Advances in Social Science, Education and Humanities Research, volume 480
Proceedings of the 2020 5th International Conference on Modern Management and Education Technology (MMET 2020)

Blended Learning Strategies Exploration of Biomedical Electronics Under OBE Education Concept

Yutong Zha [1], Jiayong Yan [1], Xuan Wang[1], Boyu Si [1], Yue Huang [2]*

[1] *College of Medical Instrumentation, Shanghai University of Medicine & Health Sciences, 201318, Shanghai*
[2] *Innovation Academy for Microsatellites of CAS, Institute of Satellite Electronics Technology, 201210, Shanghai*
[*] *Corresponding author. Email: huangy@microsate.com*

ABSTRACT
Under the background of the demand of blended learning, under the guidance of OBE education concept, the blended learning strategy of biomedical electronics based on results was explored. Biomedical electronics curriculum design emphasizes students' exploring "the model of build", mainly through autonomous learning for knowledge system, build the biomedical electronics machine structural concept, and objectively in formative assessment to assess learning outcomes, for the purpose of this course teaching method provides a new paradigm.
Keywords: *OBE, blended learning, results-oriented, curriculum design*

1. INTRODUCTION

Biomedical Electronics is a course that uses electronics to solve problems of bioscience. It combines bioscience and engineering closely while deepening the basic knowledge of electronics. As a professional course system of Biomedical Engineering, this course is so important as a professional required course to the students in the learning process, which is not only to use instruments skillfully and related knowledge of electronics, medical diagnosis and treatment of improving the capacity of engineering system. Furthermore, Biomedical Electronics build a team in the design practice ability, to set up the consciousness of product development and operation of system. Therefore, students not only need to build a modular knowledge framework through theoretical courses, but also need to use experiments to prove and consolidate the theoretical knowledge system.

Based on this, this paper proposes the curriculum design of biomedical electronics under the guidance of outcome-based Education (OBE), and explores its practical methods in the process of hybrid teaching. SPOC and design practice courses are established online and offline respectively, so that students can build their knowledge of medical device system and improve their engineering skills.

1.1. Background and Significance of Blended Learning

With the parallel development of Internet technology and education technology, teaching methods are gradually enriched, and the traditional classroom teaching has evolved into a variety of teaching methods, such as integration of truth and reality, virtual simulation, and online and offline mixing.

Online teaching activities carried out by using the Internet, relying on computers or other mobile terminals can enable students to arrange their learning tasks more reasonably, flexibly control their learning time and appropriately select learning methods, which fully reflects the initiative, enthusiasm and creativity of students as the subject of the learning process. In this process, students are more engaged in subjective exploration, while teachers provide teaching resources and integrate system knowledge digitization into learning platform.

Online learning and offline more teaching activities is for strengthening and deepening of knowledge, through practice, experiment, field test and knowledge system of basic knowledge of solid integrity, relying on face-to-face process completed 20 and in-depth discussion, and achieve more advanced teaching goal, let the students have more opportunities in the perceptual cognition level to participate in the study. In this process, students solve the driving task through collaboration, and their initiative and creativity in

learning are given play, thus realizing the meaningful construction of knowledge. Teachers are the helpers and promoters of meaning construction [1].
Under the background of normal epidemic prevention and control, blended teaching can achieve the optimal learning effect and economic benefit on the premise of meeting the requirements of epidemic prevention that universities in key areas should resume classes and not resume schooling. It organically integrates various learning elements in both online and offline learning forms, and USES various teaching theories to coordinate various elements, so as to give full play to the advantages of blended learning and realize the optimization of teaching effect [2].

2. THEORY

2.1. Background and Significance of Blended Learning

With the parallel development of Internet technology and education technology, teaching methods are gradually enriched, and the traditional classroom teaching has evolved into a variety of teaching methods, such as integration of truth and reality, virtual simulation, and online and offline mixing.
Online teaching activities carried out by using the Internet, relying on computers or other mobile terminals can enable students to arrange their learning tasks more reasonably, flexibly control their learning time and appropriately select learning methods, which fully reflects the initiative, enthusiasm and creativity of students as the subject of the learning process. In this process, students are more engaged in subjective exploration, while teachers provide teaching resources and integrate system knowledge digitization into learning platform.
Online learning and offline more teaching activities is for strengthening and deepening of knowledge, through practice, experiment, field test and knowledge system of basic knowledge of solid integrity, relying on face-to-face process completed 20 and in-depth discussion, and achieve more advanced teaching goal, let the students have more opportunities in the perceptual cognition level to participate in the study. In this process, students solve the driving task through collaboration, and their initiative and creativity in learning are given play, thus realizing the meaningful construction of knowledge. Teachers are the helpers and promoters of meaning construction [1].
Under the background of normal epidemic prevention and control, blended teaching can achieve the optimal learning effect and economic benefit on the premise of meeting the requirements of epidemic prevention that universities in key areas should resume classes and not resume schooling. It organically integrates various learning elements in both online and offline learning forms, and USES various teaching theories to coordinate various elements, so as to give full play to the advantages of blended learning and realize the optimization of teaching effect [2].

3. RESEARCH

3.1 The Guiding Significance of OBE Concept for Biomedical Electronics Curriculum Construction Purpose of The Research

The introduction of OBE makes the course construction of biomedical Electronics not only focus on the input of knowledge and the design of teaching process, but also pay more attention to the output of teaching results, the improvement of students' learning effect and the mechanism of continuous improvement. It is embodied in the following aspects:

3.2 The Unity of Curriculum Objectives and Personnel Training Objectives

As a applied undergraduate colleges and universities, the biomedical engineering in our school is to train the good humanities accomplishment and team cooperation spirit, by the characteristics of solid professional ability training theory and practice, with international advanced medical equipment involved in the mechanical and electrical technology base, as well as the medical service applications, can be engaged in medical equipment design and manufacture, application development and can be extended to medical - in the field of biomedical engineering related work in combination with engineering applied talents "as the goal.
On the one hand, the course content needs to keep pace with The Times to enable students to understand the advancement of cutting-edge technologies after completing the course; on the other hand, it needs to enable students to have the ability to adapt to the needs of talents after completing the course. Therefore, the course objectives have been adjusted as follows:
In terms of professional knowledge, students are required to integrate medical knowledge with engineering knowledge, master the analysis and processing methods of biomedical electronics, and understand the relevant principles and design principles of circuits and systems of typical medical instruments.
In terms of professional skills, students should be able to apply electrical and medical knowledge, analyze and deal with practical biomedical problems. Students are able to analyze actual biomedical needs, select appropriate electronic devices, design functional principle instruments according to requirements, and

have the ability to analyze and debug the system. Students can have certain innovation consciousness and innovation practice ability.

In terms of professional accomplishment, students can have rigorous scientific attitude, professional dedication and professional ethics. Students cultivate independent learning ability and team writing ability, and become an "excellent medical engineer" in the new era of "Made in 2025 in China".

3.3 The Customization of Student Learning Outcomes

In view of the OBE concept, Program Learning Outcomes (PLO) will be formulated according to the SMART principle, and Learning Outcomes will be classified according to different levels of requirements in accordance with the objectives of Bloom education. The table shows that PLO is divided into six categories from low to high level of competence for biomedical electronics courses under the guidance of Bloom's educational objectives. They are memory, understanding, application, analysis, evaluation and creation of knowledge [3].For learners with different learning abilities and goals, they strive to achieve hierarchical customization of learning outcomes.

Table 1 PLO Classification under The Guidance of Bloom's Taxonomy

Ability Level (↑from Low to High)	Learning Outcomes
Create	Learners can take product design as the goal, improve on the basis of design prototype, and propose feasible solutions for performance optimization. Have the ability to design and optimize the whole process of new products from scratch, from principle machine to product level.
Evaluate	Learners can design principle machines according to the needs of medical electronic devices; It can also make error analysis with clinical gold standard detection method, evaluate the principle and design effect, and check the design loophole.
Analyze	Learners can optimize the selection of devices according to specific clinical needs.Through debugging the hardware circuit design, the effect of balancing the factors restricting each other in the instrument system design is achieved.
Apply	Learners can select appropriate integrated devices to complete the module design of medical electronic instruments, and realize the principle prototype of conventional medical electronic instruments after debugging to meet the basic functional requirements.
Understand	When the design requirements of a medical electronic device are given, learners can infer module composition and select appropriate integrated devices to be applied to the module to achieve basic functions.
Remember	Learners can explain the constituent modules of conventional medical electronic instruments, give examples for the selection of different types of functional modules of instruments, and explain the performance requirements.

3.4 Results-Oriented Teaching Evaluation Scheme

The traditional teaching evaluation scheme usually takes the teaching objective as the starting point and designs the teaching contents, teaching methods and the final teaching results from top to bottom. Although there are a variety of assessment methods such as supervision, peer lectures, questionnaire survey in the learning process, and final evaluation of teaching, etc. [4], these assessment methods generally attach more importance to teaching behavior than teaching effect, and lack the student-centered awareness of results.

Therefore, the instructional evaluation program for biomedical electronics follows the principle of results-oriented reverse design, that is, the evaluation is based on the learning outcomes that students are expected to achieve. That is to say, according to the learning outcomes that students at different levels should achieve, the teaching objectives of the course are reversed, and then the evaluation criteria and the program for process assessment are determined. The assessment of experts and supervisors, supervisors and peers, teachers' self-evaluation and students' evaluation of teaching are all incorporated into the teaching output evaluation system. Through the organic combination of process assessment and improvement, the allocation of teaching resources on demand and the continuous improvement of teaching effects can be realized.

3.5 Quantifiable Criteria for Performance Evaluation

The achievement evaluation standard should match and unify with the student's expected learning result, and realize the achievement evaluation. In order to achieve quantifiable achievement evaluation criteria, teachers should first help learners establish multi-level expectations for learning outcomes to achieve goals. According to the different levels of learning outcomes, the course grades of biomedical electronics are evaluated. Different levels of achievement result in different grades. The learning objectives achieved will be embodied by the teacher into objective topics, or for teachers and students to jointly develop practical activities, especially high-level creative projects to carry out completion evaluation.

The subject of grade assessment can be teacher, can be learner, also can be student mutual evaluation. However, no matter who is the evaluation subject, it is necessary to ensure that the evaluation of learning outcomes should be carried out in a comprehensive and multi-dimensional manner. During the performance evaluation, the teacher should encourage students to think about the expected learning outcome of the course and give full play to their individuality in the learning process, so as to cultivate students' awareness of project process management and improve their overall ability.

3.6 Competency-Based Teaching Activities

Result-oriented teaching requires students to measure what they can do and to what extent they can achieve [5]. Therefore, the arrangement of biomedical electronics teaching activities based on the educational concept of OBE should be designed around ‘results’, that is, from the perspective of solving problems with fixed answers, the higher-order ability of solving open problems should be gradually cultivated.

First of all, at the beginning of learning, teachers should provide learners with a blueprint of learning outcomes, that is, to help students understand the goals of multi-level learning outcomes and build a ceiling of competence and vision suitable for learners. Secondly, for the biomedical electronics course teaching, teachers need to provide all the teaching materials, teaching materials should cover the entire biomedical electronics related independent unit boundaries clear knowledge, comprehensive knowledge modules as support, after learning this course, make the learners have a build system of knowledge. Thirdly, learners should be made to "see both trees and woods", and learning outcomes are both the end point and the starting point of learning. Reverse design principle should be adopted in teaching, which is guided by the peak goal, knowledge integration and reverse design with disassembled units as the starting point, so as to achieve the high-level goal of system design.

4. METHOD

In order to make learners before studying biomedical electronics course content, understand the development of biomedical electronics, key technology and the development direction, grasp the common medical electronic instrument classification, main technical characteristics, design idea, design principles and steps, and to help learners understand medical electronic instrument unit circuit and the design of the whole circuit relations, set up related guide to learn the course content, in order to help learners to the end of this course learning outcomes have a correct forecast.

4.1 Online Teaching Strategy of Biomedical Electronics under The OBE Concept

The online teaching resources are centrally built on the "CHAOXING" website. The online SPOC courses developed by teachers, learning materials involved and process documents are integrated on the platform to establish "one-stop" learning resources.

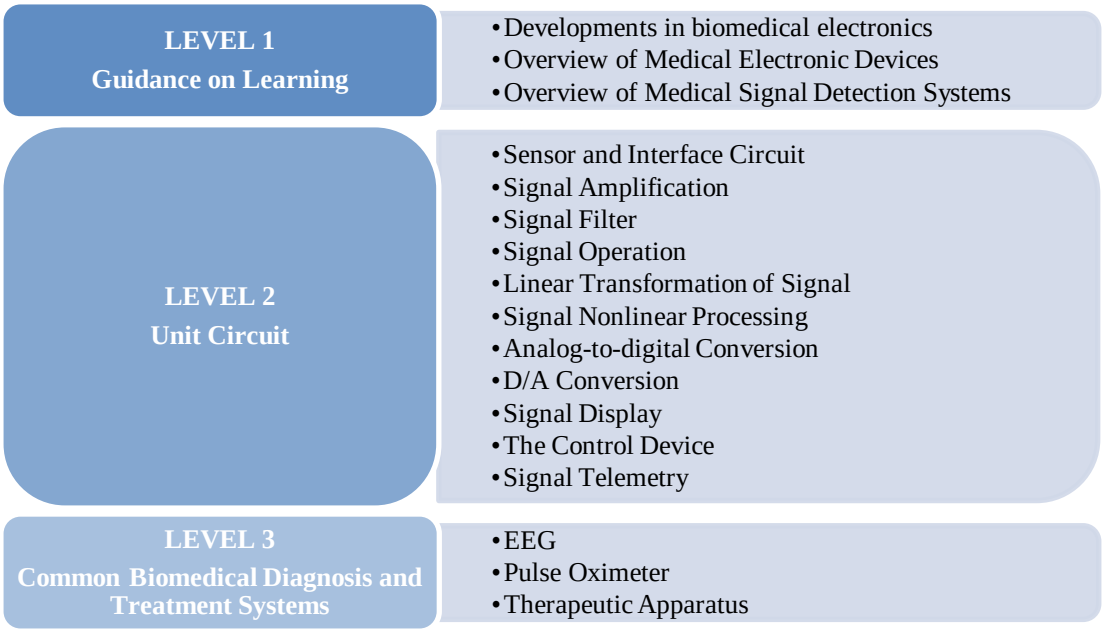

Figure1 Composition of Biomedical Electronics Online Learning Resources

The content of the textbook is rearranged in 17 modules at the three levels as shown in Figure 1, with each module varying from 2 to 4 class hours.Among them, LEVEL 1, as the guidance part, contains three modules to help learners establish a brief and overview of the cognition of biomedical electronics;LEVEL 2, as a unit circuit part, contains 11 modules. It introduces the universal functional unit of the conventional medical signal diagnosis and treatment system in the medical field.LEVEL 3 contains example modules for three common biomedical diagnosis and treatment systems to help students understand medical electronics from a composite structure LEVEL.

With the goal of achieving a kind of complete biomedical diagnosis and treatment system, learners can choose module resources to study according to their learning needs and complete at least 32 hours of online courses. The evaluation of module knowledge is based on the completion test in the learning process.

4.2 Offline Teaching Strategy of Biomedical Electronics under The OBE Concept

Offline teaching adopts the principle of reverse design and cultivates students' ability of scientific research and practical innovation in the form of 'study + practice'. In the offline learning process, learners need to complete two projects, which are respectively as follows:

One item is to write a comprehensive survey of any kind of medical electronic device.The content includes the research progress at home and abroad, the selected technical principle and system design scheme, and then deepens to the specific device selection and basis, and finally analyzes and summarizes the development prospect and trend.Students are the subject of information processing, rather than the passive receiver of external stimulus and the object to be instilled [6]. The setting of this project enables learners to become the active constructor of meaning and cultivate the awareness and driving force of scientific research.

The other is a practical design project based on PBL teaching method.Aiming at the system development of certain medical electronic devices, especially instruments related to self-selected research reports, students adopt PBL teaching method to independently carry out design and platform building, and prove and consolidate the theoretical knowledge system accumulated in the online learning process through practical training.In this process, students can complete the project independently or as a group.It can not only cultivate students' ability to practice and innovate, but also encourage and support learners to actively explore and solve problems cooperatively, which is conducive to the development of comprehensive qualities such as interpersonal communication, and effectively change learners' passive learning style.

To adopt the reverse design principle and make students become active meaning builders means to give play to the initiative and enthusiasm from the following three aspects in the learning process: first, students should have the ability to self-explore and discover the meaning of knowledge construction;Secondly, they should be able to actively collect and analyze data and information, and put forward hypotheses and try to verify them.Finally,

establish a connection between the current learning content and the existing knowledge system, and think about this connection seriously.In this process, teachers give full play to the work of organizing, assisting, observing and evaluating in the teaching process, and conduct formative evaluation on students' offline learning results based on the degree of project completion.

5. CONCLUSION

The OBE educational philosophy is student-centered learning. Under the hybrid teaching demand and trends, this study based on OBE education concept of biomedical electronics teaching strategy to explore, to accumulate, diversified and advanced way of evaluating objectively evaluate the learning outcomes, and USES the diverse teaching evaluation method of continuous improvement in the teaching process.

ACKNOWLEDGMENT

This work was supported by Shanghai Young University Teacher Training and Support Program project (A1-2601-19-311124)

REFERENCES

[1] D Tong. Looking for Rules of Education. China Light Industry Press, Beijing, 2006.

[2]Y X Chu. Research on the Mixed Learning Mode Based on The Course of Practical Writing. Hebei Normal University, Hebei, 2013. DOI: CNKI:CDMD:2.1014.160426

[3]L Luo. Research on Cognitive Ability Test Method Based on The New Version of Bloom's Taxonomy of Educational Goals. The Science Education Article Collects, 2017, 389(06), 31-33. DOI: 10.16871/j.cnki.kjwhb.2017.06.014

[4]K J Zhang, X F Zhang, B H Su. Research and Exploration of A New Teaching Quality Evaluation System Based on OBE Concept. Education Modernization .2019 (80).

[5]R Zhou. Preliminary Study on the teaching model of OBE. Charm of China, 2017, 000(031), 126. DOI: 10.3969/j.issn.1673-0992.2017.31.108

[6]L Xiao, H B Wei. Applying Constructivism, Constructing Educational Technology Teaching Mode. Journal of Henan Institute of Education: Natural Science Edition, 2005,14(1):88-89. DOI: 10.3969/j.issn.1007-0834.2005.01.033