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Analysis of Online and Offline Teaching Pathways for Aquatic Microbiology Based on OBE Concept

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Abstract: Based on the OBE (Outcome Based Education) concept, this article analyzes and designs an online and offline teaching path for the teaching needs of aquatic microbiology courses. Firstly, the definition and characteristics of the OBE concept were introduced, as well as its application in education. Then, by setting teaching objectives, selecting teaching content, determining teaching methods, and establishing an evaluation system, a teaching path for aquatic microbiology was designed. Next, the preparation of online teaching paths, environment construction, and activity design were analyzed, as well as the arrangement and implementation of offline experimental teaching, field investigations, and academic exchange activities. Finally, the integration and optimization strategies of online and offline teaching paths were discussed, including the integration and sharing of teaching resources, the coordination of teaching activities, and the evaluation and improvement of teaching effectiveness. Through this study, reference and guidance can be provided for the teaching of aquatic microbiology courses.

1. Introduction

With the advancement of technology and the popularization of the Internet, online education has gradually become one of the important ways of learning and education. Especially under the influence of the current global pandemic, online teaching has been widely applied. However, for some highly specialized courses, such as aquatic microbiology, online teaching may face some challenges.

Aquatic microbiology is a discipline that studies the structure, function, and interactions of microorganisms in aquatic animals and aquatic environments. It involves complex experimental operations and on-site observations, and traditional classroom teaching often fails to meet the needs of students for practical knowledge. Therefore, when designing online and offline teaching paths for aquatic microbiology, it is necessary to comprehensively consider the transmission of theoretical knowledge and the cultivation of practical skills, in order to improve the learning effectiveness and application ability of students[1].

2. OBE concept

2.1 Definition and Characteristics of OBE Concept

The OBE educational philosophy, also known as outcome oriented education, ability oriented education, goal oriented education, or demand oriented education, is a student-centered and outcome oriented educational philosophy. This concept adopts a reverse thinking approach to construct the curriculum system and is an advanced educational concept.

The characteristics of OBE education include:

The results are not only the knowledge and understanding of students, but also the ability to apply them in practice, as well as the values and emotional factors that may be involved.

The achievement is not only about students believing, feeling, remembering, knowing, and understanding, but also the process of internalizing it into the depths of their hearts.

Achievements should balance important aspects of life and practical skills, avoiding becoming easily forgotten information and one-sided knowledge.

The closer the results are to the real learning experience of students, the more likely they are to persist, especially after long-term practice[2].

Education should design courses based on the ultimate results achieved by students, following the principle of reverse design, and evaluate the stage results in stages.

The principles for implementing OBE education include:

Clear focus, focusing teaching objectives on the final outcomes that students can achieve after completing the learning process.

Expand opportunities, fully consider the individual differences of each student, and ensure that every student has the opportunity to achieve learning outcomes.

Raise expectations, establish challenging execution standards, encourage deep learning among students, and promote more successful learning.

Reverse design, starting from the ultimate goal, reverse course design, and carry out teaching activities.

2.2 Application of OBE concept in education

The application of OBE (Outcome Based Education) concept in education has broad significance and important value. Firstly, it can help schools and educational institutions better design and organize their curriculum. By clarifying learning objectives and expected learning outcomes, educators can select and organize teaching content in a targeted manner, ensuring that students acquire the necessary knowledge and skills. Secondly, the OBE concept advocates for active participation and accumulation of practical experience among students, encouraging them to apply their learned knowledge to solve problems in real-life scenarios. This practice based learning approach can enhance students' interest and motivation in learning, cultivate their critical thinking and problem-solving abilities. In addition, OBE emphasizes the importance of feedback and evaluation. Through timely feedback and evaluation, students can understand their learning progress and shortcomings, thereby better adjusting learning strategies and improving learning outcomes. The most important thing is that the OBE concept emphasizes individual differences and diversity among students, and emphasizes the development needs and potential exploration of each student in the education process, making education more personalized and adaptable. Through the application of the OBE concept, education can better cultivate students' comprehensive qualities and abilities, enabling them to have the ability and confidence to face future social challenges[3].

3. Design of Teaching Pathways for Aquatic Microbiology

3.1 Setting of teaching objectives

The goal of teaching aquatic microbiology is to enable students to achieve the following abilities and literacy through systematic learning and practice: to master the basic concepts, theories, and research methods of aquatic microbiology, and to understand the role and influence of aquatic microorganisms in the aquaculture, processing, and storage processes of aquatic products.The teaching of aquatic microorganisms should enable students to have strong experimental abilities, proficiently use commonly used methods and techniques for detecting aquatic microorganisms, and be able to conduct microbial testing and analysis on aquaculture environments and aquatic products. At the same time, teaching aquatic microorganisms should cultivate students' research abilities and innovative thinking, enabling them to carry out scientific research and technological development related to aquatic microorganisms.In addition, we attach great importance to the teamwork spirit and practical ability of students, and cultivate their collaborative and expressive abilities through group discussions, experimental design, and report writing. Teaching needs to enhance students 'professional ethics and sense of responsibility, cultivate students' awareness of environmental protection and food safety, and achieve compliance management and sustainable development.By setting clear teaching objectives, selecting targeted teaching content and designing teaching methods, teachers can improve students' learning outcomes and subject literacy, laying a solid foundation for their future academic research or career development[4].

3.2 Selection of teaching content

The selection of teaching content for aquatic microbiology includes introducing the basic concepts and research objects of aquatic microbiology, including various microorganisms present in water and aquatic products, such as bacteria, fungi, viruses, etc., and introducing their functions and impacts in aquaculture systems. The teaching content should involve the classification and identification methods of aquatic microorganisms, including traditional cultivation and separation techniques, molecular biology methods, and rapid detection techniques. The teaching content needs to focus on explaining the growth characteristics, metabolic functions, and pathogenic mechanisms of aquatic microorganisms, and exploring their relationship with aquaculture health and environmental pollution. At the same time, the teaching content should introduce the microbial quality evaluation and control methods of aquatic products, including the determination of hygiene indicators, sampling techniques, and microbial detection methods. In addition, the teaching content should also include cutting-edge research on the interaction between aquatic microorganisms and environmental factors, as well as the application of microbial degradation and resource utilization technologies. Through the selection of these teaching contents, teachers can help students comprehensively understand the basic theories and practical applications of aquatic microbiology, and cultivate their scientific thinking and research abilities.

3.3 Determination of teaching methods

In the teaching of aquatic microbiology, teachers should adopt various teaching methods to promote active learning and in-depth understanding among students. Firstly, teachers can use the teaching method to introduce the basic concepts and theoretical knowledge of aquatic microbiology to students through classroom explanations, case studies, and other methods. Secondly, teachers should pay attention to practical operations, conduct experimental teaching and on-site inspections, so that students can personally participate in the detection and analysis of aquatic microorganisms,

and improve their experimental skills and problem-solving abilities. At the same time, teachers should encourage students to participate in group discussions and teamwork, strengthen communication and ideological collision, and cultivate their collaborative ability and critical thinking. In addition, teachers should use modern educational technologies such as multimedia demonstrations and virtual experimental platforms to increase the fun and interactivity of teaching, stimulate students' learning interest and innovative thinking. Teachers can also organize students to conduct research projects and reports, guide them to actively participate in scientific research and academic exchanges, and cultivate their research abilities and scientific literacy. Through diverse teaching methods, teachers can stimulate students' learning enthusiasm and initiative, improve their learning effectiveness and overall quality[5].

3.4 Establishment of evaluation system

In the teaching of aquatic microbiology, establishing a scientific and reasonable evaluation system is the key to ensuring teaching quality and student learning effectiveness. The evaluation system should include multiple dimensions and multiple evaluation methods. At the knowledge level, teachers can evaluate students' mastery of basic concepts and theoretical knowledge of aquatic microbiology through exams, assignments, and reports. Teachers should pay attention to the evaluation of practical abilities, and evaluate students' practical and problem-solving abilities in the detection and analysis of aquatic microorganisms through experimental reports, on-site inspections, and practical operations. At the same time, teachers should pay attention to the evaluation of students' innovative thinking and research abilities, and evaluate their research and academic expression abilities through research reports, paper writing, and academic speeches. In addition, teachers can also evaluate students' collaborative and communication abilities through group discussions, project presentations, and oral defense, taking into account their teamwork and communication abilities. The evaluation system should have comprehensiveness, objectivity, and impartiality, accurately reflecting the learning situation and comprehensive quality of students. By establishing a scientifically effective evaluation system, teachers can provide targeted teaching feedback to help students adjust learning strategies and improve learning outcomes in a timely manner.

4. Analysis of Online Teaching Pathways for Aquatic Microbiology under the OBE Concept

4.1 Preparation of online teaching resources

In the online teaching of aquatic microbiology under the OBE concept, it is crucial to prepare rich and diverse online teaching resources. Teachers need to collect and organize relevant courseware, teaching videos, and learning materials to provide for students to learn and review. These resources should include basic concepts, theoretical knowledge, experimental operations, and case analysis of aquatic microbiology to meet the learning requirements of students at different levels and needs. Secondly, teachers can use virtual experimental platforms and simulation software to provide students with opportunities for practical operations, allowing them to detect and analyze aquatic microorganisms through simulation experiments and gain practical experience. At the same time, teachers can also set up online discussion areas or forums for students to exchange and share learning experiences with each other, promoting collaborative learning and common progress among students. In addition, teachers can also organize online group projects, allowing students to collaborate in teams to complete relevant research projects, and to showcase and evaluate the results. By preparing a variety of online teaching resources, teachers can meet the diverse learning needs and styles of students, enhance their willingness and effectiveness in active learning[6].

4.2 Construction of online teaching environment

In the online teaching of aquatic microbiology under the OBE concept, it is necessary to build a good online teaching environment to ensure the learning experience and educational quality of students. Teachers need to choose appropriate online teaching platforms or learning management systems, provide stable and reliable network services and user-friendly interfaces, and facilitate online learning and communication among students. Teachers need to establish a clear curriculum structure and learning path, divide teaching content into modules or units, and set clear learning goals and evaluation methods for each module or unit. At the same time, teachers need to classify and organize learning resources so that students can easily access the necessary textbooks, courseware, and learning materials. Then, teachers need to provide effective learning support and guidance for students, establish online discussion areas, common question answering and other communication platforms, and promptly answer students' questions and solve learning difficulties. In addition, teachers should pay attention to online tutoring and feedback, regularly interact with students online, provide learning suggestions and homework correction services. Finally, teachers need to pay attention to the learning situation and progress of students, use data analysis and learner evaluation, adjust and optimize the online teaching environment, and continuously improve teaching effectiveness and student satisfaction. By building a good online teaching environment, teachers can provide students with convenient, efficient, and personalized learning experiences, promoting their self-directed learning and overall quality improvement.

4.3 Design of online teaching activities

In the online teaching of aquatic microbiology under the OBE concept, it is necessary to design diverse and interactive online teaching activities to promote student participation and active learning. Teachers can set up online lectures or teaching videos, where they will provide knowledge explanations and case studies to guide students in gaining a deeper understanding of the basic concepts and theories of aquatic microbiology. Schools can introduce virtual experimental platforms or simulation software to enable students to conduct practical operations in the detection and analysis of aquatic microorganisms, and improve their experimental skills and problem-solving abilities through practical operations. At the same time, teachers need to organize online group discussions or team projects, allowing students to collaborate within the group to complete relevant research projects, and to showcase and evaluate the results, cultivating students' collaborative abilities and innovative thinking. In addition, teachers can use online tests, practice questions, and case studies to evaluate students' learning situation, helping them consolidate their knowledge and identify their own shortcomings. Teachers can also organize online Q&A, classroom discussions, and academic speeches to encourage students to actively participate and enhance their expressive and critical thinking abilities. By designing diverse and interactive online teaching activities, teachers can stimulate students' interest and initiative in learning, improve their learning effectiveness and overall quality.

5. Analysis of offline teaching path for aquatic microbiology under the OBE concept

5.1 Design and organization of experimental teaching

In the offline teaching of aquatic microbiology under the OBE concept, experimental teaching is a very important part, which can help students consolidate theoretical knowledge, cultivate practical operation and problem-solving abilities. Teachers need to design and organize appropriate experimental content. Select experimental projects related to the basic concepts, experimental techniques, and research methods of aquatic microbiology based on teaching objectives and the actual situation of students. For example, teachers can conduct water sample collection and microbial

separation and cultivation experiments, allowing students to personally participate in the sampling and cultivation process, and understand the ecological characteristics and diversity of aquatic microorganisms. Meanwhile, teachers should ensure the completeness of experimental conditions and equipment. Prepare the necessary experimental materials, reagents, and equipment in advance, and provide a detailed explanation of the experimental operation process to ensure that students can smoothly conduct the experiment and obtain reliable results. Teachers should pay attention to safety awareness, strengthen laboratory safety training, and control experimental operation risks to ensure the personal safety of students and the reliability of experimental data. In addition, teachers should provide students with sufficient experimental guidance and guidance. Teachers should guide students to use experimental instruments and operating techniques correctly, and promptly answer any questions they encounter during the experiment. At the same time, teachers should encourage students to record experiments and analyze data, cultivate their experimental thinking and scientific attitude. Finally, teachers should summarize and discuss the experimental results. Teachers can organize students to write experimental reports, display experimental results, and have group discussions, allowing students to deeply reflect and analyze the experimental results, and deepen their understanding of the principles and practical applications of aquatic microbiology. By designing and organizing effective experimental teaching activities, teachers can enhance students' practical operation and problem-solving abilities, promote their active learning and exploratory spirit[7].

5.2 Arrangement and implementation of on-site inspections

In the offline teaching of aquatic microbiology under the OBE concept, on-site investigation is an important learning method that allows students to personally experience and observe the real aquatic microbial ecological environment, deepen their understanding and application of theoretical knowledge. Firstly, teachers need to arrange suitable on-site inspection locations and times. Teachers may select representative aquatic microbial ecosystems, such as lakes, rivers, or oceans, and conduct field surveys under appropriate seasonal and weather conditions.Secondly, teachers need to develop detailed inspection plans and activity arrangements. Teachers need to make clear the inspection objectives and tasks, set the learning tasks and problems, and guide students to observe and record them in the process of on-site inspection.At the same time, teachers need to determine the inspection route and stations, arrange relevant professionals to accompany and guide, and ensure the smooth progress of the inspection process. Then, teachers need to conduct on-site investigation activities. During the inspection process, teachers can introduce the environmental characteristics and biodiversity of the inspection site to students, guide them to observe and collect relevant data and samples. At the same time, teachers should encourage students to interact with the surrounding environment, carry out practical activities such as sampling surveys, field experiments, and sample collection, in order to obtain more in-depth learning experiences and opportunities for practical operations. Finally, teachers need to summarize and discuss the results of the assessment. Teachers can organize students to write investigation reports, analyze data, and conduct group discussions, guiding them to think and summarize relevant knowledge points from the investigation results, and apply them to the theory and research of aquatic microbiology. By arranging and implementing effective on-site investigation activities, teachers can enhance students' practical abilities and scientific literacy, and promote their in-depth understanding and comprehension of aquatic microbiology[8].

5.3 Conduct of academic discussions and exchange activities

In the offline teaching of aquatic microbiology under the OBE concept, academic discussions and exchange activities are essential to promote the cultivation of critical thinking and academic literacy among students. Firstly, group discussions or academic seminars can be organized. Teachers can assign students to conduct literature research and data organization on relevant topics, and require

them to engage in group discussions, share their research findings and reflections. Through group interaction, students can explore problems from multiple perspectives, broaden their horizons, enhance academic abilities and teamwork spirit. Secondly, academic presentations and speeches can be conducted. Schools and teachers can invite experts, academics or industry professionals to give academic lectures at universities, or encourage students to give academic lectures and share their research findings and perspectives. This can improve students' expression ability and academic communication skills, enhance their confidence and academic thinking ability. At the same time, academic writing workshops can be organized to guide students in learning how to write scientific papers, academic reports, and research plans[9].

6. Integration and optimization of online and offline teaching paths for aquatic microbiology under the OBE concept

6.1 Integration and sharing of teaching resources

The integration and optimization of online and offline teaching paths in aquatic microbiology under the OBE concept aims to achieve student-centered, results oriented, and continuous improvement teaching objectives. Firstly, the integration and sharing of teaching resources are crucial. In the teaching process of aquatic microbiology, teachers should fully explore and utilize various online and offline resources to provide students with rich, practical, and targeted learning materials. On the one hand, teachers need to screen and integrate online resources, including excellent domestic and international courses in aquatic microbiology, academic forums, professional websites, etc., to ensure that students can learn independently outside of the classroom. On the other hand, teachers should make full use of offline resources, such as textbooks, experimental manuals, reference books, etc., to provide students with a comprehensive knowledge system. In addition, teachers should encourage students to participate in online and offline interactions and discussions, such as online Q&A, group discussions, and sharing of experimental reports, in order to improve their participation and self-learning ability[10,11].

6.2 Connection and coordination of teaching activities

To achieve the teaching goals of student-centered, results oriented, and continuous improvement, teachers need to carefully design various teaching activities to ensure smooth connection and coordination between online and offline activities. In offline teaching activities, teachers should pay attention to the connection between classroom teaching, experimental operations, discussion and communication, and ensure the close integration of theoretical knowledge and practical skills. Teachers can conduct experimental teaching to help students consolidate theoretical knowledge and cultivate practical skills in practice. At the same time, teachers can organize group discussion activities to guide students to use their learned knowledge to solve practical problems, improve their innovation ability and teamwork spirit. In online teaching activities, teachers should make full use of online platforms to carry out a variety of teaching activities. For example, teachers can publish course previews, study guides and course summaries, and then teachers need to guide students to clarify learning goals and make learning plans; teachers can establish online question and answer sessions to answer any difficulties in learning; teachers can also organize online discussion areas to encourage students to participate in academic discussions and share learning experiences and insights[12].

6.3 Evaluation and improvement of teaching effectiveness

Teachers need to be student-centered, focus on results orientation, adopt diversified evaluation methods, and comprehensively and objectively evaluate teaching effectiveness. According to the evaluation results, teachers constantly adjust and optimize the teaching strategy to improve the

teaching quality and students' comprehensive quality.The evaluation of teaching effectiveness should focus on students' knowledge mastery and ability development. Teachers can use forms of assessment such as classroom questioning, practice questions, experimental reports, and group discussions to understand students' performance in various teaching stages. In addition, teachers can analyze students' learning progress, participation, and learning outcomes through online learning data, providing a basis for teaching improvement[13].

In the process of teaching improvement, teachers should adjust teaching content and methods in a targeted manner based on the evaluation results. For example, in response to the weak links in students' mastery of theoretical knowledge, teachers need to strengthen classroom teaching and after-school tutoring; For the cultivation of practical abilities, teachers can optimize the design and organization of experimental teaching, and increase practical opportunities; Teachers need to provide differentiated teaching resources and support to meet the personalized needs of students.

7. Conclusion

The analysis of online and offline teaching paths for aquatic microbiology based on the OBE concept is of great significance. In the future, innovative teaching methods and tools such as virtual laboratories and online learning platforms can be further explored to promote the development of aquatic microbiology education and cultivate more outstanding aquatic microbiology talents.

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