Research on Evaluation of Blended Learning Process Based on Mobile Terminal

Jian-mei XU*, Fang YANG, Qing LIN, Qian ZHANG

ABSTRACT

In the spring term of 2017, we carried out the blended teaching of medical imaging physics based on the cloud class course platform of mobile terminals, recorded and evaluated the students' participation in various learning activities using the platform, and counted these scores in different proportions into the total score of the course. This paper analyzes these raw data which reflect the students' learning situation through factor analysis method and makes clear which abilities are mainly evaluated by the blended learning process evaluation, and analyzes the correlation between the evaluation of learning process and the test scores, and discusses how to improve the evaluation mode of learning process so as to play a better role.

INTRODUCTION

The progress of information technology provides strong support for the construction of new teaching mode, the development of mobile technology makes learning more convenient, thus promote the application of new teaching mode in teaching. As an important part of the teaching process, learning evaluation must be adapted to the new teaching model. Because learning process evaluation can guide, motivate and improve students' learning, it has been paid attention by more and more teachers, and is gradually incorporated into the learning evaluation system.

Blended learning combines classroom learning with online learning, and combines a variety of learning modes. With the help of information technology, it provides the resources and activities that fit with the teaching objectives, so as to obtain the optimized teaching goals. [1] Blended teaching organizes teaching activities through online learning platform, the online learning, discussion, testing and submitting assignments can be carried out, so that the learning track of each student can be recorded in real time, and the learning process evaluation and feedback can be carried out in a timely manner. Niu Kuihuan explored the evaluation of learning process, from the four dimensions of individual, autonomy, creativity and input of learning process. [2] Zhang Junchao et al found that the evaluation of learning process had an impact on the students' learning input and learning effect, by analyzing the study and development of college students' learning and development. [3] Li Fengqing et al tried to build a blended teaching quality evaluation system, and found that the diversified evaluation method based on the blended teaching process can objectively reflect the correlation between students' learning behaviors,

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attitudes and results. [4] Zhang Rui et al studied the causes of the improvement of blended learning effect in SPOC mode. [5]

In the spring term of 2017, we carried out the blended teaching practice of medical image physics course on the platform of the cloud class course of mobile terminal. This paper applied factor analysis method to comprehensive evaluation of blended learning process, analyzed the main factors that determine the score of learning process evaluation, and the correlation between learning process evaluation and test results, and discussed how to improve the evaluation method of learning process so that it can play a better role.

DATA SOURCE FOR BLENDED LEARNING PROCESS EVALUATION

For blended teaching of medical imaging physics, online learning included pre-class learning, video learning, group learning, testing, experiment preview, review and summary, etc. Classroom learning included discussion, teaching, experiment and hospital probation. The students downloaded the cloud class course APP, participated in online and offline learning activities. The final course score is made up of two parts, process score and final exam score. The data source of the blended learning process evaluation is a data table that was recorded by the cloud class course platform to reflect the students' learning situation, which was made up of the following variables.

(1) The pre-class learning: It included four pre-class learning tasks. The teacher provided 15 micro-videos to ask the students to study before class, and put forward the course of study tasks. The students could get the corresponding score by uploading the homework after completing the learning task. The teacher could then make a score based on the completion of the student's homework, and also gave written feedback.

(2) Group learning: It included three group learning tasks. Each student first completed the work independently, and then completed the group discussion. After that, the team finally uploaded the learning results and got the prescribed scores. The teacher then scored according to the completion of each group and gave text feedback.

(3) Test: An online test was scheduled at the end of each unit, including 15 tests. The students would be able to know the test results after finishing the test and the system would automatically publish the correct answers.

(4) Experiment preview: It included 2 micro-videos, 3 PPT, 2 experiment preview documents. The teacher asked the students to finish the experiment preview before the experiment began. The student can get the corresponding score by uploading the answers of the preview question.

(5) Experiment Score: Including 3 experimental items. The experimental group is the same as that of the group learning. The students completed the experiment in units of the group. After the experiment, each student wrote the experiment report, and the teacher evaluated the experiment results according to the experiment process and the completion of the report.

CARRYING OUT A COMPREHENSIVE EVALUATION METHOD OF BLENDED LEARNING PROCESS BY FACTOR ANALYSIS

According to the seven original variables including pre-class learning, group learning, test results, test times, experimental preview, experimental results, review and summarize, a few common factors with representative meanings were constructed, which required that these original variables should have certain correlation. Pearson correlation analysis of the above 7 variables showed that there was no significant correlation between pre-class
learning and other variables. Therefore, we used IBM SPSS Statistics 24 to make factor analysis on the data table made up of 6 original variables.

**KMO Test and Bartlett’ Spherical Test**

The KMO statistic was 0.686 and closed to 7, factor analysis could be done. The Bartlett test, P=0.000<0.05, there was a significant correlation between 6 original variables.

**Extracting the Common Factor**

Three common factors were extracted by principal component analysis and 76.03% of the original information was carried. The relationship between common factors and eigenvalues was shown in figure 1. We choose the maximum variance method to rotate the common factors, and got the main variables that affect the common factors. The common factor 1 had a strong positive correlation with the test scores, test times and experimental preview scores. It reflected the students' willingness to learn and their degree of effort, and it was called "autonomous learning ". The common factor 2 was mainly determined by the variables of reviewing and summarizing, and still named "review summary". The common factor 3 had a strong positive correlation with group learning and experimental performance, while group learning and experiment were done in group collaboration, named "collaborative learning". The variance percentages of the three common factors after rotation were 28.679%, 24.8245% and 22.527%, respectively. Their size indicated the degree of influence of each common factor on the comprehensive evaluation of the blended learning process.

![Figure 1. Relationship curve of common factors and eigenvalues.](image)

**Common Factor Score and Comprehensive Evaluation Score of Blended Learning Process**

According to each factor score coefficient matrix, SPSS can automatically calculate each student in the three common factor scores. Taking the percentage of variance after rotation of three common factors as the weight, the comprehensive score of each student in the evaluation of blended learning process could be calculated according to the factor score. Factor analysis results showed that the evaluation of blended learning process mainly reflected the students' performance in three aspects: autonomic learning, cooperative learning and review.
THE CORRELATION ANALYSIS OF THE MIXED LEARNING PROCESS EVALUATION AND THE FINALITY EVALUATION

Through Pearson correlation analysis, we found that in the process of blended learning, there was a significant positive correlation between autonomic learning, review and summary, collaborative learning and final exam scores, as shown in table 1. The Pearson correlation coefficient between the comprehensive score of blended learning process evaluation and final examination scores reached 0.627 at the level of 0.01. It showed that in the process of implementing blended teaching, through timely evaluation and feedback of learning process, it could effectively exert the guidance, excitation and corrective action of process evaluation to students' learning activities. The role of motivation and correction can not only promote the students' autonomous learning ability and cooperative learning ability, improve the practical ability of learning, but also effectively promote the students to master and understand knowledge and skills. Improve the learning effect. It can not only improve students' autonomous learning ability and collaborative learning ability, improve their hands-on practical ability, but also effectively promote their knowledge and skills, and improve their learning effect.


<table>
<thead>
<tr>
<th></th>
<th>Autonomic learning</th>
<th>Review</th>
<th>Collaborative learning</th>
<th>Comprehensive scores</th>
</tr>
</thead>
<tbody>
<tr>
<td>Final exam score</td>
<td>0.481**</td>
<td>0.288*</td>
<td>0.297*</td>
<td>0.627**</td>
</tr>
</tbody>
</table>

** At the level of 0.01, the correlation is significant. * At the level of 0.05, the correlation is significant.

ANALYSIS OF THE PERFORMANCE OF DIFFERENT CATEGORIES OF STUDENTS IN THE PROCESS OF BLENDED LEARNING

By analyzing the final examination results, we found that there are five characteristic peaks, as shown in figure 2. Therefore, the students were divided into five categories by cluster analysis, and the test scores of each cluster center are shown in table 2.

**TABLE 2. NUMBER OF STUDENTS IN 5 CATEGORIES AND EXAM SCORE CORRESPONDING TO CLUSTER CENTER.**

<table>
<thead>
<tr>
<th>Category</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of students</td>
<td>2</td>
<td>14</td>
<td>21</td>
<td>23</td>
<td>5</td>
</tr>
<tr>
<td>The exam score</td>
<td>26.8</td>
<td>51.6</td>
<td>63.3*</td>
<td>75.5</td>
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Figure 2. Final exam score distribution curve.

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The Performance of Five Categories of Students in Autonomous Learning Scores

The distribution of autonomous learning scores for the five categories is shown in figure 3. The distribution of category 5 and category 4 in autonomous learning is very similar. 80% of students in category 5 and 78.2% of students in category 4 scored more than average. Therefore, autonomous learning ability is an important guarantee to get good results in the final examination. Category 1 of the students scored low in autonomous learning, and 57.14% of students in category 2 scored below the average, which means that if they didn't work hard at ordinary times, it would be very difficult for them to get good marks in examinations.

The Performance of Five Categories of Students in Review Summary Scores

The percentage distribution of the review summary scores for the 5 categories is shown in figure 4. Category 4 showed the best performance in review summary score, with 73.91% of the students scoring more than the average score. This part of the students attached importance to the summary of the learned knowledge, be good at systematize knowledge, and help to achieve good results in the examination. 19.05% of students in category 3 had higher scores, they had a strong desire to improve their examination results by reviewing and summarizing. 57.14% of students in the category 2 scored above the average score. But they lacked the accumulation of learning at ordinary times, it's difficult to really master knowledge only by review. Although category 5 does not perform well on the review summary score, it did not prevent this part of the students from getting good grades in the exam, because they had learned their knowledge well in their usual studies.
The Performance of Five Categories of Students in Collaborative Learning Scores

The percentage distribution of the 5 categories of students' cooperative learning scores is shown in figure 5. All of category 5 and 73.91% of students in category 4 scored higher than average scores, most of the students with good test results had good cooperative learning ability and played a leading role in group learning. Category 1 and category 2 also had 50% of the students who scored more than the average score, however, whether this score reflects the real situation of these two categories of students participating in group learning is worth considering.

The Performance of Five Categories of Students in the Comprehensive Score on the Blended Learning Process Evaluation

The percentage distribution of the comprehensive scores of blended learning process evaluation for the five categories of students is shown in figure 6. The scores distribution of category 5 and category 4 were close to each other, all of category 5 and 91.3% of students in category 4 scored higher than the average score, significantly higher than the other categories. It showed that students with strong comprehensive learning ability could get good results in the final examination.
The score distribution of category 3 was close to category 2, and category 1 had the lowest score. The scores of 50% of students in category 2 and category 3 are close to the scores of category 4 and category 5. Different category of students have little difference in the scores of comprehensive evaluation of blended learning process, which weakens the guidance and correction function of learning process evaluation to the students with poor test scores, and was not conducive to their study.

CONCLUSION AND DISCUSSION

Through factor analysis of the blended learning process data, it is found that the blended learning process evaluation mainly reflects the students' performance in three aspects: autonomous learning, review and summary, and collaborative learning. Moreover, there is a positive correlation between students' scores in these three aspects and final examination scores. It shows that learning process evaluation can not only evaluate students' learning from more dimensions, but also promote students' ability to understand and apply knowledge, through learning process evaluation to guide, incentivize and improve students' learning behavior.

The students were divided into five categories according to the final examination scores, we analyzed their learning behaviors, found that the students with good scores had strong comprehensive ability, positive learning attitude and willingness to solve the problem in the course of the blended learning, and the leading role in the group learning could help to understand and master the knowledge effectively. At the same time, it is also found that 14.29% of students in category 2 have high scores in autonomous learning, but poor scores in the examination, so we should strengthen the guidance to the students in their learning methods. The evaluation of the review and summary should also be placed after the end of each unit, so as to enable students to systematize the fragmented knowledge in time, and to check and fill the gaps in time. In order to evaluate the whole process of students' participation in group learning, the more evaluation index should be added to the evaluation of cooperative learning ability, so as to promote students' progress in cooperative learning.

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REFERENCES