Ind. J. Pharm. Edu. Res., 2025; 59(1):56-64.
https://www.ijper.org

Original Article

Research on the Application of the "BOPPPS+Blended Teaching" Model in a "Food Biochemistry" Course

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ABSTRACT

Background: Massive Online Open Course (MOOC) provides a new research idea and direction for educational reform with the internet era. The authors designed a "BOPPPS+blended teaching" model and carried out the practice in a "Food Biochemistry" course in order to improve the learning effect. **Materials and Methods:** 42 students in grade 2018 (experimental group) were divided randomly into seven groups (six students in each group) and taught using a "BOPPPS+blended teaching" model. The forty-two students in grade 2017 (control group) was taught using a traditional teaching model. To assess achievement, a final examination in Food Biochemistry was administered at the end of the course and a questionnaire survey was conducted at the end of the term to determine students' attitude to the new teaching model used. **Results:** The results show that, compared with the control group, the students are significantly superior in the depth of knowledge understanding, and there is also a significant difference in learning effect ($p<0.05$). Their academic performance (81.57±4.12) was about six points higher than the control group (75.16±2.45). The results of the questionnaire survey show that compared with the control group, students are more willing to accept the new teaching model, and are willing to support the continuation of the new teaching model in the future semesters.

Keywords: Food Biochemistry, BOPPPS, SPOC, Blended teaching.

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Received: 13-05-2023;
Revised: 22-08-2023;
Accepted: 07-10-2024.

INTRODUCTION

Food Biochemistry is a professional basic course of Food Quality and Safety majors. The course starts in the second semester of freshman year. Food Biochemistry lays a solid foundation for the subsequent core specialized courses of Food Quality and Safety majors, and the importance of the course is obvious. Due to the characteristics of the course itself, such as more knowledge points and abstract content, it brings some difficulties to students' learning. The traditional teaching model results in students' lack of motivation, low efficiency and poor effect. The development of the discipline is inseparable from the continuous efforts of researchers, which of course brings about the rapid development and rapid update of biochemistry knowledge. On the premise of mastering the original basic knowledge, students also need to keep up with the pace of science and track the introduction of the subject. In the case of continuous compression of class hr, to complete these teaching contents will undoubtedly increase the learning pressure of students.

Facing with the difficulties in teaching, the researchers decided to introduce the BOPPPS in class after many discussions. BOPPPS teaching model is the theoretical basis of ISW, a teacher skill training system established in Canada in 1976 and widely implemented.[1] BOPPPS divides the complete classroom teaching process into six modules, which are new knowledge introduction (bridge in, B), learning Objective (O), Pre-assessment (P), Participatory learning (P), Post-assessment (P) and Summary (S).[2] In order to distinguish the three P in BOPPPS, the following BOPPPS were described as $BOP_1P_2P_3S$. Using situational cases as the import module has an excellent effect, which not only stimulates students' learning motivation and interest, but also popularizes abstract problems, which is easy for students to understand and improve the learning effect. With the passage of time, it is found that the $BOP_1P_2P_3S$ is adopted in class; students have to be familiar with the situational case in class every time, which wastes a lot of class time and is not efficient. If there is a way to familiarize students with situational case and learning objectives in advance, and teachers can supervise them at any time, this would be a good complement to $BOP_1P_2P_3S$. In order to achieve this goal, the research group built and introduced the Food Biochemistry online course in the form of a standalone SPOC (Small Private Online Course) on the MOOC platform in 2019. SPOC is a learning management system that hosts content for the institution's enrolled students only.

DOI: 10.5530/ijper.20253755

In order to maximize the improvement of students' learning effect and efficiency, the classroom is divided into three stages of teaching before, during and after class. The first three modules of $BOP_1P_2P_3S$ including B, O and P_1 are completed online before class. The last three modules of $BOP_1P_2P_3S$ are completed in class including P_2, P_3 and S. After class, some online exercises will be provided to help students understand and preview the content of the next course.[3] Online and offline blended teaching is a teaching strategy that combines online learning with face-to-face class. Blended teaching subverts the traditional learning environment and promotes students' more thorough and lasting understanding.[4] The new teaching model of combination $BOP_1P_2P_3S$ with online and offline blended teaching ($BOP_1P_2P_3S$+blended teaching) has been completed for 4 semesters, and the Food Biochemistry course has been approved as a Quality Open Online Courses of Huanghuai University in 2021. Practice has proved that the new teaching model has many advantages, in the later application; we will continue to make efforts to make the model more perfect. Here, taking Food Biochemistry course as an example and expounding the design and implementation of this teaching method.

MATERIALS AND METHODS

$BOP_1P_2P_3S$ teaching method

The teaching model of $BOP_1P_2P_3S$ focuses on what students learn rather than what teachers teach, which consists of 6 teaching modules, namely, Bridge-in (B), Objective (O), Pre-assessment (P_1), Participatory learning, (P_2), Post-assessment (P_3) and classroom knowledge Summary (S)[2]. Bridge-in (B) means that before the course, combining with the main theoretical knowledge of the course, the teacher selects a situational case close to life to stimulate students' interest in exploring new learning. The case runs through the whole teaching process. Objective (O) means to draw out teaching objectives or learning tasks on the basis of situational cases. The learning tasks run through the whole teaching process and are finally achieved. Pre-assessment (P_1) means to test students' knowledge to be taught in this course before class. The purpose is to analyze students' preview status, so as to determine again whether the learning objective of this course need to be adjusted and make learning more focused. Participatory learning (P_2) means that on the basis of learning tasks, students discuss in groups and express their understanding or opinions, then teachers give comments and supplements after the representatives of the group give answers to questions randomly. Post-assessment (P_3) means to test the learning effect of students. Summary (S) means a summary of the whole lesson. $BOP_1P_2P_3S$ has the advantages of simple process and clear goal, easy to use in the classroom. But the $BOP_1P_2P_3S$ wastes a lot of class time and annoys teachers.

The emergence of online and offline blended teaching model provides potential solution to the problem. Blended teaching not only allows teachers to have time to prepare cases and upload before class, but it also leaves plenty of time for students to analyze and learn the cases sent by teachers after class. In addition, engagement with the internet also allows teachers to provide updated information in real time and carry out classroom interactions, and to observe, track, quantify and evaluate the learning of each student before class, in class and after class. These benefits support the achievements sought through the establishment of an active learning environment.

Online and offline blended teaching model

Blended teaching is a teaching strategy that uses computer technology to reverse the traditional learning environment. Instead of only providing content in the classroom, in a blended teaching environment, content is provided outside the classroom so that students can acquire basic knowledge and concepts by using online audio-visual tools, such as Massive Open Online Course (MOOC) video resources or micro-lesson videos pre-recorded by teachers.[5,6] Students watch these videos according to their own schedule before class to achieve self-guided and self-paced learning.[7] Each student shares his or her own understanding and ideas about the problem through the internet.[8,9] In this environment, learning changes from teacher-centered to student-centered. The lower levels of Bloom's taxonomy, including remembering and understanding, are moved outside the group learning space, allowing students to naturally apply the higher levels of Bloom's taxonomy, such as creating, evaluating and analyzing, within the group learning space.[10]

Massive Open Online Course (MOOC) first appeared in education in 2008. Since 2012, MOOC has emerged around the world, and many of the world's top universities have joined in, bringing opportunities for learners around the world to learn the courses of the world's top universities.[11] Since 2019, due to the impact of the COVID-19 pandemic, the construction of MOOC has reached a climax. Following the MOOC platform, other online platforms are also popular, such as super star learning APP and Rain Classroom mini program. The establishment of standalone SPOC courses in MOOC is also popular among educators in China. SPOC have the same advantages as MOOC, except that it hosts content for the institution's enrolled students only. SPOC platform allows teachers to communicate with students via smartphones or other internet-enabled devices. Teachers can modify teaching materials and release videos, voice, courseware and exercises to the platform through the SPOC. Students can preview the learning materials published online by teachers before class, also can consolidate and review the knowledge after class. In addition, teachers are able to facilitate rapid virtual discussions through connected groups on WeChat platform. The SPOC platform can also dynamically record each student's learning behavior and other relevant data throughout the online and offline learning process. All student activity, including answers to questions and other information, can be seen by teachers via

the platform. Teachers can view feedback that students provide on classroom exercises and homework assignments. Through the analysis and integration of these data, teachers can quantitatively evaluate their own teaching effectiveness and dynamically adjust their own teaching strategies. Thus, SPOC promote a comprehensive interrelationship among pre-class, in-class and after-class learning.

Design and practice of "$BOP_1P_2P_3S$+blended teaching" model

Biochemistry is a foundational course for freshman. A full semester consists of 48 hr of class time. The main course content includes three modules: structural chemistry of substances, metabolic chemistry and bioenergetics of substances, and transmission of genetic information. The entire teaching process is divided into three stages: pre-class (knowledge acquisition), in-class (knowledge internalization) and after-class (knowledge consolidation) in "$BOP_1P_2P_3S$+blended teaching" model, as shown in Figure 1. An analyze the effectiveness of this model was conducted in the spring of 2019.

In order to study the influence of "$BOP_1P_2P_3S$+blended teaching" model on students' academic performance, the 42 students of grade 2018 (experimental group) majoring in Food Quality and Safety adopted the new teaching model in the spring 2019. The 42 students majoring in Food Quality and Safety of grade 2017 (control group) adopted the traditional teaching model. Students in both groups are taught by the same teacher and study the same material, and their learning is assessed by the same final exam at the end of the semester.

A questionnaire survey was administered to the students of experimental group to investigate satisfaction with the "$BOP_1P_2P_3S$+blended teaching" model, and to understand students' reaction to the new teaching model. The questionnaire consists of 6 parts and 16 questions. The first part investigates students' attitudes toward the new teaching model, including the use of the SPOC platform, satisfaction with existing teaching resources, and the applicability of the SPOC platform to existing courses. The second part is an evaluation of curriculum design and organization, mainly investigating the influence of teachers' teaching style, course design and timely feedback on learning. The third part is a survey of students' participation in classroom learning, including whether they read carefully and completed their homework and whether they sought feedback and whether they think that this teaching method promotes learning. The fourth part is an evaluation of the effect of the method on learning, focusing on the impact of the SPOC on learning efficiency, autonomous learning and knowledge internalization. The fifth part asks students how long they studied before class and their opinions on the length of pre-class videos. The sixth part is a general evaluation of SPOC and whether students advocate for the use of the standalone SPOC in future courses.

Teaching implementation

This study takes the actual teaching process of Food Biochemistry in Food Quality and Safety major of grade 2018 (experimental group) as an example. Forty-two students were divided into seven groups of six. SPOC platform was used for dissemination of guidance materials, and the WeChat function provides a discussion platform.

Before class

One week before class, teaching videos, cases (corresponding to the B part of $BOP_1P_2P_3S$), lists of pre-class learning tasks (corresponding to the O part of $BOP_1P_2P_3S$) and preview effect test (corresponding to the P_1 part of $BOP_1P_2P_3S$) questions were released online. Teacher logged into the standalone SPOC platform to analyze students' preview. Students' preview and feedback show that the results in the standalone SPOC platform are as shown in Figure 2.

As can be seen from Figure 2, the number of students watching videos and their viewing progress can be obtained through the platform, and students' feedback can be grasped through the comment section at any time by teachers. Before class, teachers understand students' preview situation and problems, so as to achieve the purpose of learning situation analysis. At the same time, this method facilitates internalization of knowledge by the students. Teachers analyze the suitability of learning objectives according to online testing questions. If the preview does not meet teachers' expectations, teachers can timely adjust teaching objectives in class.

In class

Each case that has been presented in pre-class comes from real life in order to stimulate students' interest in learning. According to the students' preview situation, on the basis of cases, the teaching objectives of this course are introduced in the form of questions. Students are divided into groups to discuss each question introduced by teacher in cases; each question in each group is discussed, analyzed and summarized within 5 min. Subsequently, the representatives of each group take the place of the representatives of other groups in a clockwise direction, and participate in the discussion of other groups for 2 min, then representatives returned to their seats and continue the discussion with the group members for 1 min. After discussion and analysis of the problem within the group, one student from each group will be selected as a representative to summarize the problem briefly to the class, and other members of the group provide supplementary information. After each group of students completes the exercises, the teacher determined the students' understanding degree and correctness of the knowledge. At the same time, the teacher evaluated the answers of each group, answered the questions rose by students online, analyzed and summarized the content emphatically and completes the second

internalization of knowledge (corresponding to the P_2 part of $BOP_1P_2P_3S$). In order to deepen students' understanding and mastery of what they have learned and to achieve the third internalization of knowledge, a few additional exercises is added to the platform, which is required to be completed in class (corresponding to the P_3 part of $BOP_1P_2P_3S$). Finally, the teacher led the students to make a summary of the course (corresponding to the S part of $BOP_1P_2P_3S$).

After class

At the end of a section of the course, in order to encourage the students to consolidate and deepen knowledge, the platform provides students with a series of unit testing exercises. Teachers can judge their mastery of learning through unit test exercises; distinguish between high-performing and low-performing students. These exercises not only consolidate the previous knowledge, the content of the next class is also introduced, and there is a link between the preceding and the following role. At

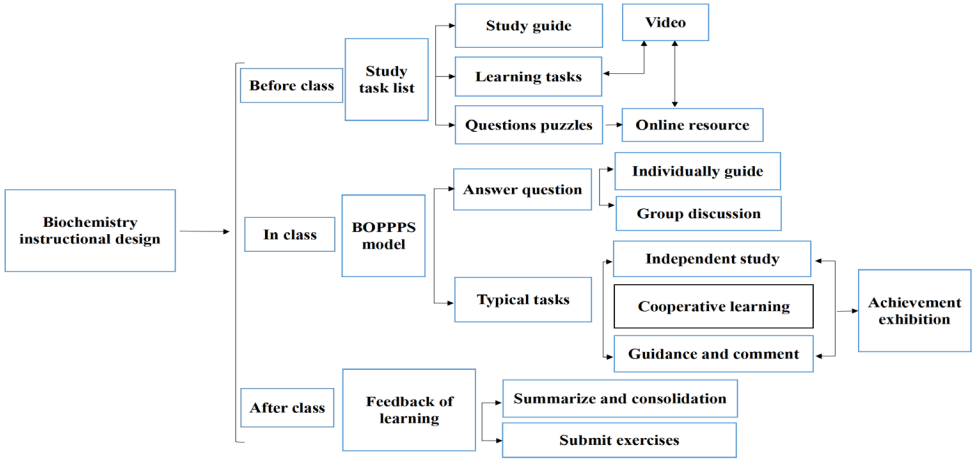

Figure 1: The design of "BOPPPS+blended teaching" model. The teaching process is divided into three stages: before class, during class and after class. Before class and after class correspond to online resources, while during class corresponds to offline classroom. And through BOPPPS model, case teaching, classroom discussion and other modes to stimulate students' interest in learning, improve the learning effect.

Students ID information	Grade	Performance	Number of videos watched	Videos viewing times	Videos viewing duration	Number of iscussion topics	Number of comments
1838130107	2019	40	32	32	13:40:20	6	13
1838130130	2019	38	32	32	14:30:17	6	11
1838130124	2019	38.68	32	32	14:41:22	6	11
1838130121	2019	36	32	32	17:24:36	6	10
1838130115	2019	32	32	32	10:36:42	6	12
18381130120	2019	32	32	32	15:32:40	6	8
1838130109	2019	27	32	32	4:40:18	6	5
1838130106	2019	32	32	32	11:23:16	6	10
1838130110	2019	36	32	32	15:37:23	6	13

Figure 2: Screenshot of students' preview before class. After students complete the video viewing and discussion area content, the system will automatically score. According to the above, the teacher will judge the students' preview situation.

the same time, teachers can log on to the platform to analyze students' detailed learning; the result is shown in Figure 3.

RESULTS

Analysis of test scores

The new teaching model has been implemented for 4 semesters, starting in spring 2019. Due to the COVID-19 pandemic, all students majoring in Food Quality and Safety have adopted "BOP$_1$P$_2$P$_3$S+blended teaching" model in the spring of 2019. The results show that the students' learning effect is improved compared with the traditional teaching model. In order to verify the reliability of the new teaching model, this teaching model was continued in the spring of 2020, 2021 and 2022, and the results were consistent with those in 2019. SPSS software was used to process and analyze the final examination scores of students in

	Chapter	Release time	Current state	The number of students submitted	Average score/total score	Scoring methods	Operation	
Unit detection	Protein unit detection	2019/3/23 10:20	Have finished	42 people	61.5 points/66 points	Score by system	Viewing or modifying	The score has been confirmed
	Nucleic acid unit detection	2019/3/30 20:20	Have finished	42 people	26 points/28 points	Score by system	Viewing or modifying	The score has been confirmed
	Enzyme unit detection	2019/4/6 22:10	Have finished	42 people	41 points/41 points	Score by system	Viewing or modifying	The score has been confirmed
	Sugar structure unit detection	2019/4/13 12:30	Have finished	42 people	23 points/27 points	Score by system	Viewing or modifying	The score has been confirmed
	Lipid and biofilm unit detection	2019/4/27 13:12	Have finished	42 people	32 points/32 points	Score by system	Viewing or modifying	The score has been confirmed
	Glycogen synthesis and breakdown unit detection	2019/5/14 19:20	Have finished	42 people	12 points/12 points	Score by system	Viewing or modifying	The score has been confirmed

Figure 3: Screenshot of the report interface of students' completing test exercises after class in the SPOC platform. Students complete the unit test activities, the system automatically scores. After the teacher confirms the unit test result in the background, students can also see their own score and the completion effect.

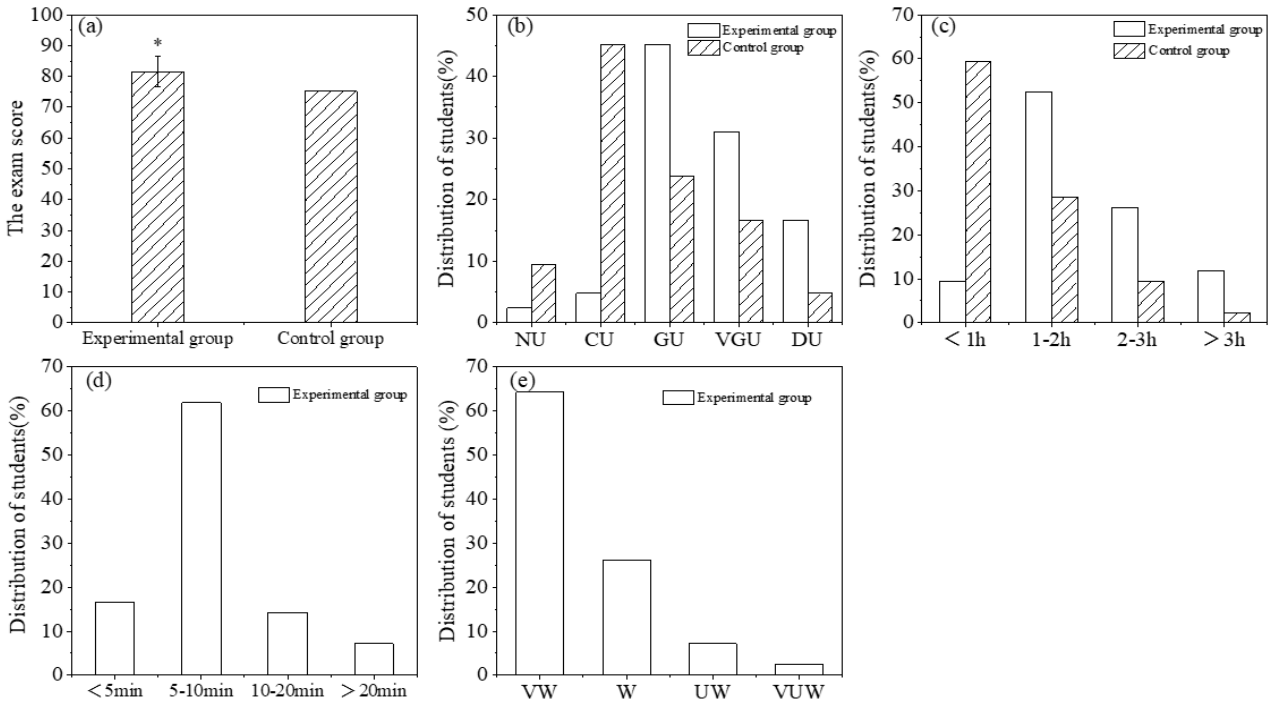

Figure 4: (a): The final exam scores of each group. The final exam scores were monitored at the end of the term. Results shown are the means of all samples in each group. Data are means±standard errors. Asterisks indicate a significant difference (p<0.05) between the exam scores of each group. (b): Level of understanding of knowledge in each group. Through the analysis of the examination paper, the students' understanding of the knowledge is summarized, which is regarded as an overall evaluation of the effect of the new teaching method. Note: NU: No Understanding; CU: Common Understanding; GU: Good Understanding; VGU: Very Good Understanding; DU: Deep Understanding. (c): The survey of study time after class in each group. Including the numbers of people and the typical amount of time they spent on pre-class activities, according to the length of preview time, the preliminary analysis of students' preview effect. (d): A survey of experimental students' preference for the length of pre-class videos. The length of the video was surveyed. They are used as an evaluation of the student's concentration. The survey consisted of four items and asked students to make choices based on their own situation. The number of people who selected given results was calculated for each item. (e): A survey on continue using SPOC platform in subsequent classes. A survey was the acceptance of this teaching method of the platform. They were used as a summative evaluation of the new teaching method. The survey consisted of four items in which students were asked to rate their level of agreement. The number of people who selected given results was calculated for each item. Note: VW: Very Willing; W: Willing; UW: Unwilling; VUW: Very Unwilling.

Table 1: Survey results regarding student experience with the use of online and offline blended teaching model based on case method.

Survey question	percentage (%)			
	Fully agree	Agree	Partially agree	Totally disagree
I like the "$BOP_1P_2P_3S$+blended teaching" model.	61.3	30.2	8.5	0
I think this kind of blended teaching model can make up for some of the shortcomings of traditional classroom teaching.	58.2	34.8	5.5	1.5
I like to study through the SPOC platform.	61.3	30.2	4.6	3.9
I love the interaction between teachers and students in SPOC class.	60.6	32.2	4.8	2.4
With SPOC as the background, the design and organization of biochemistry courses aroused my interest in learning.	61.8	31.0	6.0	1.2
The course design and organization make my study more efficient and high quality.	54.2	41.5	3.2	1.1
The teacher can answer my questions timely and effective.	59.5	38.2	2.3	0.0
Teachers conducted effective guidance and management of the whole classroom learning activities.	63.1	24.4	9.6	2.9
I like analyse the situational case and carefully read the study content posted on the SPOC.	61.8	31.0	6.0	1.2
I completed the study content published by the SPOC platform carefully.	63.1	24.4	9.6	2.9
I like to complete assignments in SPOC to get feedback.	59.5	38.2	2.3	0.0
SPOC make our learning plans more thorough, richer and more effective.	54.2	41.5	3.2	1.1
SPOC enable us to interact with teachers more closely.	61.8	31.0	6.0	1.2
SPOC deepen our understanding of knowledge.	61.8	31.0	6.0	1.2
SPOC improve our ability to learn independently.	63.1	24.4	9.6	2.9
Blended learning improves learning efficiency.	54.2	41.5	3.2	1.1

the spring of 2019 and the final examination scores of students in the spring of 2018. $p<0.05$ indicated that the difference was statistically significant.

The students' understanding of knowledge is compared and analyzed, and the answer results and scores of the analysis questions (5 small questions, 5 points for each question, a total of 25 points) and the essay questions (2 small questions, 7.5 points for each question, a total of 15 points) in the examination paper were taken as the judgment standards. Those who score 0-5 points are recorded as No Understanding (NU), those who score 5-10 points are recorded as Common Understanding (CU), and those who score 10-20 points are recorded as Good Understanding (GU). Those who score 20-30 points are recorded as Very Good Understanding (VGU), while those who score 30-40 points are recorded as Deep Understanding (DU).

The results show that the students of two groups not only have significant differences in the final exam scores ($p<0.05$), but also have significant differences in the understanding of knowledge, as shown in Figure 4(a) and Figure 4(b), the experimental group have a good understanding of the knowledge. Control group students' understanding of the knowledge was concentrated at the common understanding. This resulted in the average score of the experimental group (81.57±4.12) was about 6 points higher than control group (75.16±2.45), as shown in Figure 4(a).

Analysis of study time after class

Good academic performance is inseparable from the effort of time. In order to explore the influence of students' after-class learning on their academic performance, the study time of the two groups was investigated respectively. The specific method is

to investigate the learning time of students after class for 8 times and take the average value.

The results showed that most of the students of experimental group spent 1 to 3 hr studying after class Students thought it would take nearly 35 min to watch and understanding two videos before each class, and it took about 30 to 50 min to summarize and digest the difficult knowledge points in the videos. After that, it still needed more than 50 min to complete the test questions before class and the consolidation exercises after class. Only 4.2% of the students spent less than 1 hr, and 9.1% spent more than 3 hr, as shown in Figure 4(c).

Due to the lack of online supervision by teachers, most of the students in the control group spent 1 to 2 hr studying after class. They often only complete the exercises assigned by the teacher after class, and are not active in the preparation of the next class. Only 11.8% of the students spent 2 to 3 hr for after-class learning, and 6.8% of the students spent more than 3 hr for after-class learning, as shown in Figure 4(c). This means that the good or bad scores of students may not depend entirely on the classroom learning, and may also be positively related to the extracurricular learning time of students.

The new teaching model makes it easy for students to spend about 2 hr on online learning, and the situational case stimulates students' learning motivation and interest. It shows that the new teaching model not only affects students' learning efficiency in class, but also improves students' interest in learning after class.

The experimental groups were surveyed about the length of the learning video, and the result shows that most students believe that videos between 5 and 10 min are the most suitable for pre-class videos (Figure 4(d)). In 10 min, the teacher can introduce one or two knowledge points, and the students' attention is relatively concentrated in 10 min, this is also consistent with the significance of micro class.[12]

Analysis of the new teaching model satisfaction

In order to explore the acceptance of the new teaching model for the experimental group, a survey was conducted after the course was over. A total of 42 questionnaires were sent out, and 42 were recovered, giving an effective recovery rate of 100%. The contents of the questionnaire are shown in Table 1. More than 90% of students agree with the new teaching model.

Judging from the data, most students thought that the new teaching model led to important improvements in their learning. They like the interaction between teachers and students on SPOC platform and believe that "$BOP_1P_2P_3S$+blended teaching" model can make up for some shortcomings of traditional classroom teaching. More than 92.8% students believed that the situational cases in the new teaching model stimulated their interest in learning. They are willing to carefully read and complete the learning questions posted on the platform. More than 87.5% students believed that "$BOP_1P_2P_3S$+blended teaching" model improved their self-directed learning ability and learning efficiency. These figures show that students' learning efficiency and effective have been improved significantly by the design and organization of courses.

Finally, the students were surveyed whether they would like to continue to use the new teaching model or traditional classroom teaching in the next semester. The result showed that 90.5% of the students hoped to use the new teaching model, as shown in Figure 4(e). These students believe that the "$BOP_1P_2P_3S$+blended teaching" model can stimulate their interest in learning more than the traditional classroom.

DISCUSSION

This study reports the design and implementation of a "$BOP_1P_2P_3S$+blended teaching" model. Compared with a traditional lecture-based teaching method, this teaching model guides students to take the initiative to learn, promotes application and collaboration, and optimizes face-to-face time.[12] Compared with simple online and offline blended teaching, the addition of "$BOP_1P_2P_3S$" has achieved the purpose of stimulating students' interest in learning.[13-16] The results of the study show that this innovative teaching model promotes students' learning. Students tend to choose the new teaching model. The use of open online courses maximizes the using of existing free courses and reduces the burden of curriculum design by teachers.[17,18] But teachers are also expected to integrate the various teaching models available based on curriculum content, student needs and available resources to best facilitate learning.

Teachers are listeners and observers. Timely participation in group activities and timely feedback are critical, so that students can objectively understand the status of their own learning. Students no longer passively and quietly listen to the teacher, but instead actively participate in the learning process. Demonstration, listening, questioning, answering, discussion, and even debate is combined to make students' learning more fun in this process. Therefore, students tend to be more satisfied with the learning experience of the new style of classroom.

Research shows that the "$BOP_1P_2P_3S$+blended teaching" model is generally welcomed by students majoring in food sciences.[19] However, there are some limitations. For example, we cannot rule out the possibility that students answered questions in a socially expected way, nor can we rule out the idea that the positive views expressed by students depended partly on the characteristics of the course. Future research should explore whether the use of "$BOP_1P_2P_3S$+blended teaching" model is consistent with the learning objectives of other courses and whether such positive results are seen in other disciplines.

CONCLUSION

The research results show that the new teaching model is more vivid and interesting than the traditional teaching model. In the new teaching model activities, students' learning forms are more diverse, the interaction with teachers is more efficient, and the mutual assistance and cooperation with classmates are more intimate, which significantly improves students' learning autonomy and enthusiasm, and is widely welcomed and highly praised by students. From the aspect of achievement, both knowledge understanding and final scores of the experimental group were significantly higher than those of the control group, the average score of the experimental group (81.57±4.12) was about 6 points higher than control group (75.16±2.45). The experimental groups have a good understanding of the knowledge, and the control group students' understanding of the knowledge was concentrated at the common understanding. Which indicate that a more perfect teaching design is conducive to improving students' comprehensive ability and teachers' teaching effect.

ACKNOWLEDGEMENT

We acknowledge the cooperation of students who participated in the research. This report was supported by the Project of Ideological and Political Model Course of Huanghuai University, Grant/Award Numbers: 502300180058; the Research Project of Quality Open Online Courses of Huanghuai University, Grant/Award Numbers: 502300110027; Henan Province Science and Technology Research Project: Metabolomics combined with O-GIcNAc glycoomics to study the mechanism and application of resveratrol in promoting spermatogenesis, Grant/Award Numbers: 242102111020; Henan Province higher education teaching reform project: Research and Practice of Classroom Teaching Advancement Evaluation System under the Background of New Engineering-Taking Biological Engineering Major as an Example, Grant/Award Numbers: 2021SJGLX532; Henan Province higher education teaching reform project: Research and practice on the reform of talent training mode of "three modernizations and one system" for biological majors under the background of new engineering, Grant/Award Numbers: 2024SJGLX0482; The Research and Practice Project of Inquiry Teaching Reform in Henan Province: Applied Research on Inquiry Teaching Mode Serving Local Characteristic Industries in the Course of Biological Separation Engineering in Application-oriented Universities, Document number, Grant/Award Numbers: 388[2023].

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

ABBREVIATIONS

MOOC: Massive online open course; **SPOC:** Small Private Online Course; **BOPPPS:** Bridge in (B), Objective (O), Pre-assessment (P), Participatory learning (P), Post- assessment (P) and Summary (S).

SUMMARY

The teaching model of "$BOP_1P_2P_3S$+blended teaching" conforms to the teaching philosophy of modern higher education. Compared with traditional teaching methods, the teaching objectives and knowledge points are more clear, which can stimulate students' enthusiasm, improve their ability to analyze and solve problems, and improve students' academic performance. Practice has proved that students have a high degree of recognition for the "$BOP_1P_2P_3S$+blended teaching", which is a teaching model for reference.

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Cite this article: Hu L, Li Y, Li D. Research on the Application of the "BOPPPS+Blended Teaching" Model in a "Food Biochemistry" Course. Indian J of Pharmaceutical Education and Research. 2025;59(1):56-64.