A Research-Based Smart Classroom in An Exercise Physiology Course

https://doi.org/10.3991/ijet.v16i18.25339

Hongyan Su
Qilu Normal University, Jinan, China
suhongyan2009@163.com

Abstract—The outbreak of COVID-19 has accelerated the construction of educational informationization and strengthened the integration and application of education and digitalization. Educators have increased demands for smart education to guarantee the quality of online teaching during the epidemic. As a key factor of smart education, smart classroom is expected to produce an important effect on education and teaching. However, at the present stage, there are some problems with smart classroom, such as complex equipment environment and inadequate combination with professional knowledge. Exercise Physiology is a course with strong practicality. For the traditional teaching mode, it is hard for students to gain a deep understanding of related knowledge. In view of this, this paper attempts to introduce a research-based teaching mode based on the smart classroom environment, make it run through three parts of the class, i.e., pre-class, in-class and post-class, make use of all kinds of equipment and functions in the smart classroom to form an interactive teaching mode that integrates pre-class, in-class and post-class. To be specific, the process includes storing in the cloud, pushing smartly, asking questions, creating scenarios, forming an individual learning mode, combining online teaching method with collaborative learning mode, giving quantitative results according to the status of collaborative learning and finally performing feedback evaluation and expanding after-class knowledge. Through the practical teaching of Exercise Physiology, the teaching mode established in this study can achieve a good teaching effect and teaching quality. In particular, it is of great significance for promoting students' classroom satisfaction and ability to analyze problems and developing good learning habits in them.

Key Words—Smart classroom; Exercise Physiology; research-based teaching; evaluation of teaching quality

1 Introduction

Due to the outbreak of COVID-19, online teaching is now being vigorously promoted in schools. The development of online teaching has changed the original teaching and learning methods rapidly, and brought new experience to students in the short time. Exercise physiology, as a part of life science, investigates a variety of physiological activities in the motion process of human body and occupies a very important

position in medical education system and physical education system [1]. However, in the previous teaching of exercise physiology, the class was mainly taught by teachers actively and accepted by students passively. Students have a very low participation and lack the abilities of independent thinking and analysis. This is not beneficial to the future development of students, and students' grasp of knowledge related to exercise physiology [2]. In recent years, with the rapid development of information technology, smart classrooms have been introduced into classroom teaching in colleges, providing a great quantity of resources and tools. If teachers can make full use of tools related to smart classroom during the teaching of exercise physiology, students' learning interest and classroom participation can be significantly enhanced. This is also of great significance for the training of talents with strong analytical and creative abilities. On this basis, by taking Exercise Physiology as an example, our study designs a teaching mode for the course of Exercise Physiology in the smart education environment, in order to enhance students' course participation, innovation ability, learning interest and attract their attention.

Many domestic and foreign scholars have carried out research on the design of physiological teaching mode. Unlike previous studies, the research in this paper also applies the smart education environment, and focuses on improving students' course participation during teaching. At the same time, the research in this paper takes the research-based teaching mode, and fully considers student's individual learning mode and writing learning mode. What's more, to ensure the quality of the teaching mode, this paper also sets up an evaluation system for teaching effect of smart classroom of exercise physiology.

2 State of the art

In the historical context of Internet+, educational informationization has taken a giant step towards a new height, and smart education has become a research hotspot and development trend in the field of education. The concept of smart classroom was coined by IBM (International Business Machines Corporation) [3]. At the same time, a smart education service solution was also propounded. This solution not only set up a smart teaching environment, but also presented a design scheme related to smart teaching. The "Intelligent Classroom" project at McGill University, Canada, ameliorated teaching through technology. The 'intelligent classroom was equipped with teaching facilities like computers, tablet PCs, document cameras, interactive electronic whiteboards, writing boards, button panels, etc., as well as many telecameras, microphones and other devices. They were adopted to shoot scenes in teaching and what had been taught by teachers [4]. The University of Szeged teamed up with Microsoft to set up a future classroom project. According to the design principle of learning space, it was advised that the future classroom should be characterized by mobility, family atmosphere, good learning environment and the latest multimedia learning and teaching tools, etc. [5]. The future classroom space had the characteristics of flexible space layout, dynamic combination of desk and chair, rich color variations and multi-screen, etc. So far, the application of smart education in teaching is

mainly manifested in three aspects: first of all, scholars argue that the smart classroom model realizes the autonomy and individuation of teaching, for example, after research, Wallace et al. [6] held that smart classroom paid more attention to teaching autonomy. In this model, students can learn the knowledge they are interested in, according to their own circumstances. Secondly, scholars consider that smart classrooms can promote students' classroom participation. For example, Chen [7] posited that the smart classrooms applied wireless intelligent devices and that these devices encouraged students to get involved in classroom teaching. Thirdly, the research regarding smart classroom focuses more on learning activities themselves. For example, Reinschlüssel et al. [8] contended that the tangible interactive interface in smart classroom can raise students' social skills, while improving their learning ability.

With the application of smart classroom in teaching, Chinese scholars have also conducted a lot of research, which mainly focused on two aspects. First of all, by comparing the teaching mode of smart classroom with that of the traditional teaching mode, scholars assume that the teaching effect of smart classroom model is better. For example, Hu Wang et al. investigated the design of teaching mode under smart classroom. They contended that the teaching-oriented teaching method in the traditional teaching mode was not beneficial to students' individual learning and restricted their creative thinking. The learning-oriented teaching method cost students a lot of time to explore and their learning efficiency was low. The teaching mode of smart classroom created a multi-scenario teaching mode, which greatly lessened the workload of teachers and students. At the same time, the smart classroom model can also fulfill instant and deep interaction between teachers and students [9]. Secondly, scholars design courses based on the characteristics of smart classroom. For example, by taking "Laboratory Production of Gas", a chemistry lesson in junior middle school for example, Lin Yan designed this lesson on the basis of the smart classroom environment. Throughout the design of the course, the author utilized document camera, electronic whiteboard, IRS instant feedback system, etc. in the smart classroom environment, and took advantage of the functions of "vying to answer first" and "picking people" to stimulate students' learning interest. At the same time, the author also applied "video recording", "shooting" and "timing", etc. to increase students' participation and the teaching effect in classroom [10]. Some scholars examine the teaching application of smart classroom in the course of physiology, while other scholars have also done relevant research. For example, Sha Ailong enquired into the application of multimedia teaching based on smart educational technology in the teaching of animal physiology. The author compared the teaching effect of students' intelligent multimedia teaching and traditional teaching and found that intelligent multimedia teaching made the whole teaching more visualized, and greatly enhanced students' interest in experiments. To this end, the author was of the opinion that in the teaching of animal physiology, teachers should implement more intelligent multimedia teaching based on the advantages of traditional teaching [11].

To sum up, the research on smart classroom and intelligent class is still in its infancy in the field of education of developing countries. For example, there are still deficiencies as to how to make proper use of the facilities in smart classrooms to perform teaching activities, gain instant access to the dynamic information of students and

increase the efficiency of classroom teaching. Therefore, the construction of classroom teaching methods suitable for smart classroom warrants further exploration and practice. Secondly, the main research objects of most teaching activities in smart classroom are students in primary and secondary schools, and intelligent classes in colleges and universities are seldom involved. However, from the physical and mental development of students and other objective factors, college students should also be engaged in smart classroom activities [12]. Last but not least, it is a technical problem for non-computer teachers to full leverage information technology to change the way the course is taught. For this reason, what kind of incentives should be adopted in the learning process and how to evaluate the teaching effect of smart classroom objectively is also worth further study and discussion by scholars. In light of this, this paper innovatively proposed to employ the research-based teaching mode in the smart classroom environment, applied it to the course Exercise Physiology, designed an interactive learning process for three parts of the class, i.e., pre-class, in-class and post-class, in accordance with the learning characteristics of college students, and developed an evaluation system for the effect of the teaching mode of Exercise Physiology that was applied in the smart classroom environment, so as to provide an objective reference for the course development of smart classroom.

3 The Teaching of the Course Exercise Physiology Based on the Smart Classroom Environment

3.1 Application of Smart Classroom in the Teaching Mode

With a view to improve the teaching effect of the course, teachers must go through three parts of the class, i.e., pre-class, in-class and post-class in the design of course. Smart classrooms can utilize all kinds of equipment and functions, to form an interactive teaching mode that integrates pre-class, in-class and post-class. Under this teaching mode, teachers can guide and motivate students to think by using smart classrooms, communicate knowledge with students in a timely manner, and evaluate the learning effect of students. Students can learn independently, inquisitively and cooperatively and also assess themselves. The teaching mode of smart classroom in the course Exercise Physiology can be designed as shown in Figure 1.

By using the teaching mode that integrated pre-class, in-class and post-class in Figure 1, teachers make the utmost of resources, environments and tools related to teaching and learning, while teaching the course Exercise Physiology. To be specific, before class, teachers upload resources to guide students to preview the lesson, assign preview tasks and let students finish homework. In the course of class, according to the students' preview, teachers decide on the starting point of the course Exercise Physiology, carry out classroom teaching and checks students' learning performance in the form vying to answer first in class and quiz, and the teachers organize discussions based on students' feedback. Teachers can also stimulate students' learning interest in the course Exercise Physiology via experiment and document camera, thus deepening students' understanding of relevant knowledge. At the end of class, teach-

ers should recapitulate and evaluate the teaching content, and students should sort out the knowledge points according to the summary. After class, the teachers assign homework hierarchically, according to students' feedback to the class Exercise Physiology. Students finish homework and reflect on their learning.

Fig. 1. Application of Smart Classroom in the Teaching Mode

The course Exercise Physiology given in the smart classroom environment can also be carried out online. For details, see Figure 2 below. Prior to the class, teachers can instruct students to preview the course of Exercise Physiology by recording micro-videos. Simultaneously, preview knowledge quizzes can be sent to students in electronic form. After preview, students take an on-line test. In this way, teachers can gain a preliminary insight into weak portions in students' learning of Exercise Physiology and prepare electronic courseware. During class, teachers demonstrate electronic courseware, inspire students to think by leading in through scenarios, creating scenarios and asking questions, etc. and improve students' learning interest. In addition, teachers organize students to discuss and share in groups, deepening their comprehension of the knowledge learned. In an effort to test the learning effect, teachers also design a phased test in the electronic courseware of Exercise Physiology. Last of all, teachers sum up and expand the teaching knowledge and assign after-class homework. After class, students upload the homework they have finished to the system and the teachers review and comment online, and push the expansion learning materials to students according to the learning effect. At the same time, if students run into trouble when finishing homework, they can also communicate with teachers online.

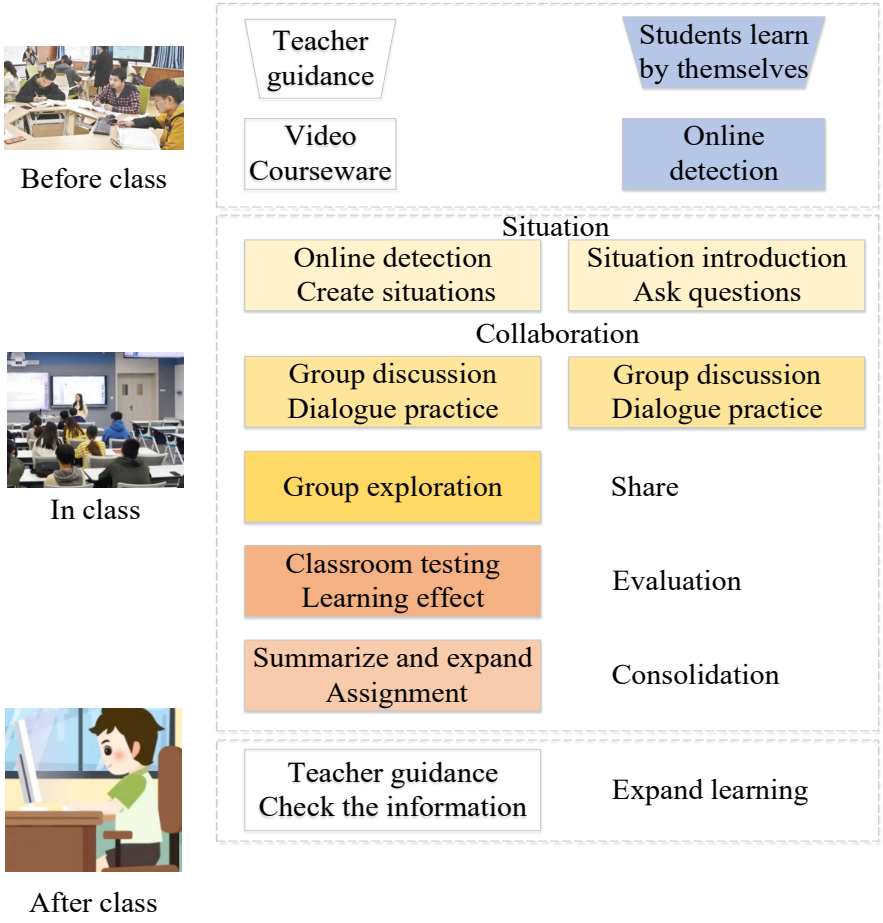

Fig. 2. Application of Smart Classroom in Online Teaching

3.2 Application of Research-based Teaching Method in the Course Exercise Physiology

This paper discusses the teaching mode of the research-based teaching method in the course of Exercise Physiology, based on the smart classroom environment. It is mainly designed from individual learning mode and collaborative learning mode. For details, see Figure 3 below. This teaching mode can solve the drawback of the traditional teaching mode in learning and obtain the best smart teaching results.

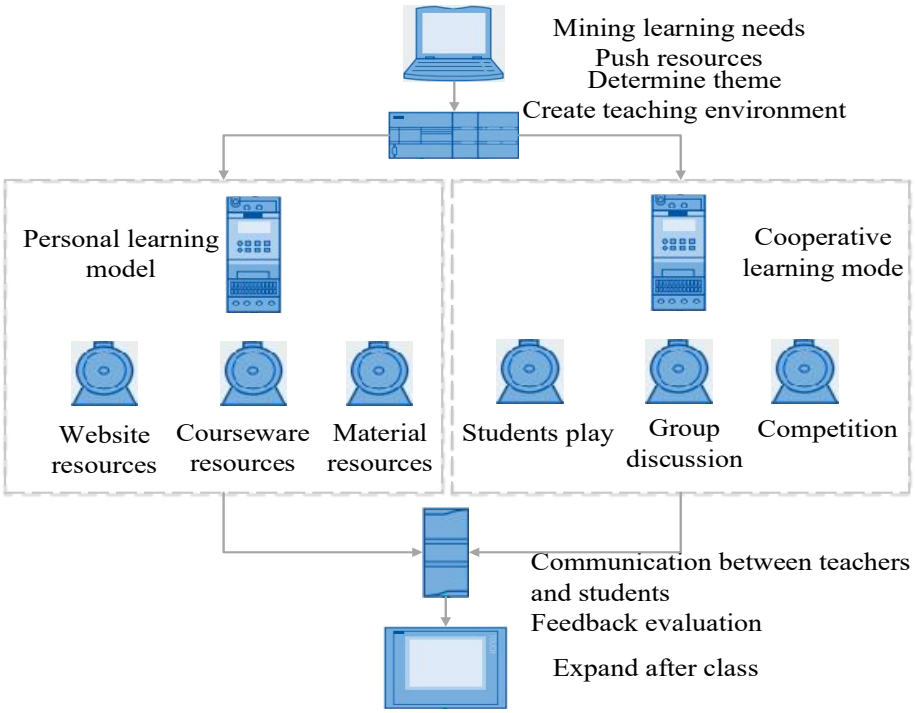

Fig. 3. Design of the Application of Research-based Teaching Method in the Course Exercise Physiology

As can be seen from Figure 3 (1) cloud storage and smart push: the smart classrooms can predict students' potential needs before teaching the course Exercise Physiology via data mining, context awareness and learning analysis, etc., record a large quantity of process data obtained from the network platform using cloud computing and store them in the cloud. The topic of the course Exercise Physiology is determined through an analysis of these data and learning resources are pushed to students as needed. (2) Asking questions and creating scenarios: in addition to smart push, when teaching Exercise Physiology, teachers will also adopt virtual simulation, augmented reality, holographic technology and other technical means to create scenarios for the problems, by associating with problems existing in students' preview, thereby increasing students' learning interest, so that learners can experience the scenarios personally. (3) Individual learning mode: in the smart classroom environment, students can retrieve online website resources, courseware resources and material resources. During learning, students can choose relevant resources and tools independently based on their own preferences. It is thus clear that in the smart classroom environment, students' individual learning mode is characterized by autonomy and self-help. Under this mode, teachers play the role of "shopping guide" and provide guidance and consulting services for students, so that they can obtain relevant resources in a quick and accurate way when learning courses related to Exercise Physiology. (4) Collaborative learning mode: under the collaborative learning mode, when

teachers teach the course Exercise Physiology, and adopt the cloud learning platform to perceive the needs of each student, mine data of each student and form a unified learning task and learning plan, by associating with intra-group discussion. On the other hand, the collaborative learning mode also takes such forms as role-play, competition, debate and design, so that students can discuss a certain problem and eventually achieve the purpose of solving the problem. Lastly, each group shares its own learning outcomes, and peer review and group review are done within and between groups, and then the teachers recapitulate and give feedback for each problem. The cloud platform in the smart education environment gives quantitative results according to collaborative learning. (5) Feedback of assessment: on the one hand, in the Exercise Physiology classroom, teachers and students can have real-time and deep interaction through the cloud platform, leading and assessing students' learning process. Whether in individual learning mode or collaborative learning mode, teachers always feedback the assessment results based on students' learning performance, and instruct students to learn in a more effective way. On the other hand, at the end of the course of Exercise Physiology, teachers make a summative assessment on students' learning. In the teaching mode based on smart classroom, teachers can make an intuitive and quantitative analysis of learners' learning status through big data and learning analysis, so that the analysis is more all-round and objective. (6) Expansion after class: Before the each lesson of Exercise Physiology is completed, teachers might as well adopt the perception system of smart classroom to push learning resources that conform to students' learning status and personalities intelligently, in line with their study of the course of Exercise Physiology, and help students better complete after-class study.

3.3 Design of an Evaluation System for the Teaching Quality of Exercise Physiology Based on Smart Classroom

With a view to measure the teaching effect of Exercise Physiology after the reform in the context of smart classroom designed in this study, we intended to build a teaching quality evaluation system to evaluate the teaching mode of Exercise Physiology based on smart classroom. For details, please refer to the evaluation method for the quality of economic development to objectify the evaluation results and realize dynamic evaluation of teaching quality.

While constructing underlying indicators to evaluate the teaching quality of exercise physiology based on smart classroom, the train of thought of the evaluation method of economic development indicators was referred to, and their settings are shown in Table 1.

Through a pairwise comparison of relevant factors, namely, according to the scoring method of 9-point scale (1-9), a fuzzy complementary matrix was obtained. The meanings of the 9-point scale are as table 2.

Table 1. Determination of Underlying Indicators

System Layer	Domain Layer	Indicator Layer	Weight of Indicator Layer
A1: Teaching equip-ment	B1: Teaching resources	C1: Number of videos in each chapter	0.03
		C2: Number of quizzes in each chapter	0.04
		C3: Update rate of teaching resources in each chapter	0.03
		C4: Number of times students complete online assignments in each chapter	0.05
		C5: The learning resources uploaded by students inde-pendently in each chapter	0.04
	B2: Teaching team	C6: Teaching experience of the lecturer (years)	0.05
		C7: Proportion of teachers with a postgraduate degree or above	0.04
		C8: Proportion of teachers with senior professional titles	0.07
A2: Teaching imple-mentation	B3: Teaching design	C9: Number of teacher-student exchanges and interactions in each chapter	0.04
		C10: Number of knowledge expansions in each chapter	0.05
		C11: Number of exercises embedded in each chapter	0.08
		C12: Proportion of students' questions disabused y teachers	0.05
		C13: Average disabuse time students obtain after asking questions	0.04
	C4: Teaching support	C14: The amount of time the teachers spend preparing lessons	0.09
		C15: Number of times teachers push personalized contents to students	0.05
		C16: Improvement of teachers' efficiency of lesson prepara-tion	0.03
		C17: Push learning suggestions on how to improve students' final grades	0.03
	C5: Teaching effect	C18: Students' average score in Exercise Physiology	0.08
		C19: Students' evaluation and scoring of teachers' teaching	0.05
		C20: Proportion of students completing all of the learning tasks	0.06

Table 2. 1-9 Nine-scale Quantity Scale

Scale	Definition	Description
1	Equally important	Two elements are equally important
3	Slightly important	One element is slightly more important than the other
5	Significantly important	One element is significantly more important than the other
7	Much more important	One element is much more important than the other
9	Extremely important	One element is more important than the other
2, 4, 6, 8	Inverse comparison	An inverse comparison of the above comparison

Through calculation, suggesting that the matrix had good consistency. For this reason, the weight of the system layer of the evaluation system for the teaching quality of exercise physiology based on smart classroom was finalized, i.e., (0.41,0.59). Likewise, this paper finally determined the weights of the domain layer and indicator layer, based on the analytic hierarchy process. For details, see Table 1.

4 Teaching example and effect

4.1 Teaching example

41 sophomores from Cohort 2019 in a given college in Shandong Province from September to December, 2020 were selected as research objects. Exercise Physiology consisted of 18 periods, once a week, a total of 5 sessions (4 periods/session). In the first four sessions of Exercise Physiology, the research-based teaching method was adopted. Each lecture can be divided into two parts. The first part explained the professional lesson of this course, which took 3 periods. The second part epitomized and expanded knowledge and literature related to the current lecture on Exercise Physiology, which took 1 period. The research-based teaching mode of the course Exercise Physiology in the smart classroom environment is shown in Figure 4:

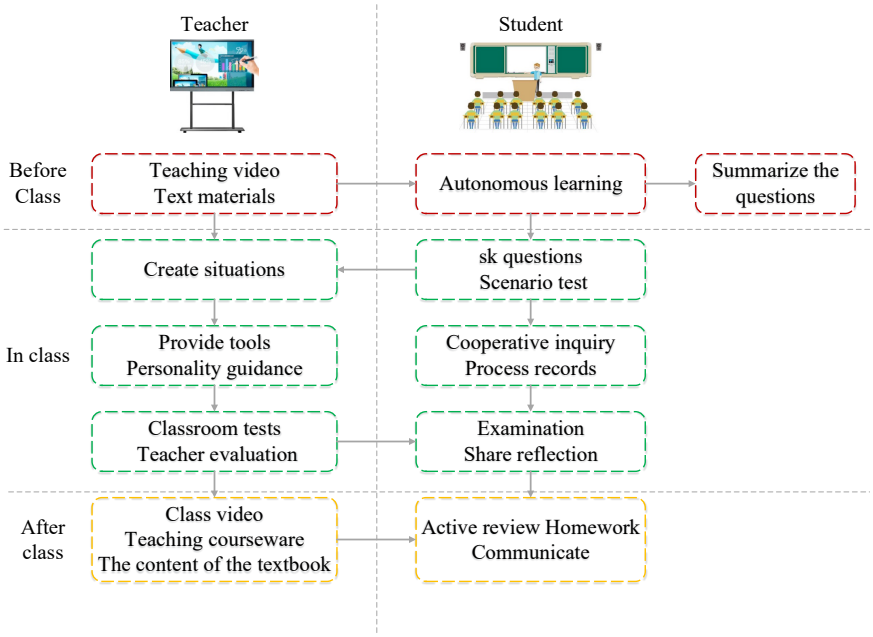

Fig. 4. The Teaching Mode of Exercise Physiology Based on Smart Classroom

In the research-based teaching mode based on smart classroom in Figure 5, the whole teaching ran through three parts of the class, pre-class, in-class and post-class.

Therein, in the pre-class preparation, teachers of Exercise Physiology uploaded relevant teaching videos and texts to the system, and students learned autonomously in accordance with these materials and aggregated learning questions accordingly. During in-class teaching, teachers of Exercise Physiology prepared teaching contents in a targeted way, according to students' questions. During the explanation of course, teachers taught by giving in-class quizzes, creating scenarios, providing tools, making comments, guiding, and establishing a knowledge frameworks, etc. While students followed the teachers' teaching, ask questions boldly, guess, hypothesize, explore collaboratively and share results, etc. After class, teachers uploaded micro-videos, teaching courseware, textbook content, etc. concerning Exercise Physiology to the system. Students reviewed by utilizing these materials and completed after-class homework. Depending on the completion of homework, teachers recommended learning resources to students pertinently. Figures 6 and 7 show learning steps of the course exercise physiology in the context of smart classroom. Figure 8 shows a discussion-based teaching and learning scene, in which teachers and students learned in a mobile interactive smart classroom during the outbreak of COVID-19.

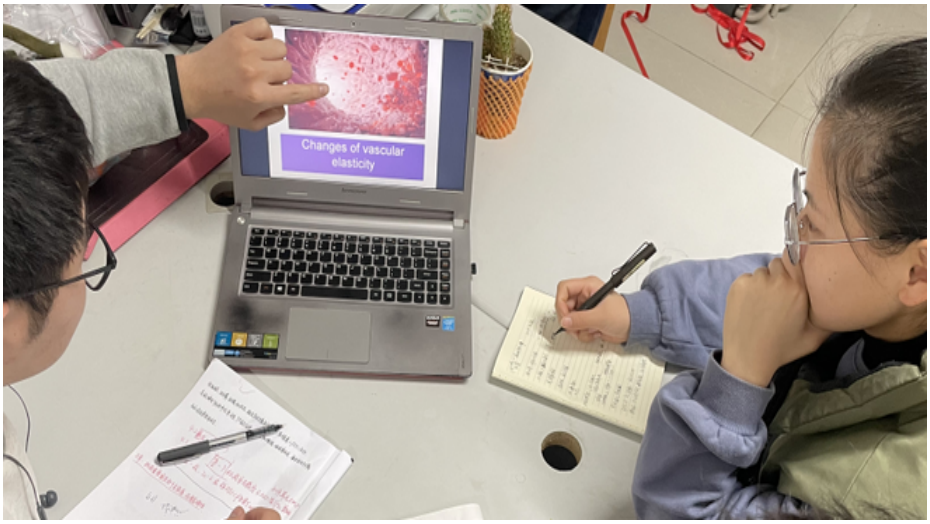

Fig. 5. Students learned autonomously in the course of exercise physiology

By using questionnaire survey, this paper appraised the research-based teaching mode of Exercise Physiology in the smart classroom environment. The specific questionnaire survey was held in class after the end of the examination of Exercise Physiology. Specifically, after the end of the examination of Exercise Physiology in January, 2021, the questionnaires were handed out to 41 sophomores from Cohort 2019 in Institute of Physical Education. To be specific, the questionnaire included 8 items, that is, liking the teaching mode of Exercise Physiology, increasing students' cognition about exercise physiology and promoting their ability to discover problems. By taking an anonymous form, a total of 41 questionnaires were handed out and 39 questionnaires were retrieved, with a retrieval rate of 95.12%.

Fig. 6. Students watched micro-videos related to exercise physiology after class

Fig. 7. Teachers taught and students learned in a discussion-based smart classroom

URL: http://www.ceiea.com/html/202006/202006111340493416.shtml

The teaching quality was evaluated by using the constructed evaluation system for teaching quality of Exercise Physiology in the smart classroom environment (Table 1). To be specific, our study intended to invite experts in other physiological fields from the Institute of Physical Education to score the teaching quality of the teaching mode of Exercise Physiology with four grades: very good, good, average and poor.

4.2 Teaching effect

The evaluation results of students on the research-based teaching mode of Exercise Physiology in the smart classroom environment are shown in Table 3.

Table 3. Evaluation of Teaching Effect

	Totally Agree	**Basically Agree**	**Disagree**
I like the teaching mode of Exercise Physiology	31(79%)	8(21%)	0(0%)
Deepen students' understanding of the knowledge of Exercise Physiology	27(69%)	10(26%)	2(5%)
Improve students' ability to discover problems	25(64%)	13(33%)	1(3%)
Improve students' ability to analyze problems	30(77%)	7(18%)	2(5%)
Improve students' ability of logical thinking	27(69%)	11(28%)	1(3%)
Improve students' ability of collaborative inquiry	26(67%)	13(33%)	0(0%)
Improve students' ability of independent thinking	19(49%)	19(49%)	1(3%)
Help students develop good learning habits	33(85%)	6(15%)	0(0%)

As can be seen from the evaluation results of teaching effect in Table 3, 39 sophomores from the Institute of Physical Education generally identified with the teaching mode of the research-based Exercise Physiology in the smart classroom environment, especially in terms of helping students develop good learning habits, teaching mode and improving their ability to analyze problems, etc.

As suggested above, 20 basic influence factors C1~C20 were considered in this section. In the evaluation of grade, the experts should evaluate the importance of factors affecting reliability with four grades: very good, good, average and poor. The experts' scoring is shown in Table 4.

Table 4. Evaluation Results of Teaching Quality

	Very Good	**Good**	**Average**	**Poor**
C1: Number of videos in each chapter	0.3	0.3	0.3	0.1
C2: Number of quizzes in each chapter	0.3	0.2	0.4	0.1
C3: Update rate of teaching resources in each chapter	0.5	0.3	0.2	0.0
C4: Number of times students complete online assignments in each chapter	0.4	0.1	0.4	0.1
C5: The learning resources uploaded by students independently in each chapter	0.2	0.4	0.3	0.1
C6: Teaching experience of the lecturer (years)	0.4	0.4	0.2	0.0
C7: Proportion of teachers with a postgraduate degree or above	0.5	0.3	0.2	0.0
C8: Proportion of teachers with senior professional titles	0.1	0.5	0.4	0.0
C9: Number of teacher-student exchanges and interactions in each chapter	0.3	0.2	0.2	0.3
C10: Number of knowledge expansions in each chapter	0.4	0.1	0.4	0.1
C11: Number of exercises embedded in each chapter	0.3	0.3	0.3	0.1
C12: Proportion of students' questions disabused y teachers	0.7	0.1	0.1	0.1
C13: Average disabuse time students obtain after asking questions	0.4	0.2	0.3	0.1
C14: The amount of time the teachers spend preparing lessons	0.5	0.3	0.2	0.0
C15: Number of times teachers push personalized contents to students	0.6	0.3	0.1	0.0

	Very Good	Good	Average	Poor
C16: Improvement of the efficiency of teacher's lesson preparation	0.4	0.2	0.3	0.1
C17: Push learning suggestions on how to improve students' final grades	0.7	0.3	0.0	0.0
C18: Students' average score in Exercise Physiology	0.4	0.1	0.3	0.2
C19: Students' evaluation and scoring of teachers' teaching	0.6	0.3	0.1	0.0
C20: Proportion of students completing all of the learning tasks	0.5	0.2	0.1	0.2

With the data shown in the table, a fuzzy evaluation matrix R of this alternative point was obtained, and the weight W of each factor was incorporated in it, and the final result was:

$$S = W^T R = (0.418, 0.256, 0.245, 0.081)$$

The score of "very good" was set as 100, "good" as 80, "average" as 60 and "poor" as 40, then

$$D_A = SC^T = （0.418,0.256,0.245,0.081）(100, 80, 60, 40)^T = 80.22$$

Through analysis, it can be seen that the score of the research-based teaching mode of Exercise Physiology in the smart classroom environment was 80.22, which implied that the research-based teaching mode of Exercise Physiology in the smart classroom environment was good as a whole.

5 Conclusions

Due to the impact of the outbreak of COVID-19, colleges and universities have actively launched a teaching mode in the form of smart classroom. Nonetheless, while conducting smart teaching online, teachers can't keep abreast of the state of students. This study suggests integrating the research-based teaching mode into smart teaching, and practicing it in the course of exercise physiology, by taking the implementation process of teaching as the principal line, to provide a strong reference for educators to better promote the efficiency of smart teaching. Through research, the following conclusions are drawn:

1. The smart classroom environment offers many resources and tools for the teaching of the course of Exercise Physiology and reflects the autonomy and self-help of students in learning. It has a better teaching effect.
2. The research-based teaching mode of Exercise Physiology in the smart classroom environment not only runs through three parts of the class, pre-class, in-class and post-class, but also takes the individual learning mode and collaborative learning in the learning process of students into full account.
3. The results of questionnaire survey indicate that the teaching effect of the research-based teaching mode of Exercise Physiology in the smart classroom environment is

good as a whole, especially in terms of student satisfaction, helping students develop good learning habits, and improving students' analytical ability.

4. The research-based teaching mode of Exercise Physiology in the smart classroom environment has a good teaching quality. Nevertheless, the course of Exercise Physiology has strong practicability, and more resources and tools can be adopted in the smart classroom environment. How to make full use of the smart classroom environment and stimulate students' learning initiative has yet to be studied in depth.

6 References

[1] Kong, J. Innovative applications mode of network learning space in exercise physiology based on ubiquitous learning. International Journal of Emerging Technologies in Learning, 2019, vol. 14(4), pp. 113-126. https://doi.org/10.3991/ijet.v14i04.10117

[2] Ma, G.D. Research on flipped classroom teaching mode of exercise physiology under the background of Applied Talents Training, Shanxi Youth, 2019, vol. 4(17), pp. 23-24

[3] Ali, S. Potassium application mitigates salt stress differentially at different growth stages in tolerant and sensitive maize hybrids. Plant Growth Regulation, 2015, vol. 76(1), pp. 111-125. https://doi.org/10.1007/s10725-015-0050-1

[4] Bouchard, K.L., Hollweck, T., Smith, J.D. Fostering Classroom Communities through Circling With Teacher Candidates. Mcgill Journal of Education, 2017, vol. 51(3), pp. 1103-1120. https://doi.org/10.7202/1039630ar

[5] Healy, E., Kárpáti, S., Kemény, L. A World of Scientific Endeavors and Friendships. Journal of Investigative Dermatology, 2020, vol. 140(9), pp. S164-S166. https://doi.org/10.1016/j.jid.2020.04.005

[6] Wallace, L.B., Sung, H.C., Williams, J.D. The defining features of teacher talk within autonomy-supportive classroom management. Teaching & Teacher Education, 2014, vol. 42, pp. 34-46. https://doi.org/10.1016/j.tate.2014.04.005

[7] Chen, H. Smart Classroom Equipment Control System Design Based on Zigbee Technology. Electronic Technology, 2013, vol. 50(8), pp. 55-57.

[8] Reinschlüssel, A., Alexandrovsky, D., Döring, T., Kraft, A., Braukmüller, M., Janßen, T., ... & Malaka, R. Multimodal algebra learning: From math manipulatives to tangible user interfaces. i-com, 2018, vol. 17(3), pp. 201-209. https://doi.org/10.1515/icom-2018-0027

[9] Hu, W., Yang, C. On Teaching Mode Design based on Smart Classroom. Journal of Open University of Guangdong, 2015, vol. 25(4), pp. 87-92.

[10] Lin, Y. Teaching design based on the cultivation of scientific inquiry ability in smart classroom environment. Chemistry Teaching And Learning. 2019, vol. 10(3), pp. 52-54.

[11] Sha, A.L. Application of multi-media technolog in Animal physiology experiment. Journal of Anhui Agricultural Sciences,2013, vol. 52(7), pp. 3258-3260.

[12] He, G. Schema interaction visual teaching based on smart classroom environment in art course. International Journal of Emerging Technologies in Learning, 2020, vol. 15(17), pp. 252-267. https://doi.org/10.3991/ijet.v15i17.16441

7 Author

Hongyan Su is a librarian in the Qilu Normal University, Jinan, Shandong, China.

Article submitted 2021-07-08. Resubmitted 2021-08-07. Final acceptance 2021-08-09. Final version published as submitted by the authors.