Reform and Application of Biochemistry Teaching Based on Formative Evaluation of Mobile Network Platform

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Abstract. Objective: To explore the construction and implementation of a formative evaluation system based on the mobile network platform in biochemistry teaching. Methods: The biochemistry online course is established on “Xuexitong” mobile network platform. Based on the online course, a comprehensive formative evaluation system is constructed, including segmented and diversified evaluation before, during, and after class with the integration of online and offline to perform a formative evaluation on the biochemistry teaching for students in 2017 undergraduate medical-related majors. Results: 95.7% of the students achieved excellent scores, and 1.3% failed to pass the online periodic examination, 97.1% of the students liked the online examination method, 46.7% of the students liked the homework assigned after each class, and 28.8% of the students liked to practice once a week, 99.6% of the students thought that Xuexitong was helpful to biochemistry study. Conclusions: The formative evaluation based on the mobile network platform is a useful evaluation method that requires further study.

Keywords: Formative Evaluation, Biochemistry, Mobile Network Platform

1. Introduction
On August 22, 2018, the Ministry of Education issued the notice on the implementation of the spirit of the National Undergraduate Education Conference in the new era. The document required that colleges and universities should strengthen the management of learning process[1-2]; to comprehensively sort out the teaching content of each course, eliminate the “poor-quality courses” and create the “gold-quality course”; effectively strengthen the evaluation of learning process and increase the proportion of process evaluation results in the total course results. At the same time, the document requires colleges and universities to accelerate the improvement of the deep integration mechanism of modern information technology and education and teaching, promote the construction of online open courses orderly and effectively, and facilitate the process of using information technology to transform
traditional teaching and improve teaching level\cite{3,4}. Pursuant to the document spirit of the Ministry of education to improve the quality of medical education, based on the current education situation of our school, the course group, according to the construction of Jiangxi Province's top online open courses and top-quality resource sharing courses, it is necessary to keep pace with the times\cite{5,6}, break through the traditional “one volume” examination model at the end of the term, adopt the “Xuexitong” mobile network platform to carry out formative evaluation of biochemistry teaching, and conduct the evaluation in the educational activities, monitor and test students' learning of biochemistry knowledge and skills, strengthen their process learning, evaluate the learning progress timely, and adjust teaching properly through feedback to achieve the purpose of improving teaching quality and creating “gold-quality courses”.

2. Construction and implementation of formative evaluation based on the mobile network platform
Based on the biochemistry online course, the course group established a comprehensive formative evaluation system that combines evaluation before, during, and after class with the integration of online and offline. The evaluation items of this course include the preview on the front line of class, check-in during class, online test, online person selection and answer, online homework after class, online stage examination after class, thematic discussion, questionnaire survey, offline final exam, etc. Except for the final examination, the rest of the examinations are formative evaluation, and the scores account for 40% - 50% of the total curriculum scores. The off-line final examination belongs to the final evaluation, and the score accounts for 50% - 60% of the total score of the course.

A formative evaluation was carried out on the theoretical biochemistry courses for 1114 students majoring in clinical medicine, stomatology, preventive medicine, anesthesiology, forensic medicine, medical imaging, medical law, medical psychology, mental health, and other disciplines. The list and student ID of 1,114 students are posted in the online course of biochemistry in the background of “Xuexitong”. After downloading the “Xuexitong” app, students can use the student ID to log in to the “Xuexitong” mobile network platform for online learning of this course.

Given sample data set, \(D = \{x_1, x_2, ..., x_n\}, x_i \in R^d, i = 1, ..., n\). It is assumed that the first sample is labeled as \(\varepsilon = (x_1, x_2, ..., x_{\varepsilon})\), and the corresponding label is \(\eta = \{y_1, y_2, ..., y_{\varepsilon}\}\).

In view of the classification problem, the following symbols are used:

\[ S = \{(x_i, x_j): x_i \ and \ x_j \ are \ in \ the \ same \ category. \ x_j \ is \ a \ close \ neighbor \ of \ x_i \} \]

\[ R = \{(x_i, x_j, x_k): x_i, x_j, x_k \ are \ in \ the \ same \ category \ . \ x_i \ and \ x_k \ are \ not \ in \ the \ same \ category\} \]

In the classification problem, the importance of each feature dimension is different. To some extent, the big data weak symmetric manifold can overcome the shortcoming that the big data weak symmetric Manifold treats each feature dimension equally. Its definition is as follows:

The big data weak symmetric manifold between samples \(x_i\) and \(x_j\) is defined as follows

\[ d_A(x_i, x_j) = \sqrt{(x_i - x_j)\ A(x_i - x_j)} \]
$x_i \in \mathbb{R}^d$, $A \in \mathbb{R}^{d \times d}$ represents a symmetric semi positive definite matrix

According to the properties of semi positive definite matrix, $A$ decomposable into $A = L^T L$:

$$d_A(x_i, x_j) = \sqrt{(x_i - x_j)^T A (x_i - x_j)}$$

$$= \sqrt{(x_i - x_j)^T L^T L (x_i - x_j)}$$

$$= \sqrt{(L x_i - L x_j)^T (L x_i - L x_j)}. \quad (2)$$

It is equivalent to the matrix as a mapping, mapping the data of the original space to the new space, and transforming the big data weak Symmetric Manifold of the original space into the big data weak Symmetric Manifold of the new space.

In the teacher’s mobile terminal, a learning app can be used to organize classroom teaching activities, such as check-in, test, grading, task activity, live broadcast, topic, etc. Among them, check-in is a real-time check-in. Teachers in the course group start a course at a time and initiate the real-time check-in activities to obtain the number of students coming to class. Based on the feedback of task completion before class and classroom teaching, teachers launch online classroom exams on the learning platform, which can provide the overall completion analysis of the whole class (Figure 1) and the completion of each student; or set questions at key points of the course, use learning candidates to answer questions or guide students to think about online answers. These classroom teaching activities not only mobilize the enthusiasm and engagement of students effectively but also help teachers determine the learning status of students in real-time and capture teaching information in time. Teachers can analyze students' mastering status of the course content according to the platform data objectively, adjust their teaching content, and reflect the key and challenging problems in the students' exams or have universal significance. It can effectively regulate the teaching process and improve the quality of classroom teaching.

![Figure1. Classroom online test (Mobile terminal)](image-url)
In the online homework after class, the relevant knowledge points are extracted from the constructed homework base. The topics selected focus on the understanding and application of basic knowledge in teaching materials and highlighting the teaching focus and difficulties. The course group arranges online homework after class according to the principle of “small exercises after class, big exercises at weekends”. Students submit their homework through the learning platform at the designated time. Teachers can urge students to complete homework on time. The objective questions are reviewed by the system automatically; while the subjective questions need to be reviewed by teachers themselves. In the process of marking homework, teachers can understand students' learning situations and can reject the homework with poor quality and require the students to rework on their homework.

The course group divides the content of biochemistry course into four parts (i.e. structure and function of biomolecule, metabolism, and regulation of substance, the transmission of genetic information, special topic of medical biochemistry). After the teaching of each part, the online periodic examination is carried out: the teacher releases examination information to the students during learning, prepares papers by using the built examination database, and issues examination questions at a fixed time. The students use their mobile phones or computers to take online exams at a specified time point. At the end of the exam, the learning system will rate the students immediately. The students can view their scores and details of wrong questions. In this way, they can consolidate their learning according to the knowledge points of the board. At the end of each stage of the examination, the teacher analyzes the results of the stage examination according to the system, understands the students' mastery of knowledge in time, and urges the students to consolidate the learning in time.

Einstein said: “Education is not the learning of facts, but the training of the mind to think.” To cultivate students' capabilities to acquire knowledge independently and improve students' capabilities of divergent thinking, the course group assigns students more interesting and interdisciplinary topics on the learning platform selectively for students to study and discuss in groups after class combined with the theoretical knowledge of biochemistry that students have learned. Three to four students are assigned to a study group. The students make self-evaluation and mutual evaluation. Then the group leader records the discussion and submits it in a written report. Teachers judge students' comprehensive learning capabilities according to their discussion. For example, when students have learned the knowledge of “structure and function of biomolecules”, they have arranged a special discussion on “please use dialectical materialism to analyze life-based on biomolecules”. These open problems require students to give full play to their initiative and creativity. After class, students complete a series of work, including consulting literature, sorting out materials, analyzing research materials, etc. through independent learning and discussion. The students complete the written reports, which can broaden their research vision, so that they can gradually establish scientific research thinking, laying a solid foundation for improving their capabilities to solve scientific research topics and writing papers in the future.

3. Effect evaluation

Based on the formative evaluation of the mobile network platform, the implementation of 2017 undergraduate students majoring in clinical medicine, stomatology, preventive medicine,
anesthesiology, forensic medicine, medical imaging, medical law, medical psychology, and mental health in our university was conducted. In the first online stage examination of Biochemistry, 1066 students scored above 80 points, accounting for 95.7% of the total; 33 students scored between 60-79. Among the scores, it accounts for 3.0% of the total number of students; only 15 students have scores below 60, accounting for 1.3% of the total number of students. The exam scores of students are much higher than before, and the fail rate is low (Figure 2). The results of sampling questionnaire survey on students show that (Figures 9-13): 97.1% of students like the evaluation method of online examination; 46.7% of students like to assign homework after each class, 28.8% of students like to practice once a week; 99.6% of students think that learning is good for learning biochemistry; 17.5% of students think that case teaching is excellent, teachers should use it often, 61.7% of students think that case teaching is good, 69.9% of the students think that bilingual teaching is difficult for them, and only 4.6% of them think bilingual teaching is easy to understand.

Figure 2. Examination scores in the first stage

4. Conclusions
Based on the established online course platform, the Internet, mobile phone, computer, and other related information technology are fully used to perform auxiliary teaching. With the traditional evaluation method as a breakthrough point, a comprehensive formative evaluation method is established, including segmented and diversified evaluation before, during, and after class with the integration of online and offline, focusing on the timely feedback of students' learning and the comprehensive evaluation of their comprehensive capabilities.

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