

# Flipped classroom is an approach of basic medical education for undergraduate students

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## Research article

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# Abstract

**Background:** With the development of medical education, new teaching method, such as flipped teaching model, was paid attention in the process. However, the sharing elaborate courses was used in the flipped teaching model in basic medicine has not been well investigated. Therefore, the aim of this study was to evaluate students' learning effect of the histology and biochemistry between traditional teaching methods and flipped teaching method in the basic medicine classes to provide a scientific evidence of a new model establishment in the medical students' education.

**Methods:** 180 medical students at the Dalian Medical University were enrolled in the process. Hyperthyroidism was chosen for the content of this study. The participants were randomly allocated into the common teaching model group with the traditional lecture-based manner or the flipped teaching model group with the sharing elaborate courses manner. There are paper test, online test and lab test for histology and embryology after learning. The scores including total score, paper test score, online test score and lab test score were compared in two different teaching model and students were required to complete the questionnaire to evaluate the teaching model.

**Results:** The scores of total, online and lab test with flipped teaching model were higher than those in common teaching model in histology and embryology. Additionally, the scores of total, paper and lab test with flipped teaching model were higher than those in common teaching model in biochemistry. The feedback of all items in the questionnaires were much positive. More students agreed and accepted the flipped teaching method could help to improve their performance.

**Conclusions:** The medical students at Dalian Medical University can benefit from the flipped classroom teaching model, and a flipped classroom teaching model may well serve some subject areas such as histology and biochemistry. The flipped classroom approach can serve as a potentially exciting new modality for teaching model in the future.

## Background

In the past for a few decades, the students always received information from teachers in the traditional class time[1]. As the information and communication technologies such as smart phones and laptops developed rapidly which have resulted in e-learning becoming some part of higher education in many fields[2–3]. There are a lot of potentials for reasonably combining e-learning and face-to-face teaching into structured learning environments [4]. Under the situation, the change of medical education model has gradually become a concerned problem from medical educators.

The flipped classroom, also called inverted classroom which has received much attention in medical education[5–6]. It was first described by Lage, Platt and Treglia in 2000 and then popularized by Bergmann and Sams in 2012[7–8]. Learning with flipped classroom has many advantages including the implication that more responsibility for learning of students and the educators can be given more

flexibility to cover a wider range and depth of material, as well as offer timely feedback and supervision to the students[9].

As a new teaching mode, flipping teaching makes the traditional mode reversed to the concept that fully reflect the student-centered and teacher-led. It makes the medical students change from passive learning to active learning to improve the learning interests and effectiveness of medical students. Recently, the study reported that the flipped classroom was proposed as a modern and suitable model for medical education and has been established mainly for learning preclinical subjects like anatomy or biochemistry[10]. As student-centered and self-learning learning mode outside the classroom, and then the teacher makes the final induction, it is the method for learning something new. The flipped teaching model will become a new challenge for the teachers. Moreover, the resource is also a key element for flipped classroom medical education effectively.

In this study, we will make full use of the elaborate courses sharing class network resources which uses modern educational technology making high-quality teaching resources sharing can improve the quality of personnel training from Dalian Medical University in the flipped teaching model of medical education to evaluate the using perspective of flipped classroom in the basic medicine education.

## **Methods**

### **Elaborate courses sharing class network resources**

We used the Elaborate courses sharing class network resources which were established by Dalian Medical university. On this website, we have different parts for the class containing 1) Digital teaching website : including theoretical teaching and experimental teaching; 2) Online Classroom: The video teaching online learning system; 3) Teaching effect quality monitoring platform. 4) Virtual basic medical experimental teaching platform.

### **Participants**

A total of 180 students majoring in clinical medicine from Dalian Medical University. They were enrolled in the studying the histology and biochemistry experiments. Some participants were randomly located into common(n=93) and flipped(n=87) group for histology and biochemistry. All students were unaware of their group assignments before class. The flipped teaching group is that students use the relevant teaching resources to learn outside the classroom firstly, and then the teachers and students cooperated to solve the problems that encountered in the study. The common teaching group is the traditional education model with the traditional lecture-based manner.

### **Data evaluation and statistical analysis**

To evaluate students' understanding of course, the total score is consist of three parts including paper test(40%), online test(30%) and lab test(30%) for histology and embryology. However, the total score is consist of three parts including paper test(40%), online test(20%) and lab test(40%) for biochemistry.

Results of the statistical analyses were presented as the mean  $\pm$  standard deviation ( $\pm$  SD). The scores between two groups were analyzed using the t-test. All statistical analyses were performed using the SPSS 17.0 version and p-values of less than 0.05 were considered significant. Besides, we also use the questionnaire to receive the feedback of the teaching method from students.

## Results

### 1 Flip learning resource at Dalian Medical University

In our department, we established some elaborate courses sharing class network resources successfully. The resource was showed digital teaching website (figure 1A) including theoretical teaching and experimental teaching. Online Classroom contained the video teaching online learning system (figure 1B). Teaching effect quality monitoring platform and Virtual basic medical experimental teaching platform (figure 1C&D). The resource were taken advantage fully by students.

### 2 Teaching quality evaluation of flipped teaching mode in Histology and Embryology

The evaluation of flip teaching mode in Histology and Embryology was divided into two parts including the score grade analysis and grade division. In the score grade analysis, it was also consisted of total score, paper test score, online test score and lab test score. The results was showed in figure 2.

The total score of students in the common mode class is  $83.87 \pm 11.22$ , and the total score of students in the flipped mode class is  $86.70 \pm 10.01$ . There is a difference between the two groups ( $p < 0.05$ ) (figure 2A). Analysis of online evaluation results: the average score of the common mode class was  $26.31 \pm 3.83$ , and the average score of the flipped mode class was  $27.41 \pm 2.62$ , which was different between the two groups ( $p < 0.05$ ) (figure 2C). The experimental teaching pictures and slice test results analysis: the average score of the common mode class was  $25.25 \pm 1.77$ , and the average score of the flipped mode class was  $28.13 \pm 0.63$ , which was different between the two groups ( $p < 0.05$ ) (figure 2D). However, the average of papers test with no differences between common and flipped model ( $p > 0.05$ ) (figure 2B). The results analysis shows that the flipping teaching mode can greatly improve the enthusiasm of students' self-directed learning, effectively using time, significantly improve their academic performance, and improve the performance of teaching content supported by network resources.

We also compared the distribution of grades among students in the two teaching modes. The results are not showed here. In the different distribution of grades, there are some students. Moreover, the number of student is increasing with distribution of grades rising. Particularly, the excellent rate (the total score is more 90) in the flipped teaching group near to 50.57% is higher compared with common teaching group about 36.56%.

### 2.2 Teaching quality evaluation of flip teaching mode in biochemistry experiment

The evaluation of flip teaching mode in biochemistry experiment was divided into two parts including the score grade analysis and grade division. The results was showed in figure.3

The data in figure.3 above shows that the total score of 90 students in the normal mode class is  $85.87 \pm 14.87$ , and the total score of 85 students in the flip mode class is  $91.70 \pm 10.01$ . There is significant difference between the two groups ( $p < 0.01$ ). Analysis of paper test results: the average grade of the average mode class was  $30.63 \pm 5.28$ , and the average grade of the flip mode class was  $35.23 \pm 1.72$ . There was a significant difference between the two groups ( $p < 0.01$ ). Analysis of the results of the experimental operation test: the average grade of the average mode class was  $34.45 \pm 1.26$ , and the average grade of the flip mode class was  $37.16 \pm 0.54$ , which was different between the two groups ( $p < 0.05$ ). There is no difference between the two groups in the usual results. There are some experimental design topics in our paper exams. The flip teaching mode effectively enhances students' experimental design ability and logical thinking ability. The grades of the experimental design of the class using the flip teaching mode are much higher than those of the ordinary mode class. And the hands-on ability in the experimental test is far superior to the ordinary mode class.

Besides, we also compared the distribution of grades among students in the two teaching modes. The results were not showed here. In the different distribution of grades, there are some students. Moreover, the number of student is increasing in common group compared with flipped group during the score between 70 and 79. However, the excellent rate(the total score is more 90) in the flipped teaching group near to 43.52% is higher compared with common teaching group about 27.78%.

### **2.3 Investigation on issues related to flipping mode teaching**

Investigation of questionss related to flipping mode teaching in clinical medicine students aiming to receive some feedback of this study from students. We put forward some related questions about the using of the flip teaching model in the students of clinical medicine, and set three options A(postive), B(medium) and C(negative). The survey results were showed in Table 1.

## **Discussion**

Medical science is a lifelong learning subject. Learning individuals must be in the main position in learning. Therefore, cultivating students' independent learning ability and developing innovative thinking methods have become the central task of medical talent training. With the introduction of high-tech information technology into the field of education, the digital teaching environment supported by digital network technology has become the main direction of the medical science education teaching infrastructure in China or all over the world especially in special circumstances[11]. In the previous research, after six years of construction and application of the network independent learning platform, we evaluated and analyzed the teaching quality of multi-level students, gradually improved the construction and application of the basic medical digital teaching platform, and applied the teaching model. The problems found in the process were discussed and solved[12]. Flipping the classroom as a new teaching model was first proposed by Khan in 2011[13]. In generally, flipping classroom teaching is carried out with its mode of extracurricular learning and communication and discussion in class. The flip teaching is based on video teaching and inquiry-based classroom communication outside the classroom[14]. It can

be seen that information technology is the support of flip teaching. The flipping classroom teaching of basic medicine can effectively improve the active learning and active thinking ability of medical students, and deepen the understanding and grasp of medical knowledge. The construction of our early digital teaching resources and the introduction of national and provincial quality resource sharing courses have made it possible to flip teaching.

The roles of students and teachers have changed in flipping teaching. First, students use high-quality educational resources in multiple ways and freely choose the time, place and progress of learning. Following the class, students and teachers discuss the difficult knowledge of the course together. Under the circumstances for using the flipped teaching model, it is also a challenge for teachers[15]. In teaching, teachers are more responsible for supervising the progress of students' extracurricular activities. High-level interactive teaching is required in the class. This requires teachers to adopt modern technology to digitize teaching resources and digital evaluation resources. And the computer evaluation mode is integrated into one, to grasp the students' interest, mastery and problems in the knowledge, and at the same time, the teachers are required to have a rich professional foundation reserve, and comprehensively and systematically master the basic knowledge of the subject and related disciplines. Learn more about the latest advances in medical science to better address the problems students encounter in their self-learning process so that they can better answer student questions and guide students to apply knowledge. From the analysis of the evaluation results of this study, it can be seen that the flip teaching of medical science not only satisfies the individualized needs of medical students in the learning process, but also improves the learning efficiency and teaching quality of students, and is conducive to cultivating self-study and self-control of medical students. Ability, and innovative thinking skills. In our study, we found the score of flipping teaching model is better than the common teaching method in the histology and biochemistry. Most of students accepted the flipped teaching method depend on the feedback from the students.

Strengthening the concept of independent learning and creative learning has become one of the important links in medical education. The various advantages of the flipping teaching mode are lack of the traditional teaching mode, which can be regarded as the ideal teaching mode of medical teaching. At present, basic medical flip teaching as a new teaching mode of initial development, there will be some problems to be solved. For example, how to change the simple accepted learning habits that students develop in long-term basic education as soon as possible, and adapt to the new learning model; How to make the construction of national quality teaching resources and the full sharing of innovative talents; How to enable more teachers to join the resources construction and application of the new teaching model. These problems have to be gradually explored and improved in the teaching process of the new teaching mode.

## Conclusions

The medical students at Dalian Medical University can benefit from the flipped classroom teaching model, and a flipped classroom teaching model may well serve some subject areas such as histology and

biochemistry. The flipped classroom approach can serve as a potentially exciting new modality for teaching model in the future.

## **Declarations**

### **Abbreviations**

Not applicable

### **Consent for publication**

Not applicable

### **Availability of data and materials**

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

### **Competing interests**

The authors declare that they have no competing interests.

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### **Authors' contributions**

LK, HK and XW contributed to the design of the study and funding supporting. LS, HM, BL and YD contributed to data collection, XR and LS contributed to data analysis and manuscript writing. YG and YK contributed to manuscript revisions. All authors contributed to the critical revision of the paper and approved the final manuscript for publication.

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None

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

The research project was approved by Dalian Medical University. The students were verbally informed about the research project and that completion of the survey was voluntary. Written informed consent was obtained from the participating students.

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## Tables

**Table 1.** The feedback of the flip teaching model from students

Questions	A(%)	B(%)	C(%)
The agreement of the flip teaching model	55.29	44.71	0
Is it good for learning knowledge?	38.82	50.59	10.59
Is it helpful to improve learning interest?	24.71	60.00	15.29
Is it helpful to improve the ability of understanding knowledge?	32.94	61.18	5.88
Is it good for improving students' self-study ability?	36.47	61.18	2.35
Is it useful to improve the ability of analyzing/solving problems?	21.18	72.94	5.88
Does it add some burden of study?	42.35	52.94	2.35
Are you satisfied with the flip learning resource?	63.64	36.36	0

## Figures



Figure 1

Flip learning resource at Dalian Medical University. (A) The digital teaching & learning platform of histology and embryology. (B) Liaoning Province Histology and Embryology resource sharing course. (C) Teaching effect quality monitoring platform and Virtual basic medical experimental teaching platform.

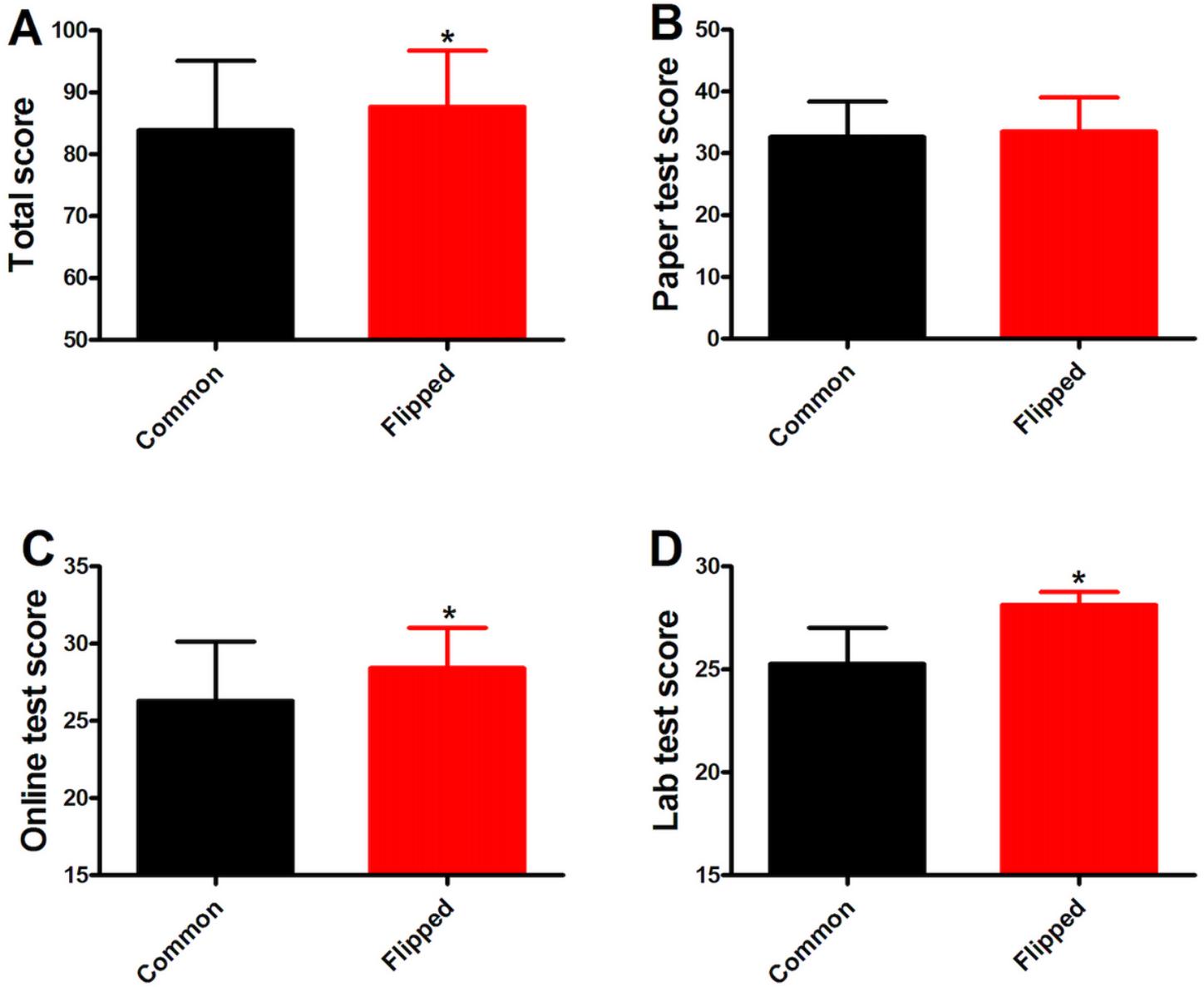


Figure 2

The score grade analysis of flipped teaching mode in Histology and Embryology. The total score(A), paper test score(B), online test score(C) and lab test score(D)of flipped teaching mode in Histology and Embryology.\*  $p < 0.05$ .

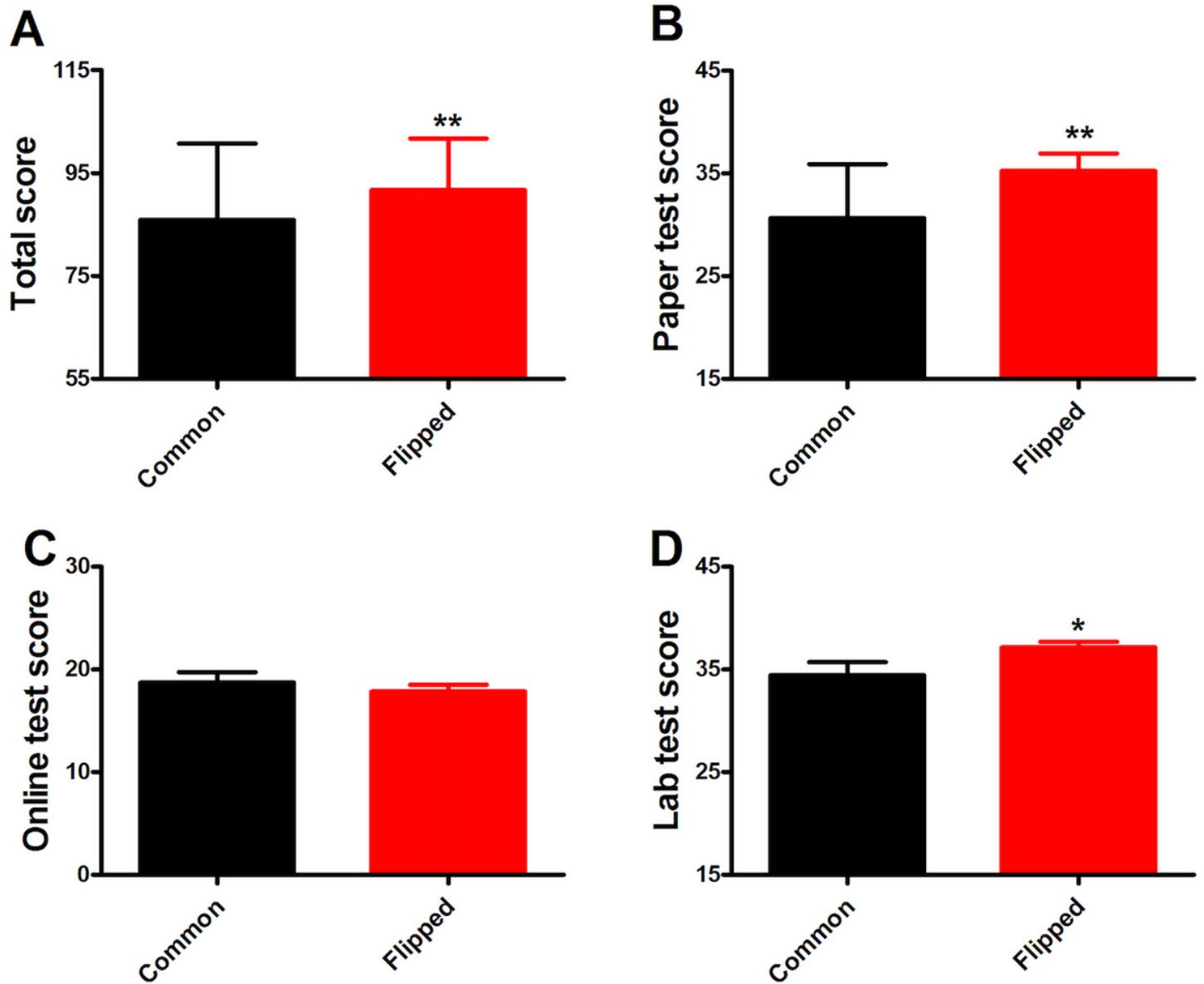


Figure 3

The score grade analysis of flipped teaching mode in Biochemistry. The total score(A), paper test score(B), online test score(C) and lab test score(D) of flipped teaching mode in Biochemistry.\*  $p < 0.05$  \*\*  $p < 0.01$ .