

# Comparison of a Traditional Practical-Based Identification for Microscopic Image Examination with a Microsoft PowerPoint Examination in the Influence of Dental and Medical Students' Learning Outcome and Motivation in a Histology Laboratory Course at NDMC in Taiwan

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## Research article

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# Abstract

Background: Histology laboratory courses are morphologic study in the structure of the cells, tissues, and organs of the body that are mainly examined with a microscope. There are two types of examinations to assess learning outcomes in Taiwan. The first is a traditional practical-based identification for microscopic image (PBIMI) examination, and the second is Microsoft PowerPoint (MS PPT) examination. Whether these two types of examinations exhibit different influences on students' learning motivation has not been evaluated. Methods: In this study, we compared the grades of dental students and medical students in the National Defense Medical Center who completed PBIMI or MS PPT examinations and investigated the influence of the type of examination on the students' learning outcomes and motivation. We also conducted a survey among the medical students to confirm the hypothesis concluded from the grade analysis. Results: There was a significant decrease in the percentage of students scoring 61 to 80 in the MS PPT group compared to that in the PBIMI group in the midterm examination of dental students. The average score on the MS PPT examination was significantly higher than that on the PBIMI examination among medical students who completing both examinations. The average failing scores on the midterm examination among the students tested with the PBIMI examination were significantly lower than the scores among the students tested with the MS PPT examination. The results of the survey also showed that the MS PPT examination is easier for students and that they will spend less time learning the material when the MS PPT examination is utilized for assessment. Conclusion: This study suggests that the type of examination affects learning motivation in less self-demanding students. The MS PPT test is easier for the students and leads to less time spent studying for the histology laboratory course, especially among the students with fewer self-demands or less interest in the course.

## Background

Histology, also called microscopic anatomy, is a morphologic study in the structure of the cells, tissues, and organs of the body and is mainly examined with a microscope [1, 2]. It is a traditional curriculum in both the school of dentistry and the school of medicine [3] and serves as a basic foundation for the future study of pathology [4]. Although it is a subject with a long history, histological studies are still a major challenge in medical schools [5]. There are many changes in the methods of teaching histology [6, 7]. The teaching of histology using a practical microscope has been complemented with the use of computers [8], especially in laboratory courses [9, 10]. In fact, a common trend in the teaching of histology laboratory courses is the replacement of the traditional light microscope with virtual microscopy [5].

Students' motivation to learn histology includes career motivation, intrinsic motivation, self-determination and grade motivation [11, 12]. A previous study demonstrated that a high level of intrinsic motivation is associated with higher academic performance, especially among male students [13]. Furthermore, examination is also a stress for medical students [14]. The attitude of teacher in assessing the performance of the students during examination affects medical students' enthusiasm in learning [15]. The type of examination plays an important role in the influence of students' learning motivation.

There are 13 medical schools in Taiwan. Additionally, in Taiwan, histology is taught in separate lecture and laboratory courses. As the type of examination used in the histology lecture course of histology has changed, many medical schools in Taiwan have changed the type of examination used in the histology laboratory course from a traditional practical-based identification for microscopic image (PBIMI) examination to a computer-based Microsoft PowerPoint (MS PPT) examination. In histology lecture and laboratory courses at National Defense Medical Center (NDMC) in Taiwan, we coordinated the use of practical traditional light microscope laboratory exercises and internet video demonstrations in teaching. With respect to the type of examination, we still utilized the PBIMI examination among the dental students before the class of 2014 of dental students and changed it to the MS PPT examination beginning with the class of 2015. Among the medical students, the PBIMI examination was changed to the MS PPT examination in the middle of the school year for the class of 2016. However, the advantages and disadvantages of this change have not been evaluated.

In this study, we compared the grades of the dental students and medical students who took the PBIMI or MS PPT examination and investigated the influence of the type of examination on the learning outcomes and motivation of these students. We also conducted a survey among medical students to confirm the conclusion from the grade analysis. We concluded that the type of examination will affect students' study motivation in the histology laboratory course, especially among less self-demanding students. Methodological improvements in the assessment of the learning outcomes of the histology laboratory course are still necessary.

## **Methods**

### **Participating students**

Students participating in this study were from the school of dentistry or school of medicine in National Defense Medical Center, Taipei, Taiwan. The dental students included the classes of 2011 to 2017. For the students in the classes of 2011 to 2014, their histology laboratory grades were evaluated by using the PBIMI examination. For the students in the classes of 2015 to 2017, their grades were evaluated by using the MS PPT examination. The medical students were members of the class of 2016. The histology laboratory grades of these students were evaluated by using the PBIMI examination at the first and second examinations and by using the MS PPT test at the third and fourth examinations. All of the individual information, except the class year, is obscured to protect the students.

### **The implementation of the traditional PBIMI and MS PPT examinations**

The questionnaires consisted of 34 questions in the examination of either dental or medical students. In the traditional PBIMI examination, the test takers entered the examination room one by one. They moved their position from station 1 to station 34. One question was asked at each station, with one microscope

showing a field of a tissue slide indicated by an arrow in the right eyepiece. The test takers had 30 seconds to write the answer on the answer sheet at each station. They had two break positions between stations 17 and 18, and had a check station for 30 seconds after station 34. In the MS PPT examination, the test taker sat in a fixed seat, and the questions were presented by a projector to a central screen in the front of the classroom. There was a 30 second break between questions 17 and 18, and a 30-second period to check answers after question 34.

## **Grade analysis**

Among the dental students, the differences in the scores on the midterm and final examinations between the traditional PBIMI examination and the MS PPT examination were analyzed. Among the medical students in the class of 2016, the average scores of the first and second examinations, which were assessed by the PBIMI examination, and the scores of the third and fourth examinations, which were assessed by the MS PPT examination, were analyzed.

## **Structure of online anonymous survey**

The results presented in this study are derived from an online survey that was administered to the medical students in the class of 2016 at NDMC. The questionnaire contains four questions: 1) What type of examination is easier for you?; 2) For what type of examination will you spend more time studying histology?; 3) What type of examination do you prefer?; and 4) What type of examination do you consider to be more fair? All the responders were anonymous and given information on the study and agreed to the publication of the results of this survey.

## **Statistical analysis**

Statistical analysis was performed by using GraphPad Prism (GraphPad Software, San Diego, CA, USA). Student's unpaired t-test was used to compare dental students' scores on the midterm and final examinations among students in the different class years tested by the PBIMI or MS PPT examinations. Student's paired t-test was used to compare medical students' scores on the PBIMI examination and the MS PPT examination. The statistical significance in the percentage of the number in the scaled scores, the percentage of students who passed and failed and the average of the failed scores were evaluated by Student's unpaired t-test. Statistical significance was set at  $P < 0.05$ .

## **Results**

### **Comparison of dental students' grades assessed by the PBIMI examination with those assessed by the MS PPT examination**

To evaluate the type of examination influencing students' grades in the histology laboratory course, we analyzed the dental students' average scores on midterm and final examinations in the classes of 2011 to 2017. For the students in the classes of 2011 to 2014, their histology laboratory grades were evaluated with the traditional PBIMI examination (Fig. 1). For the students in the classes of 2015 to 2017, their grades were evaluated by the MS PPT examination (Fig. 2). The syllabus for the undergraduate dental students shown in Fig. 3. The midterm examination included topics 1 (Orientation & The Cell) to 8 (Hemolymphatic System), and the final examination included topics 9 (Cardiovascular System) to 16 (Endocrine Organs). The final grade for this course is calculated by summing the scores of 30% attendance and class performance, 35% midterm and 35% final examinations. The passing standard is a score of  $\geq 60$ . To avoid the interference of the 30% attendance/class performance score, we only analyzed the scores for midterm and final examinations. The passing standard in each examination was also a score of  $\geq 60$ . In an analysis of the average scores on the midterm and final examinations for dental students in these class years, we found no differences between the PBIMI group and the MS PPT group in either the midterm or the final examinations (Figs. 4A and 4B).

To further clarify the influence of the type of examination in these students, we analyzed the percentage of scaled scores. We found that there was a significant decrease in the percentage of the students with a score of 61 to 80 in the MS PPT group compared to the PBIMI group for the midterm examination (Fig. 5A). However, this difference was not observed for the final examination (Fig. 5B). We also analyzed the percentage of dental students who passed and failed and who completed the PBIMI or the MS PPT examinations. Our results showed that the percentage of failed students was slightly higher in the MS PPT group for the midterm examination (Fig. 6A). However, the percentage of failed students was slightly lower in the MS PPT group for the final examination (Fig. 6B). We also found that the average failed scores among the students tested with the PBIMI examination were significantly lower than those among the students tested with the using MS PPT examination for the midterm examination (Fig. 6C). The average failed score was only slightly lower among the students tested with the PBIMI examination for the final examination (Fig. 6D). These results suggested that these dental students may underestimate the difficulty of the MS PPT examination, leading to lower motivation to study for the histology laboratory course in the midterm examination in the MS PPT group. However, when these students faced the crisis of the failed stress of this course, their study motivation increased, and they spent more time studying for this course.

## **Comparison of the grades assessed by the PBIMI examination with those assessed by the MS PPT examination in the same population**

The limitation of the above analysis in this study is that the data analyzed included dental students in different class years. Therefore, the difference in the classes' atmosphere or culture may have interfered with the results of the score analysis. For the class of 2016 in the school of medicine of the National Defense Medical Center, their final histology laboratory course grade is the average of the scores on the four examinations. Each examination includes four topics, as shown in the syllabus for medical students

(Fig. 7). For example, the first examination included topics 1 (Orientation & The Cell) to 4 (Integumentary System), and the second examination included topics 5 (Skeletal System) to 8 (Hemolymphatic System) (Fig. 7). Moreover, in this class, we changed the type of examination from the traditional PBIMI examination to the MS PPT examination due to the expansion of the number of medical students ( $n = 145$ ). The traditional PBIMI examination is too time-consuming with multiple test takers (spend more than 3 hours at one examination). Therefore, these students were tested by utilizing the PBIMI examination in the first and second examinations and by utilizing the MS PPT examination in the third and fourth examinations. Thus, we can compare the influence of the type of examination on the study motivation of the same population in students in this class year.

To evaluate the influence of the type of examination on the performance and study motivation in a population composed of the same undergraduate medical students, we first compared their average scores that were evaluated by using the PBIMI examination or the MS PPT examination. The average score of the first and second examinations (PBIMI examination) and the average score of the third and fourth examinations (MS PPT examination) were compared with Student's paired t-test. We found that the average score on the MS PPT examination was significantly higher than that on the PBIMI examination (Fig. 8A), suggesting that the MS PPT test was easier than the PBIMI examination for these medical students. By analyzing the percentage of the number in scaled scores of these students, we found that there was an increase, although with no statistical significance, in the highest interval (81–100) (Fig. 8B). We also analyzed the percentage of passed and failed students. Our results showed a slight decrease in the failed medical students who tested by using the MS PPT examination (Fig. 8C). However, when we analyzed the average score of the failed medical students, the results showed that the average score of failed students in the MS PPT examination group was significantly lower than that in the PBIMI examination group (Fig. 8D). These results suggested that the MS PPT test is easier for these undergraduate medical students; however, this factor also led to students (especially less self-demanding students) exhibiting lower study motivation in the histology laboratory course.

## **Analysis of the survey on the population of medical students who experienced both the PBIMI and MS PPT examinations**

Because the medical students in the class of 2016 experienced both the PBIMI and MS PPT examinations, to confirm the conclusion drawn from the analysis of dental and medical students' grades, we performed a survey for the medical student in the class of 2016. For the first question, what type of examination is easier for you? A total of 54.7% of the medical students consider the MS PPT examination to be easier, 24.5% consider PBIMI examination to be easier and 20.8% consider the difficulty of these two types of examination to be equal (Fig. 9A). This result is consistent with the comparison of the average scores among the medical students (Fig. 8A). In the second question, for what type of examination will you spend more time studying histology? Only 3.8% of the students will spend more time on the MS PPT examination. A total of 37.7% of students will spend more time on the PBIMI examination, and 58.5% of the students will spend equal time on these two examinations (Fig. 9B). This result showed that few

students spend more time in the study of histology laboratory when they will be examined with the MS PTT examination. In the third question, what type of examination are you prefer? Surprisingly, a total of 47.2% of the medical students preferred the PBIMI examination, 39.6% of the students preferred the MS PPT examination, and 13.2% of students had no specific preference in these two types of examinations (Fig. 9C). This result indicated that although the MS PPT examination is easier for these students, more students prefer to undergo traditional PBIMI examination. In the last question, what type of examination do you consider to be more fair? Interestingly, 58.5% of the medical students considered the PBIMI examination to be a fairer examination. Only 24.5% of the students considered the MS PTT examination to be fairer, and 17% of the students considered it equally in both examinations (Fig. 9D). This is mainly because the position of the test taker will affect the performance of the students in the MS PTT examination.

## Discussion

Histology is a compulsory subject in dental and medical schools. In Taiwan, all of the medical colleges divide this subject into lecture and laboratory courses. Learning histology as well as completing the laboratory course are important parts of students' professional education [16]. Because of the convenience of the MS PPT examination, the assessment of the learning outcomes of the histology laboratory course tended to utilize the MS PPT examination to replace the traditional PBIMI examination in Taiwan. However, this change in the type of examination on the influence of students' learning outcomes and learning motivation has not been evaluated.

Our analysis revealed that although there was no influence of examination types on the average scores of dental students in the different class years (Fig. 4A), the average score was significantly higher in the MS PPT examination among the medical students who completed both types of examinations (Fig. 8A). These different results may be due to the different class years in the dental students with different study atmospheres and class cultures. However, the percentage of the number of students with scores of 61 to 80 in the MS PPT group was significantly lower than that in the PBIMI group for the midterm examination (Fig. 5A). These results suggested that these dental students underestimated the difficulty of the MS PPT examination, which led to lower motivation in studying for the midterm examination of the histology laboratory course. This result is consistent with the result of the survey among the medical students that the MS PPT examination was considered easier than the PBIMI examination. Furthermore, when we analyzed the grades in the same population that completed both types of examinations, an influence of the type of examination on learning outcomes was exhibited, and the average score was significantly higher in the MS PPT group than in the PBIMI group (Fig. 8A).

The analysis of the grades of the failed students revealed that the average scores in the MS PPT group were significantly lower than those in the PBIMI group for the midterm examination of dental students (Fig. 6C) as well as for the results of medical students (Fig. 8D). The result of the survey among medical students also exhibited a trend indicating that students spent less time studying histology laboratory course when they would be completing the MS PPT examination (Fig. 9B).

Although the MS PPT examination is easier to implement and is a time-saving assessment method, several factors should be considered in the utilization of the MS PPT examination for the assessment of learning outcomes in dental and medical students. The first factor is fairness in the examination, which is mainly due to the position of the test takers in the examination room. A worse position provides a worse view of the picture presented on the screen, which may critically influence the performance of the test taker. This issue is reflected in the survey of the medical students (Fig. 9D) and can be improved through the use of multiple examination classrooms or utilization of a computer classroom to provide students with an individual screen to give them a better view. The second factor is high-quality equipment in the examination room, such as computers and projectors, to maintain high picture quality for the test takers. Furthermore, introducing a reward system in the examination for histology laboratory course may also provide a beneficial effect for promotion of students' learning motivation [17].

## Limitations of this study

The first limitation of this study is that the analyzed data were acquired from a medical school only. Future study should include more medical schools if they have students experienced both types of examinations. Second limitation is that only two types of examinations were compared. Although novel assessments for the learning outcome have been development, some of the attempts have failed. For example, a student self-scheduling of computer-based examination has been tested. This type of examination does not appear to provide a better performance and may even be detrimental [18]. The third limitation of this study is that this change in the type of examination on the influence of teacher did not been evaluated. A better assessment strategy for the histology laboratory course is still needed, not only for the students but also for the teachers. High job demands including heavy examination loading leads to a high stress on teachers [19, 20]. Moreover, there is an interaction effect between teachers' teaching and students' learning motivation [21]. Therefore, it is still highly worthwhile in medical education to identify novel ways of assessing student performance in a histology laboratory course.

## Conclusions

In conclusion, the type of examination affects learning motivation among less self-demanding students. The MS PPT test is easier for the students and leads to less time spent studying for the histology laboratory course, especially among students with fewer self-demands or less interest in this course. An improvement in the assessment methods of the learning outcomes of students in the histology laboratory course is still necessary.

## Abbreviations

NDMC: National Defense Medical Center; PBIMI: practical-based identification for microscopic image; MS PPT: Microsoft PowerPoint

## **Declarations**

### **Ethics approval and consent to participate**

As only descriptive data was collected, and no intervention were performed, the study was deemed unnecessary from formal ethical approval according to the Article 5, item 1: "Research on educational assessment or testing, teaching skills or effectiveness evaluation in a general teaching environment.", and Article 12, item 2: "The study is the lowest risk, the possible risk to the research participants does not exceed the nonparticipants, and exemption from prior consent does not affect the rights of the research participants." of Human Subjects Research Act of Ministry of Health and Welfare of Taiwan. All of the results are guarantee the anonymity of the participants. Informed consent was obtained from all participants.

### **Consent for publication**

We confirm that participants gave informed consent for the publication of anonymized quotations from their survey.

### **Availability of data and material**

All data and materials are contained and described within the manuscript.

### **Competing interests**

The authors declare that they have no competing interests.

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### **Authors' contributions**

The manuscript has been read and approved by all the authors. HCL and CPC contributed equally to this work. HCL and CPC acquired, analyzed and interpreted the data, and drafted the manuscript. JYC and FYY acquired the data. MHC and SHH gave the suggestions in statistics. GJL designed the study, acquired, analyzed, interpreted the data, drafted the manuscript and critically revised the manuscript.

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## Figures

# PBIMI Examination

## Examination room 2

## Examination room 1

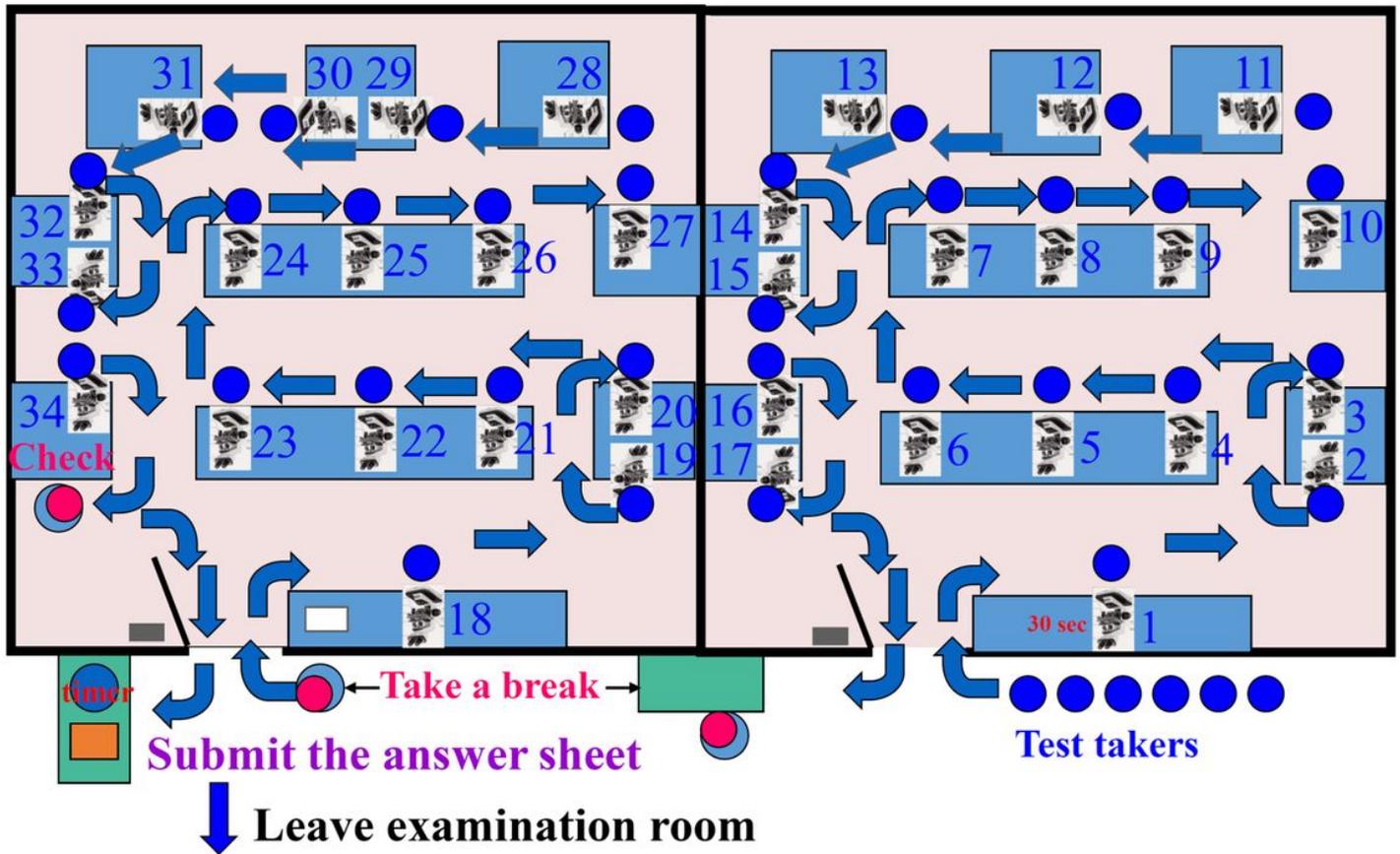


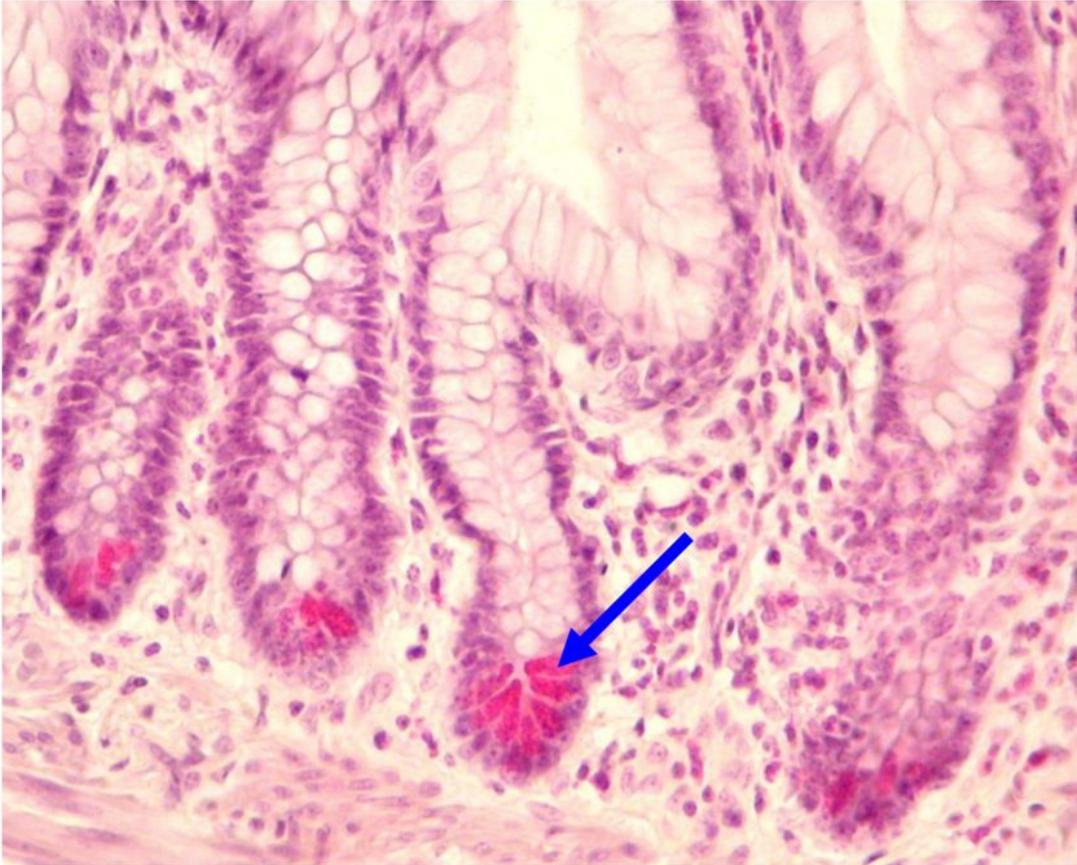
Figure 1

Implementation of the traditional PBIMI examination. In the traditional PBIMI examination, the test takers enter the examination room one by one. They moved their position from station 1 to station 34. At each station, one question is asked with one microscope showing a field of a tissue slide that is indicated by an arrow in the right eyepiece. The test takers have 30 seconds (sec) to write the answer on the answer sheet at each station. They have two break positions between stations 17 and 18, and have a check station for 30 seconds after station 34. After the check station, the test taker submits his answer sheet to the invigilator.

**A**

11. 針指細胞名稱為何？

What is the name of the cell noted by the arrow?



**B**

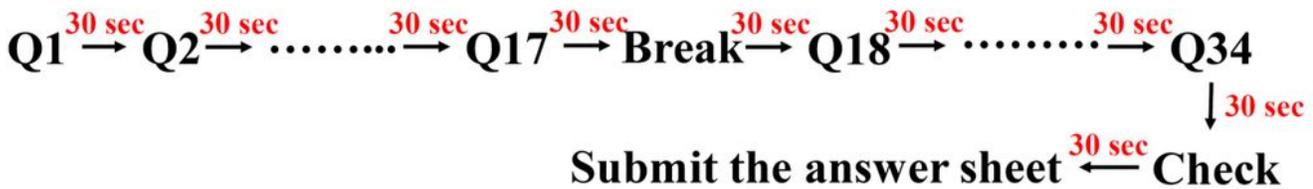


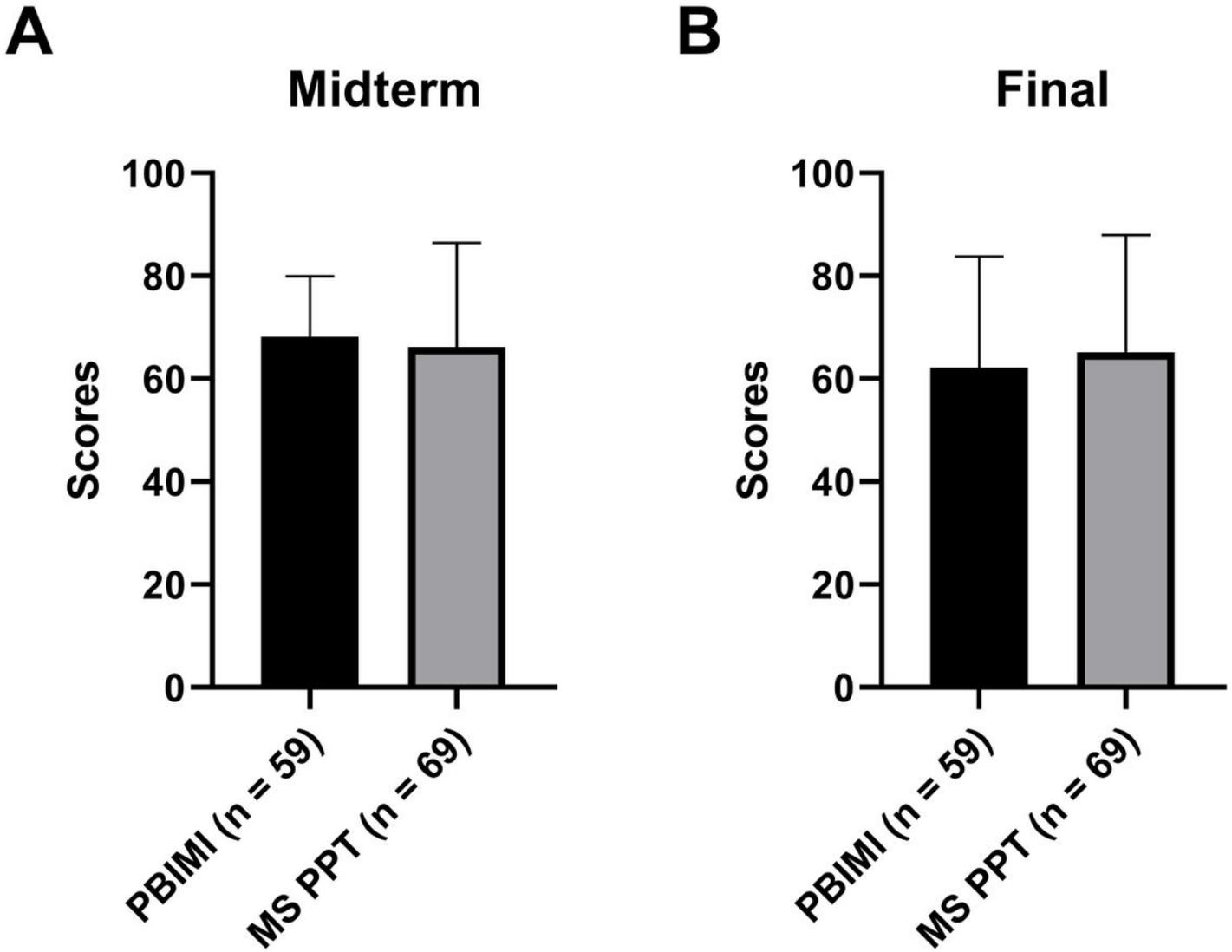
Figure 2

Implementation of the MS PPT examination. (A) An example of a question that appears on the screen in front of the classroom. (B) In the MS PPT test, the test takers were seated in a seat, and the questions were presented by a projector to a screen in the front of the classroom. There was a 30-second break time between questions 17 and 18, and a 30-second check time after question 34. After the 30 seconds (sec) of the final check, the test takers submit their answer sheet to the invigilators.

Date	Topic	#Chapter(s)
9/7	Orientation & The Cell	1~3
9/14	Epithelial Tissue	5
9/21	Connective Tissue	6 & 9
9/28	Integumentary System	15
10/5	Skeletal System (Hard Tissues)	7~8
10/12	Muscle Tissue	11
10/19	Nerve Tissue	12
10/26	Hemolymphatic System	10 & 14
11/2	***** <b>Midterm Examination</b> *****	*****
11/9	Cardiovascular System	13
11/16	Digestive Tract	16~17
11/23	Digestive Glands	18
11/30	Respiratory System	19
12/7	Urinary System	20
12/14	Male Reproductive System	22
12/21	Female Reproductive System	23
12/28	Endocrine Organs	21
1/4	***** <b>Final Examination</b> *****	*****

**Figure 3**

The syllabus for the undergraduate dental students. There are a total of 16 topics in the teaching course and two examinations. The midterm examination included topics 1 (Orientation & The Cell) to 8 (Hemolymphatic System), and the final examination included topics 9 (Cardiovascular System) to 16 (Endocrine Organs).

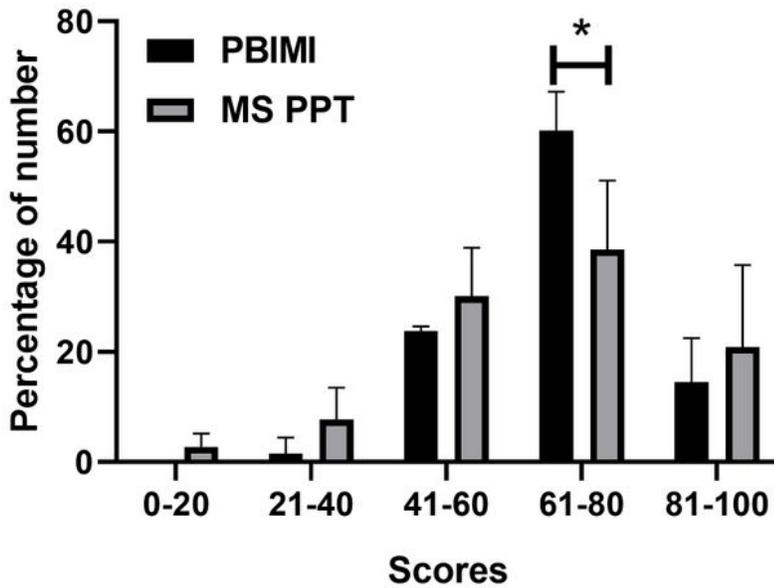


**Figure 4**

The analysis of the average scores for the midterm and final examinations through the use of different types of examinations in undergraduate dental students. The average scores of (A) the midterm examination and (B) the final examination that was evaluated by using PBIMI examination (n = 59) or MS PPT examination (n = 69) were compared with Student's unpaired t-test. There were no differences between the PBIMI examination group and the MS PPT examination group in either midterm or final examinations. Data are expressed as the mean  $\pm$  SD.

# A

## Midterm percentage of scaled score



# B

## Final percentage of scaled score

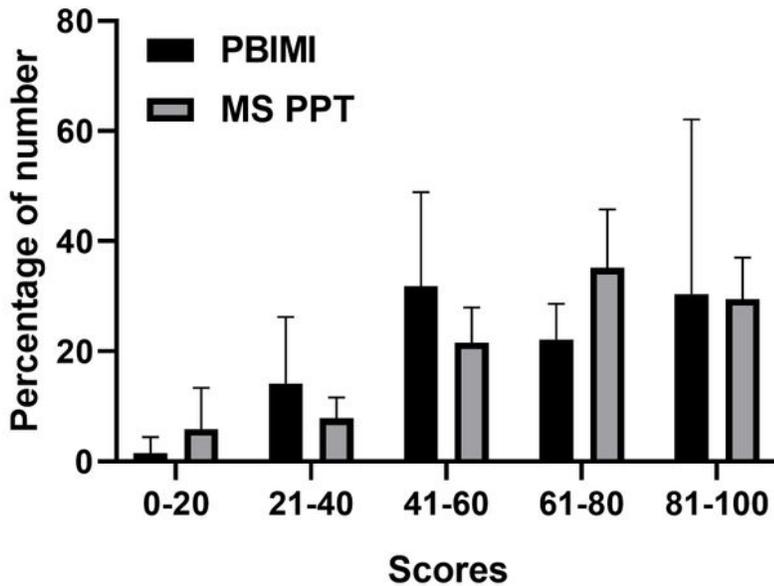


Figure 5

The analysis of the percentage of scaled scores among undergraduate dental students who were tested by utilizing the PBIMI or MS PPT examinations. The analysis of the percentage of scaled scores in (A) the midterm examination and (B) the final examination. (A) There was a significant decrease in the percentage of the number of students in the interval of 61-80 in the MS PPT group compared to the PBIMI examination in the midterm examination. Data are expressed as the mean  $\pm$  SD ( $n = 4$  in each interval of

the PBIMI group and n = 3 in each interval of the MS PPT group). (B) There was no significant difference in the final examination. Data are expressed as the mean  $\pm$  SD (n = 4 in each interval of the PBIMI group and n = 3 in each interval of the MS PPT group).

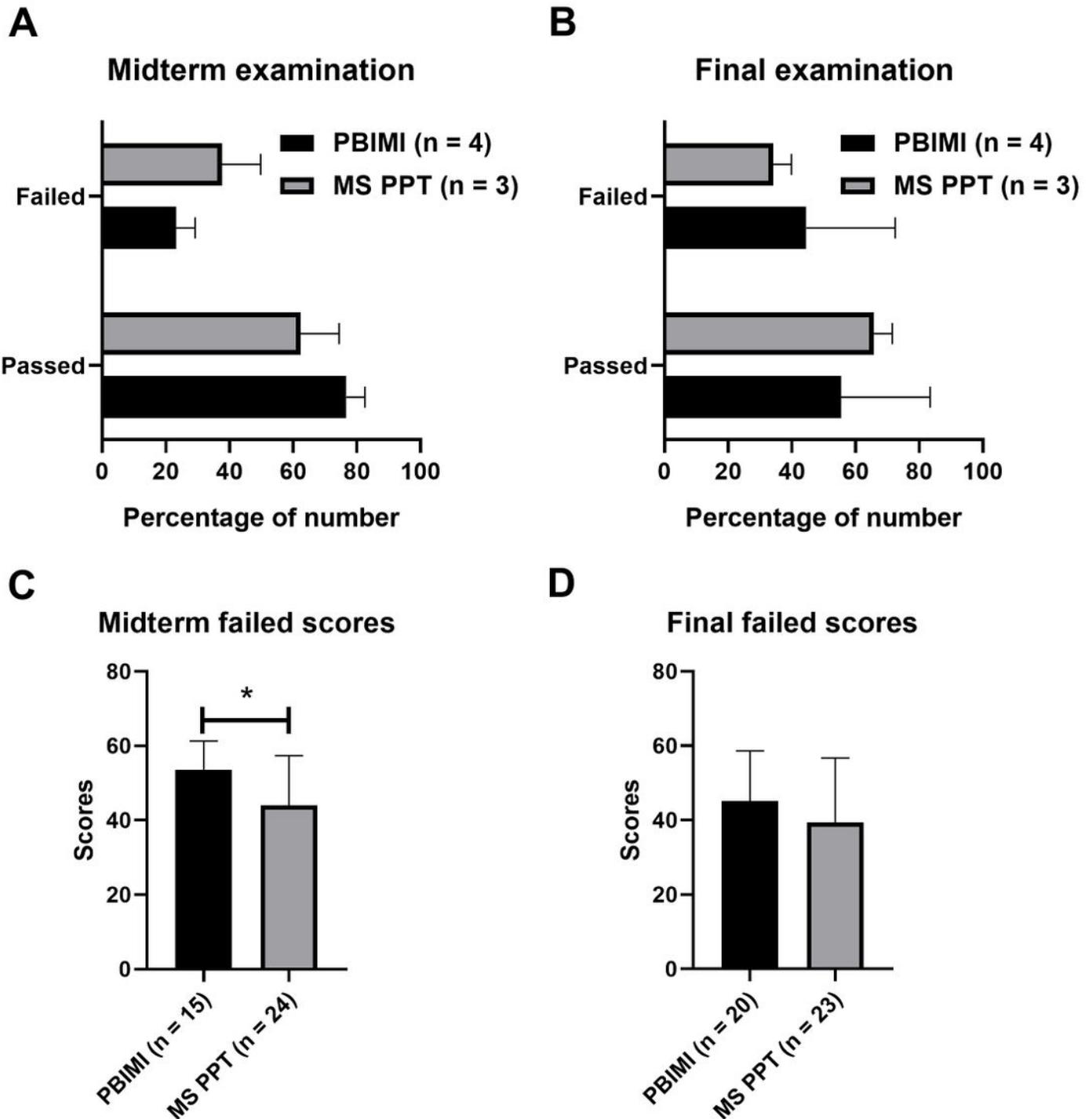


Figure 6

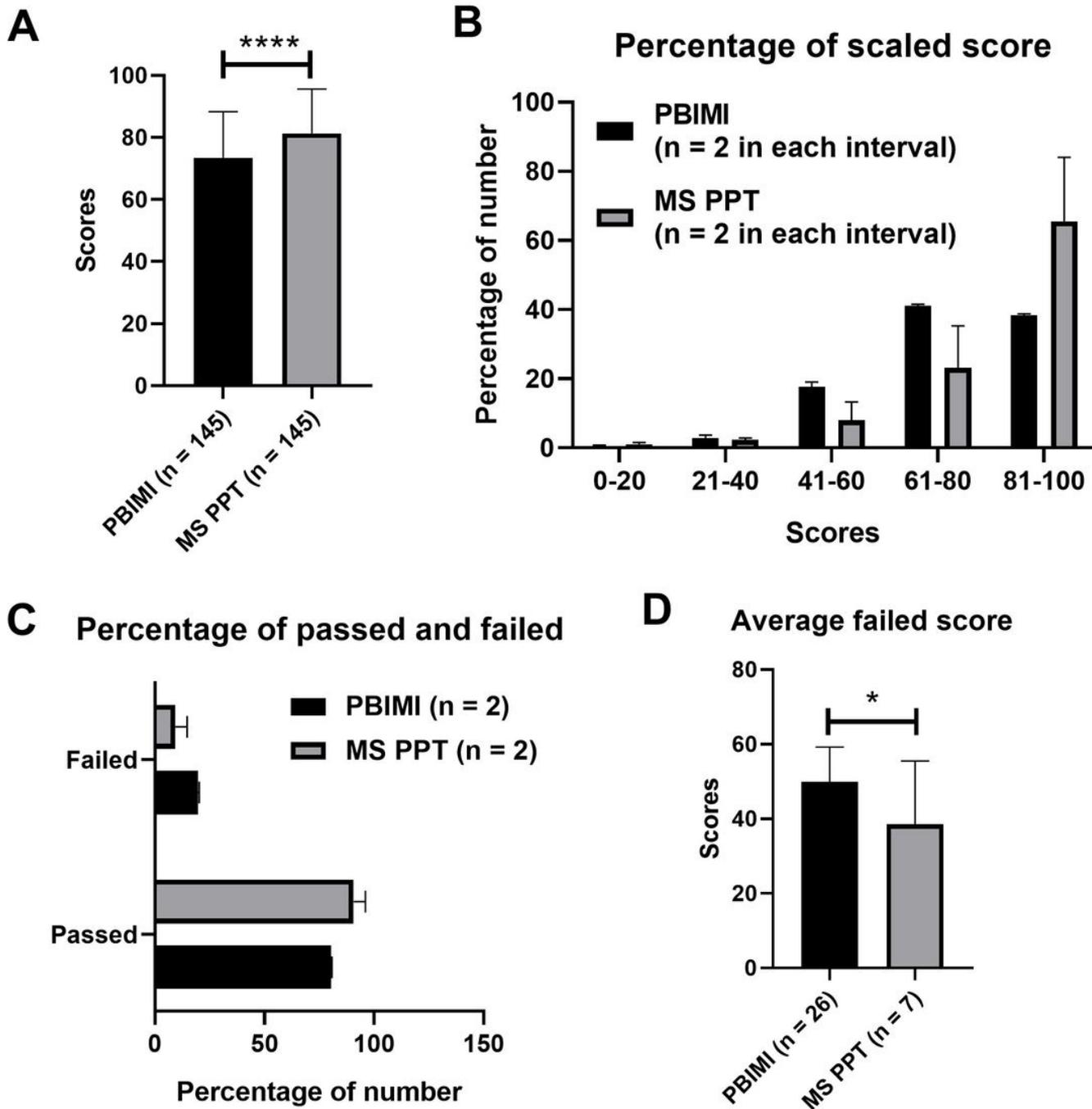
Evaluating the influence of the type of examination and the failed crisis in the study motivation of dental students. (A) The analysis of the percentage of students who passed and failed among the dental

students was evaluated by using PBIMI examination (n = 4) or the MS PPT test (n = 3) in the midterm examination. The percentage of failed students was slightly higher in the MS PPT group in the midterm examination. Data are expressed as the mean  $\pm$  SD. (B) The analysis the percentage of students who passed and failed while the dental students evaluated by using the PBIMI examination (n = 4) or the MS PPT examination (n = 3) in the final examination. The percentage of failed students was slightly lower in the MS PPT group in the final examination. Data are expressed as the mean  $\pm$  SD. (C) The comparison of the average failed scores among the students tested by the PBIMI examination (n = 15) or the MS PPT examination (n = 24) in the midterm examination. There was a significantly lower average score among the students tested by using the MS PPT test for the midterm examination. Data are expressed as the mean  $\pm$  SD. (D) The comparison of the average failed scores among the students tested by the PBIMI examination (n = 20) or the MS PPT examination (n = 23) in the final examination. The average failed score was only slightly lower among the students tested by the PBIMI examination in the final examination. Data are expressed as the mean  $\pm$  SD.

Date	Week	Period	Topic	#Chapter
1/5	五	5,6	Orientation & The Cell	1~3
1/11	四	1,2	Epithelial Tissue	5
1/11	四	3,4	Connective Tissue	6 & 9
1/15	一	7,8	Integumentary System	15
<b>1/19</b>	<b>五</b>	<b>5~7</b>	<b>***** First examination *****</b>	<b>*****</b>
1/29	一	7,8	Skeletal System (Hard Tissues)	7~8
2/5	一	7,8	Muscle Tissue	11
3/15	四	3,4	Respiratory System	19
5/7	一	3,4	Hemolymphatic System	10&14
<b>5/16</b>	<b>三</b>	<b>6~8</b>	<b>***** Second examination *****</b>	<b>*****</b>
8/29	三	7,8	Cardiovascular System	13
9/26	三	5~7	Digestive Tract	16~17
9/27	四	5,6	Digestive Glands	18
10/11	四	7,8	Nerve Tissue	12
<b>10/22</b>	<b>一</b>	<b>6,7</b>	<b>***** Third examination *****</b>	<b>*****</b>
11/19	一	3,4	Urinary System	20
12/3	一	5,6	Male Reproductive System	22
12/3	一	7,8	Female Reproductive System	23
12/17	一	3,4	Endocrine Organs	21
<b>12/25</b>	<b>二</b>	<b>5~7</b>	<b>***** Fourth examination *****</b>	<b>*****</b>

**Figure 7**

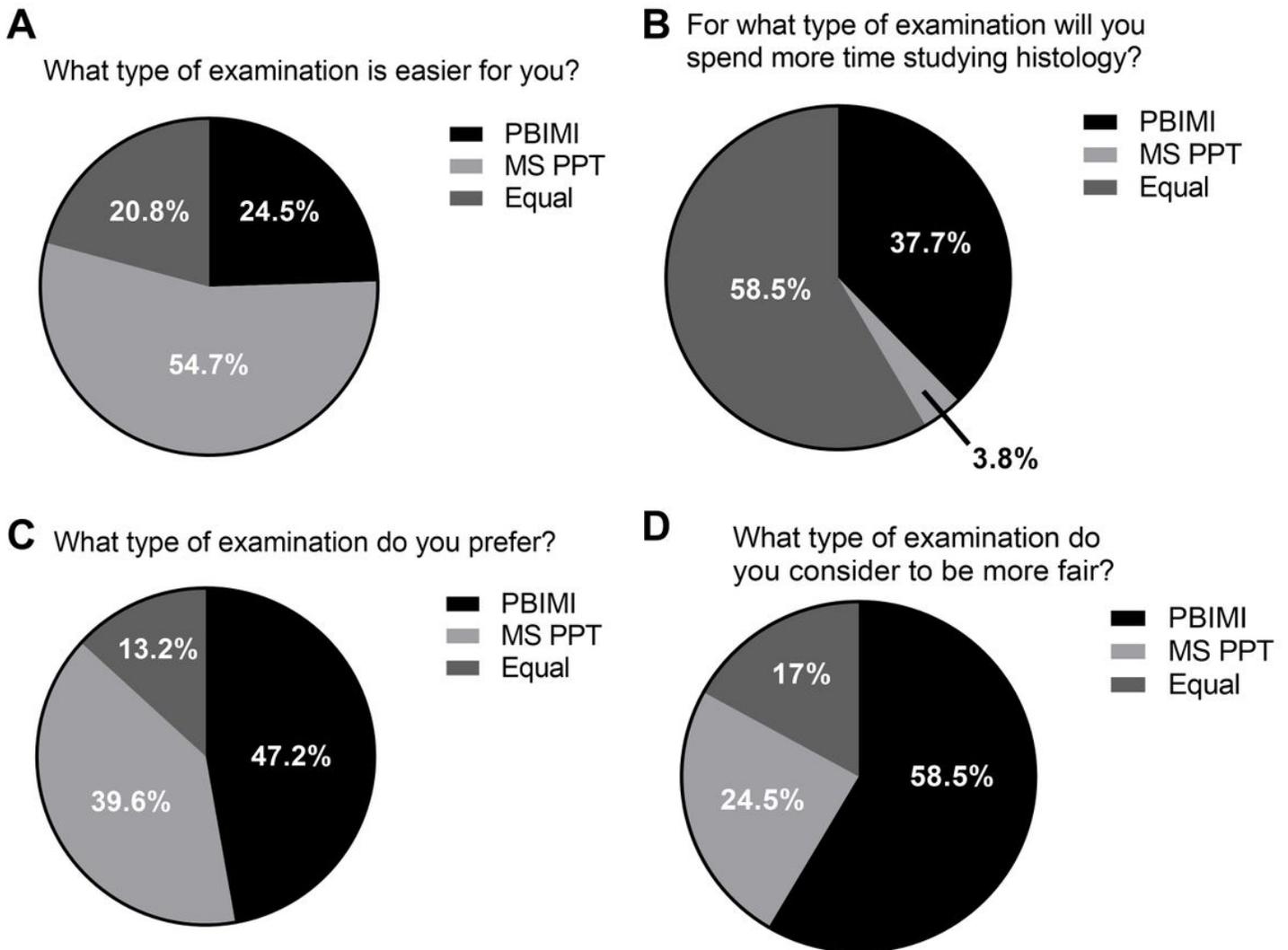
The syllabus for the undergraduate medical students. There are a total of 16 topics in the teaching course and four examinations. The first examination included topics 1 (Orientation & The Cell) to 4 (Integumentary System). The second examination includes topics 5 (Skeletal System) to 8 (Hemolymphatic System). The third examination included topics 9 (Cardiovascular System) to 12 (Nerve Tissue). The fourth examination included topics 13 (Urinary System) to 16 (Endocrine Organs).



**Figure 8**

Evaluating the influence of the type of examination on performance and study motivation in a population composed of the same undergraduate medical students. (A) A comparison of the average scores was evaluated by using the PBIMI examination or the MS PPT examination. The average score on the MS PPT examination is significantly higher than that of the PBIMI examination. Data are expressed as the mean  $\pm$  SD (n = 145). (B) Analyzing the percentage of the number in scaled scores of these students. There was a slight increase in the highest interval (81-100). Data are expressed as the mean  $\pm$  SD (n = 2 in each interval). (C) The analysis of the percentage of the number of students who passed and failed. Only a

slight decrease in the failed medical students tested by using the MS PPT examination. Data are expressed as the mean  $\pm$  SD (n = 2). (D) The analysis of the average score of the failed medical students. There was a significant decrease in the average score of failed students in the MS PPT examination group (n = 7) compared to the PBIMI examination group (n = 26). Data are expressed as the mean  $\pm$  SD.



**Figure 9**

The survey of undergraduate medical students in the class of 2016. There are four questions in the questionnaire: (A) What type of examination is easier for you?; (B) For what type of examination will you spend more time studying histology?; (C) What type of examination do you prefer?; and (D) What type of examination do you consider to be fairer? All the responders were given information about the study and agreed to the publication of the results of this survey.