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# Research on Online and Offline Hybrid Teaching Practice Based on Virtual Classroom in Post-Epidemic Era - Principles of Underwater Acoustics' as an Example

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**Abstract:** Influenced by the outbreak of the Xin-guan epidemic since the end of 2019, colleges and universities are faced with the risk of sealing and controlling at any time due to a large number of students and strong crowd gathering. It is sometimes difficult to complete the offline teaching plan on time when the epidemic situation sweeps across the local area. Therefore, college education should gradually adapt to the new changes in educational concepts, teaching methods, and assessment systems. Thanks to the rapid development of information technology, the virtual classroom has become an important online teaching method. Compared with the tangible classroom, the virtual classroom emphasizes the students' sense of participation. College education combines online teaching with offline teaching, gradually forming a new online and offline hybrid teaching method in the post-epidemic era. Taking the course "Principles of Underwater Acoustics" taught by the author's team as an example, according to the realistic teaching conditions in the post-epidemic era, with the help with virtual classroom as an information technology tool, combined with the learning characteristics of students and syllabus, this new teaching mode-online and offline hybrid learning model is adopted, which is elaborated from the aspects of teaching preparation, teaching process implementation, after-class re-examination, and reflection, teaching evaluation composition, etc. The practice shows that the online and offline hybrid teaching strategy is based on a virtual classroom. It stimulates the students' learning enthusiasm and improves the students' learning effect. It is a feasible new talent training mode in the post-epidemic era.

**Keywords:** Post-Epidemic Era, Virtual Classroom, Online and Offline Hybrid Teaching, Information Technology Tool, Principle of Underwater Acoustics

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## 1. Introduction

In December 2019, a sudden outbreak of new coronavirus pneumonia hit the world, all industries were affected by the epidemic, and college education was also greatly affected. Due to a large number of teaching staff and students in colleges and universities, the possibility of a cluster epidemic is very high. At the beginning of 2020, the Ministry of Education issued a document specifying the requirements for prevention and control work [1], notifying all kinds of schools to postpone the opening of the school and advocating "stopping classes and not stopping study" [2]. The COVID-19 epidemic situation promotes the meaningful integration of information technology and college education

to a certain extent. Against this background, the virtual classroom has become essential teaching means to replace traditional offline teaching. During the epidemic situation, the author's team deeply studied the virtual classroom, carried out the practice of online and offline mixed teaching by using the online learning platform, and discussed the concrete implementation and application of online and offline mixed education by taking advantage of the characteristics of rich teaching means, diversified teaching contents and relatively timely feedback of virtual classroom, and combining with the basic situation of students learning "underwater acoustic course."

Jonassen believes that information technology has the role of efficient tool, access to information tool, cognitive tool,

situational tool, communication tool and an evaluation tool [3]. Information technology provides these tools, through their respective functional characteristics can promote the development of different dimensions of learning, to promote the expansion and extension of students' learning to the higher order thinking ability. Relying on Jonassen's theory, this paper will from the information technology tools. From the perspective of the integration and change of teaching methods, hybrid teaching interaction and the collaborative construction of knowledge framework, this paper discusses how to endow the hybrid learning supported by information technology tools with more connotation in the post-epidemic era and information technology era, and integrate the reform of teaching methods, the change of teacher-student interaction and the construction of students' knowledge framework, to improve students' understanding of the curriculum and improve the quality of teaching.

## 2. Analysis of the Learning Situation of the Course of Principles of Underwater Acoustics

In the new era of changing world patterns and rising great powers, the implementation of the strategy of Marine Power, the promotion of China's comprehensive marine strength, the maintenance of China's marine rights and interests, and the development of Marine Science and Technology are inseparable from underwater acoustic science. Our country has the world's fourth longest coastline, long coastline and along the way many cities, and military facilities have put forward higher requirements for the development of underwater acoustic. The principle of underwater acoustic is one of the basic courses of underwater acoustic-related disciplines, taking the military academy where the author works as an example, the principle of underwater acoustic is set up for junior students of a certain specialty, which is the basic theory course of this specialty and serves as the leading course of the follow-up underwater acoustic course.

This course aims to enable the trainees to acquire the basic knowledge of underwater acoustics necessary for the correct use of relevant equipment, and cultivate the trainees' ability to understand the physical concepts of underwater acoustic propagation and the ability to integrate theory with practice, to improve the comprehensive quality of the trainees, give full play to the use efficiency of equipment and better adapt to the future post requirements, by familiarizing themselves with the basic phenomena, basic laws and mechanisms of sound wave propagation in seawater medium and its influence on relevant equipment, and taking sonar equation as the main line. Enhance their professional sense of mission and responsibility.

To sum up, the course Principles of Underwater Acoustics involve higher mathematics, physics, signal and system, and other disciplines, and the course content is highly theoretical. Under the traditional offline teaching method, because the teacher explains too many theories and it is difficult for

students to interact deeply for a long time in class, it is difficult for students to form a complete underwater acoustic knowledge framework. There are many complicated formulas in the course of Principles of Underwater Acoustics. Years of teaching practice show that that students' enthusiasm for learning will plummet because of the complicated formula derivation. The lack of learning enthusiasm lead to the weak learning foundation of underwater acoustic-related course, and students are still far from the goal of high-quality talents.

## 3. The Connotation of Virtual Classroom and the Conjunction with Blended Learning Theory

Blended learning emphasizes to improve students' professional foundation and application ability through different learning methods under the support of information technology. Its essence is not the simple superposition of traditional teaching mode and online teaching based on information technology, but also integrates the advantages of the two teaching methods to make students achieve the best learning effect. From the perspective of social and cultural theory, virtual classroom can be used as one of the intermediary tools to promote students to achieve learning outcomes. Through self-learning before and after the course, teachers' scaffolding, cognitive diagnostic evaluation and other dimensions, virtual classroom can help students think, summarize, experience, understand and apply knowledge, accumulate course experience in virtual classroom scenarios, achieve learning effect and cultivate high-order thinking. From this point of view, blended learning and virtual classroom have a certain bit in the learning process, which is the theoretical basis for carrying out blended learning based on a virtual classroom. Blended learning emphasizes the optimal learning effect and high-order thinking method. With the help of information-based virtual classroom, formative evaluation and summative evaluation can be accurately provided through the analysis of big data, so as to promote the realization of learning reflection.

The concept of the virtual classroom relies on the increasingly mature campus network construction of colleges and universities. Virtual classroom refers to "the teachers and students to the computer network platform for learning and communication space, make full use of multimedia technology and tools based on the computer network, build and share learning resources, or to individual or group or class as a unit, to certain problems of real-time or non-real-time online inquiry and communication, teachers to students online teaching counseling, answering questions, evaluation, and other activities." [3]. The emergence of the virtual classroom makes teaching more diversified, learning more autonomous, and students' learning needs easier to meet [4]. At present, a virtual classroom is usually used as an auxiliary means of traditional teaching and coexists with the offline classroom. This kind of teaching behavior relying on online virtual classrooms and offline classrooms is called

blended teaching. Virtual classrooms rely on the network, are limited by time and space are small, has the following characteristics [5, 6].

- i. Real-time and interactive. Under the condition of the Internet, video, slides, pictures, and text can be integrated on the same interface, the integration process is a dynamic interaction process. Students can operate according to the instruction of the teacher at any time, the teacher can check the operation of the students at any time, reflecting the strong real-time and interactive.
- ii. Strong leapfrogging property. Virtual classroom includes not only the specific teaching platform provided by the school for students but also the platform for learners to communicate across the school class, across the country or culture, across the semester or time. Learners from different cultural backgrounds can express their views on the same issue and discuss them in the virtual classroom, forming a collision of ideas.
- iii. Strong extensibility. The traditional classroom is usually only 45 minutes and in a specific location, and the virtual classroom is not limited by time and place, any place, any time, as long as there is a terminal and the network can be used for teaching activities.

The above characteristics make the virtual classroom have the advantages that the traditional offline classroom does not have. Teachers can use the campus network and massive resources to design and practice online teaching based on online classroom, guide students to participate in the virtual classroom, carry out self-learning, discuss together, and cultivate their ability to analyze and solve problems.

#### 4. Design of Online and Offline Hybrid Teaching Mode of Underwater Acoustic Principles

The analysis of the learning situation shows that "Principles of Underwater Acoustics" is a course with complicated formulas and needs a lot of enthusiasm and energy. Based on the above characteristics of students and courses, the online and offline mixed teaching mode of "Principles of Underwater Acoustics" based on Mooche is designed to adapt to the specific situation of changing from offline to online courses at any time in the post-epidemic era [7]. Based on the whole teaching process, the design of the hybrid teaching mode of "Principles of Underwater Acoustics" is divided into three stages: self-study before class, communication and answering questions in class, and reflection after class [8-10].

- i). Self-learning stage before class——Virtual Classroom as the Forerunner and Real Classroom as the Follow-up.

Constructivism believes that learning is the process of extracting, understanding and analyzing information, and integrating the information with its previous experience to form new knowledge. Under the technical support of the virtual classroom, student-centered learning community relies on themed and situational classroom task setting, and relies on "group activities" and "online interaction" modules of virtual classroom. According to the teacher's preset rules and quantitative evaluation rules, to carry out the learning activities.

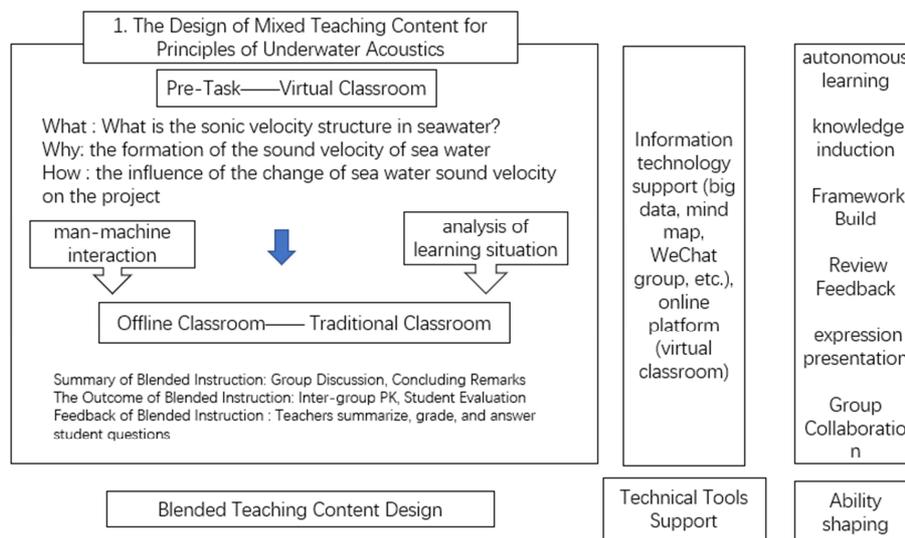


Figure 1. Design of Pre-class Content of Sound Velocity in Seawater.

Take Section 2.1 - Sound Velocity in Seawater as an example. Before class, according to the teaching plan, teachers will decompose and reorganize the traditional classroom content, give full play to the interactive advantages of online teaching according to the core requirements of professional foundation, knowledge

application and innovation ability in the training plan, and design the MOOC teaching content according to the idea of "what (concept cognition), why (principle understanding) and how to use (application innovation)"(as shown in Figure 1).

The teacher arranges the learning content in advance, emphasizes the key and difficult points of the course, issues

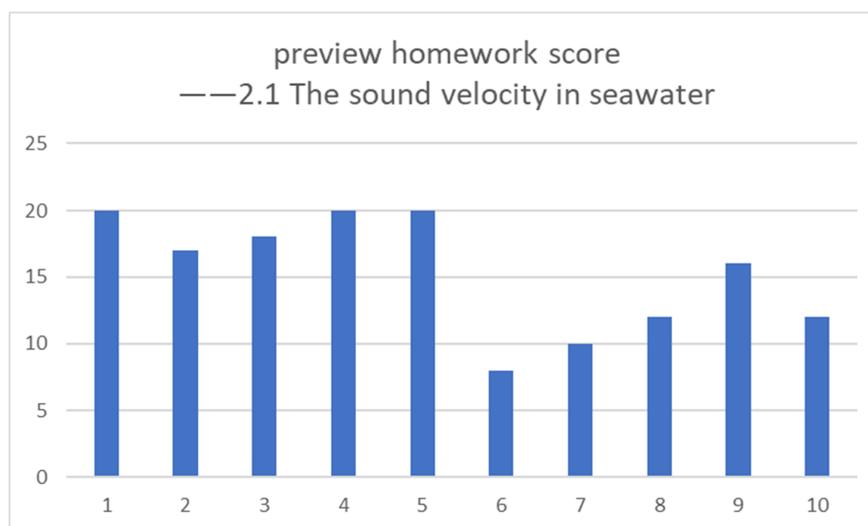
the preview homework, and selects the MOOC resources to push to the students. Before class, the students need to watch the MOOC "Sound Velocity in Seawater," mark the key content, i.e. the influencing factors of the sound velocity of seawater, and the difficult content, i.e. the structure of the sound velocity of seawater, and complete the homework. The question, as showed in Figure 2; In consideration of students' self-control, teachers set some interesting questions in the MOOC video. Only when students answer correctly can the video continues to play. According to the difficult structure of the course, teachers flexibly grasp the duration and content of

the MOOC resources. According to the powerful data statistics function of the online platform on which virtual classroom relies, as shown in Figure 3, teachers can pay attention to the learning status and effect of students at any time through video learning duration, homework completion, and answers to questions in the video before class, to adjust the content and form of class. Students shall sign in at the stage of self-study before class. By checking the learning tasks, they shall sign in according to the resources pushed by teachers. Learn, complete the preview homework, and preliminaries understand what the sound velocity in seawater is.

#### Pework for Principles of Underwater Acoustics--2.1 Sound Velocity in Seawater

1. Fluid medium acoustic wave is\_  
A. Shear waves B. longitudinal wave
2. (Multiple choices) In the sea water medium, the factors affecting the speed of sound change have\_\_  
A. Temperature B. Latitude C. Salinity D. static pressure
3. The most important factor affecting the speed of sound is\_  
A. Temperature B. Latitude C. Salinity D. static pressure
4. Sound velocity profiler measures sound velocity based on sound circulation principle. The transmitter continuously transmits pulse signals. The previous pulse reaches the receiver and triggers the next pulse to be transmitted from the transmitter. Record the number of pulses transmitted per second  $f$ . The distance  $L$  between the transmitter and the receiver is known. The speed of sound calculation formula for\_\_  
A.  $f/L$  B.  $fL$  C.  $fL$
5. (Multiple choices) The basic vertical temperature structure in the ocean is a three-layer structure, including\_  
A. isothermal layer B. the main spring layer C. Deepwater layers D. seasonal thermocline
6. (Multiple choices) In the basic temperature vertical structure in the ocean, the reasons for the formation of the surface mixed layer include\_  
A. solar radiation B. Ocean circulation C. The stirring action of sea surface wind wave in vertical direction
7. (Multiple choices) Typical deep-sea sound velocity profile including\_\_  
A. surface lay B. the seasonal thermocline C. the main spring layer D. Deep-sea isothermal layer
8. Typical deep-sea sound velocity profiles are characterized by the presence of\_  
A. the speed of sound minimum B. the speed of sound maximum C. sound velocity constant value
9. In a typical deep-sea sound velocity profile, the depth at which the sound velocity minimums is called\_  
A. Surface Channel B. Channel Axis C. thermocline
10. Seasonal changes have the least effect on the temperature of\_  
A. ocean surface B. Central Ocean C. Ocean depths

**Figure 2.** Pework for Principles of Underwater Acoustics--2.1 Speed of Sound in Seawater.



**Figure 3.** Pework Score--2.1 Sound Speed in Seawater.

ii). Class communication Q & A stage—Virtual Classroom as the Foundation and Real Classroom as the Promotion.

Offline teaching, that is, the second stage, before the start of class, teachers can through the Virtual Classroom to master before class learning situation (sign-in rate, homework completion rate, accuracy, the question in the video answer rate, etc.) on the content of this lesson targeted to explain the exchange, as shown in figure 3 of the speed of sound in the sea "course, students preview homework error

points concentrated in the first 6, 7, 8, 10 questions, It shows that the students have a preliminary understanding of the concept and characteristics of the speed of sound in seawater, but the understanding of the structure of the speed of sound in seawater is not in place. The purpose of blending teaching is to achieve the optimization of learning effect. Therefore, offline teaching is different from traditional classroom teaching. In addition to teaching knowledge, attention should be paid to the cultivation of students 'professional ability (as showed in Figure 4) [11].

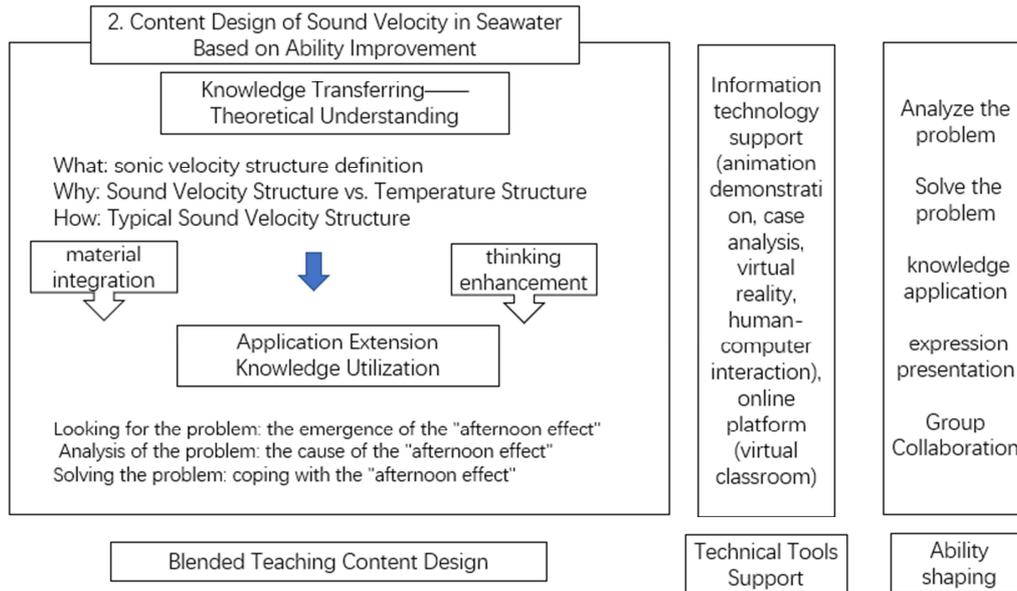


Figure 4. Content design based on ability improvement in the course of Sound Velocity in Seawater.

In the course Q A stage, based on the logical relationship between the course content, the students have understood the concept of sound velocity in the water and characteristics of the start, by the factors affecting the sound velocity of water to start, teachers focus on the structure of sound velocity of water, as well as the formation of the structure of sound velocity of water (i.e. the temperature structure in seawater).

For this part of the key and difficult content, the specific daily variation data of seawater temperature is given. Through the discussion of specific cases of daily variation of seawater temperature (as showed in Figure 3), the students 'understanding of seawater temperature change and sound velocity change is deepened.

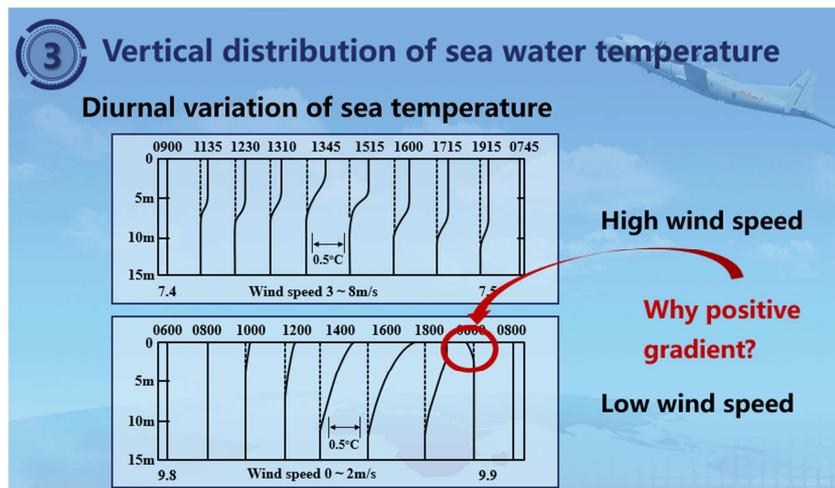


Figure 5. Diurnal variation of sea water temperature.

iii).Post-class re-examination and reflection stage—Based on the Real Classroom and Expanded by the Virtual Classroom.

After the end of the offline classroom, the students according to the learning situation of each class, on time to sort out the wrong questions and summary of the content uploaded to the online platform, the teacher through the virtual classroom notes and homework submission, the students 'learning progress supervision and guidance, for the general difficult to answer the question, through the virtual classroom discussion and offline exercises to guide the students, to complete the after-school review. It has been proved by practice those students' knowledge master's degree has been greatly improved compared with traditional offline teaching through after-class re-examination.

### 5. Evaluation System of the Course Based on Online and Offline Hybrid Teaching

For Principles of Underwater Acoustics, not only the examination results but also the students' knowledge framework, professional knowledge reserve, and the connection between theory and practice should be considered in the evaluation of score [12]. Therefore, for online and offline mixed teaching, the achievement evaluation system should increase the proportion of process evaluation besides formative evaluation.

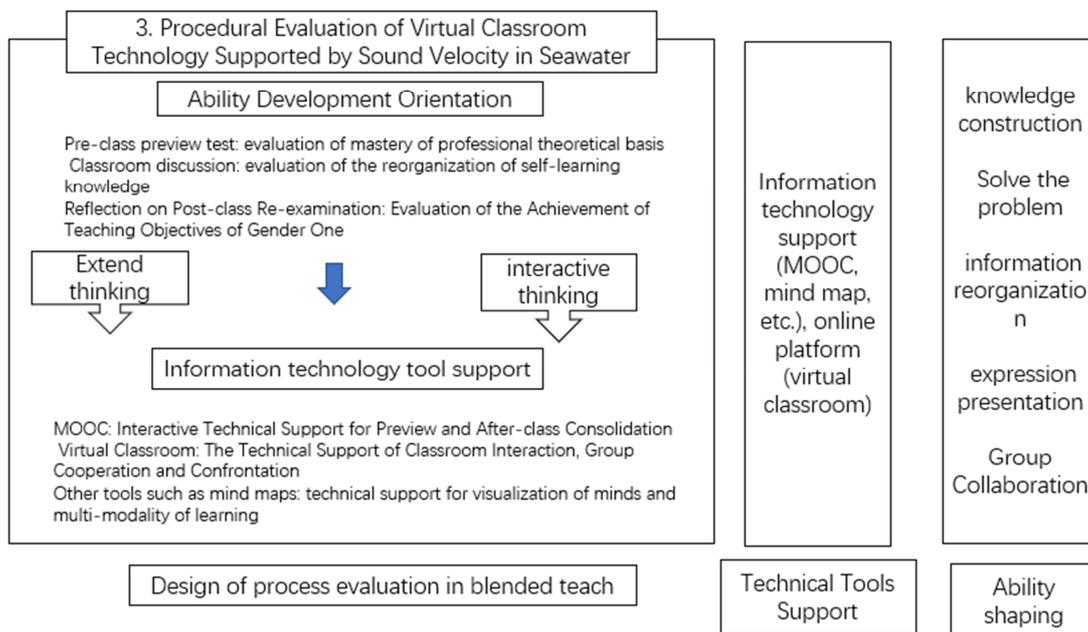


Figure 6. Design of Procedural Evaluation Based on Virtual Classroom Technology after "Sound Velocity in Seawater" Course.

It is found that in the traditional offline classroom, students are psychologically resistant to answer questions, while in the Virtual Classroom, students like to discuss questions and exchange views very much, and many new ideas are generated through online discussion. Students are encouraged to analyze and deduce new problems and ideas found online, write small research papers accordingly, and give certain bonus points in the scoring module of "Class Discussion."

The author's team applied the above experimental performance evaluation system to teach (as showed in Table 1). After a return visit to three batches of students who have completed classes and graduated, it is proved that the new experimental performance evaluation system has an obvious effect on improving students 'learning enthusiasm and cultivating their ability to analyze and solve problems [10, 13-15].

Table 1. Comparison before and after the reform of the experimental performance evaluation system.

		The old experimental performance evaluation system	The new experimental result evaluation system
Percentage of achievement module	Pre-class preparation test		20%
	Class Discussion	20%	20%
	Thoughts on Re-listing after Class		20%
	Paper Results	80%	40%
Comparison of learning effects	Student feedback satisfaction	92.3%	94.8%
	Final exam average	76	85

## 6. Conclusion

For the post-epidemic era, online and offline hybrid learning relying on information technology has been proved to be an effective new talent training mode. Integration of Virtual Classroom and traditional offline classes can enable students to study anytime and anywhere in fragmented time and complete teaching tasks satisfactorily. The practice of online and offline hybrid teaching of "Principles of Underwater Acoustics" proves that hybrid teaching can stimulate students' learning enthusiasm, promote their learning initiative, cultivate their thinking ability to find and solving problems, and then improve learning efficiency; Using the evaluation method based on online and offline hybrid teaching mode to evaluate students can encourage them to think and learn by themselves, and cultivate high-level and high-professional compound talents needed by the new era. The blended teaching mode mentioned in this paper has certain popularization value, but at the same time, it should be noted that there are still some shortcomings in this mode, which is shown in the fact that the experimental link still cannot fit well with the Virtual Classroom, which needs to be further explored in the subsequent teaching reform.

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