursing career.

## CONFLICTS OF INTEREST

We declare no known conflicts of interest in connection with this publication and no significant

financial support for this work that may affect its results.

## ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Informed consent for data collection was obtained from all participants. Ethical approval was obtained from the Research Ethics Committee of NTU (ethical approval number: 201905HS166).

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