

Exploration on the Application of BOPPPS Teaching Mode in the Course Design of Mechanical Drawing

Ling ZHOU^{1,*}, Ran LI¹, Chunyan WU¹ and ke CAO¹

¹Air Force Early Warning Academy, No.3 Qiangjun Road, Wuhan, Hubei, China

Abstract. This article takes the knowledge module of part sketch surveying in Mechanical Drawing as an example to explore the BOPPPS teaching mode and the "cloud on screen" remote learning application that combines MOOC, virtual technology, and smart classroom. Based on the six teaching links in the BOPPPS teaching mode, the case implementation process is analyzed and summarized. Practice has shown that in the project-based teaching process, the use of a new teaching mode that combines the BOPPPS teaching mode and information based teaching methods can effectively improve the remote teaching level of teachers and the remote learning effect of students.

1 Introduction

The BOPPPS teaching model originated from the ISW (Instructional Skills Workshop) instructor skills training workshop in Canada, founded by the Douglas Kerr team at the University of Vancouver in 1976^[1].^[1] The teaching process consists of six teaching stages: Bridge-in, Objectives, Pre-test, Participatory Learning, Post-test and Summary^[2-3]. The BOPPPS teaching mode mainly adopts a participatory learning approach, emphasizing students' subjectivity and teaching reflection. After clarifying learning objectives, students become the protagonist of the classroom, and teachers play a guiding role in the entire teaching process. This teaching mode has strong operability, providing specific theoretical support and practical guidance for teaching. It can effectively improve the systematicness and effectiveness of teaching.

2 Design of BOPPPS Teaching Mode in Mechanical Drawing

2.1 Design concept

Based on the basic situation of students, the characteristics of mechanical drawing courses, and the problems encountered in the teaching process, the design of the BOPPPS teaching mode in mechanical drawing will be guided by the new era military education policy, and establish a teaching philosophy of "one center, one main line, and one goal"^[4]. Centered around students, adhering to the principle of learning as the main body and teaching as the leading role. Teaching work is carried out around the selection of teaching methods and means by students. Grasp the main line of Cultivating Virtue and Cultivating People for

War, and conduct assessment and evaluation around educating people. With the goal of cultivating high-quality and specialized new military talents with both moral and professional abilities, fully apply the BOPPPS teaching mode to mechanical drawing teaching.

2.2 Teaching Content Design

This course is based on the talent cultivation plan, implements the practical reform idea of aligning the school curriculum content with job competency standards, adheres to the idea of cultivating morality and educating people for war, fully integrates ideological and political elements of the course, closely adheres to new equipment, theories, and methods, and adjusts the course content in real time.

2.2.1 Experience through war, reconstruct the content system

1. Closely adhere to the workflow and reconstruct the architecture

The original teaching content of "Mechanical Drawing" adopts a chapter and section arrangement in structure, with abstract content and separation of theory and practice, which does not conform to the cognitive laws of military cadets. The order of arrangement is also based on dimensional annotation, graphic drawing, technical requirements, part surveying, and national standards. It is inconsistent with the order of drawing and reading drawing, and has a jumping nature, making it difficult for students to learn. In terms of the new content arrangement, the course system is first divided into five projects, each of which is further divided into several tasks. Knowledge points are integrated into the work tasks, as shown in Figure 1. And

* EMAIL: 17032676@QQ.com (Ling ZHOU)

then various projects are connected according to the working sequence of national standards - graphic drawing - dimensional annotation - technical requirements - part surveying. Among them, the basic knowledge of drawing is the stage of consolidating the foundation, the basic theory

of drawing is the stage of generating ability, and part drawings, assembly drawings, and part surveying are the stage of improving ability. It is the key content of the entire course teaching, as shown in Figure 2.

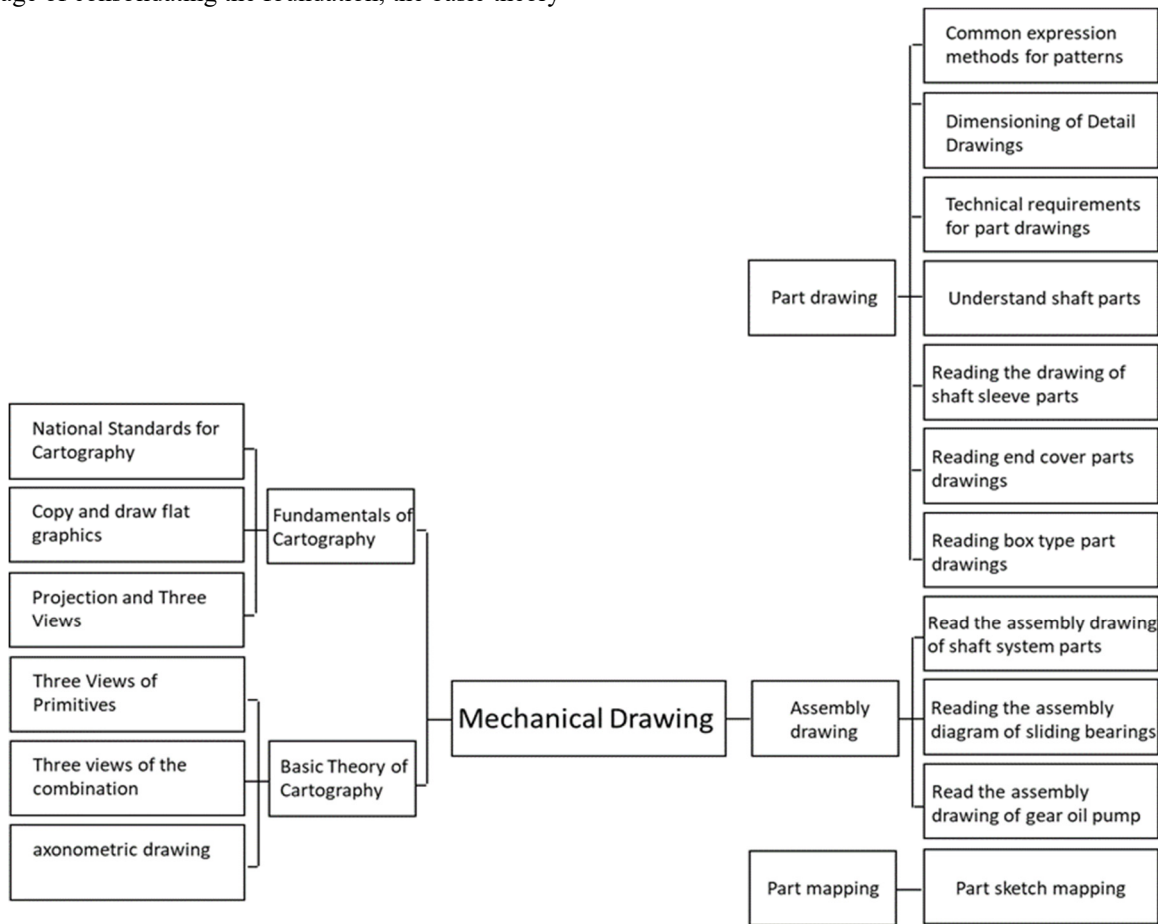


Figure 1: Content Structure

2. Closely adhere to military equipment and select work tasks

The original "Mechanical Drawing" has universality in the selection of examples and drawings, mostly for forks, boxes, and ball valves. It is not closely integrated with

equipment and lacks specificity. The selection of new tasks should be as close to the equipment as possible, mainly based on the drawings used for actual equipment repair, maintenance, and upkeep, laying the foundation for subsequent professional courses.

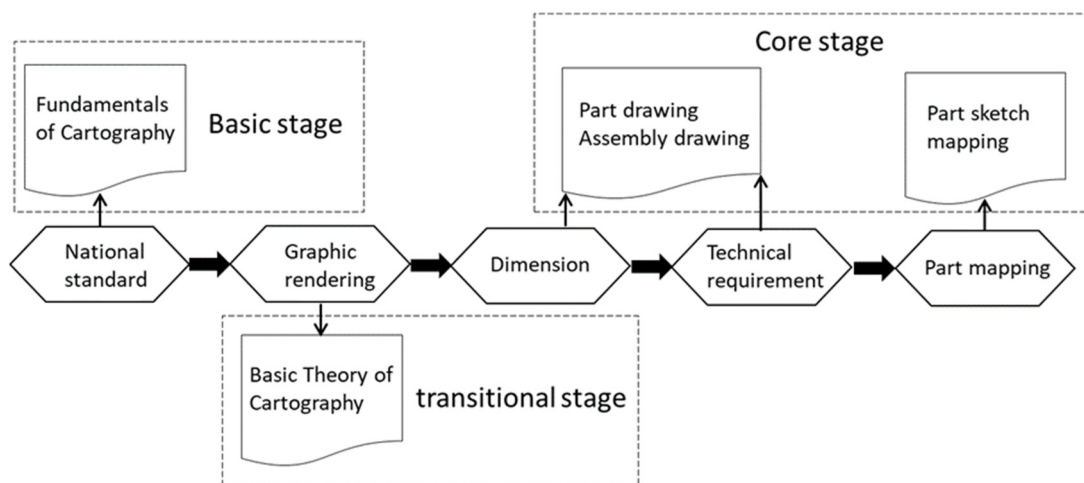


Figure 2: content order

2.2.2 Establishing Virtue and Cultivating Talents, highlight classroom moral education

In the teaching content, we will deeply explore the ideological and political elements of the curriculum in various aspects based on the characteristics of each knowledge module. Such as building cultural confidence in the teaching of basic cartography knowledge; Cultivate a rigorous scientific attitude in the teaching of basic drawing theories; Deepening the spirit of craftsmanship in teaching part drawings; Stimulating mission responsibility in assembly drawing teaching; Instill a sense of teamwork in the teaching of parts surveying and mapping, we should instill a sense of teamwork, and adhere to the principle of cultivating virtue and talent throughout.

2.2.3 Dynamic updates, keeping up with cutting-edge knowledge

In terms of course content updates, we adhere to following up on new equipment and structures, timely collecting vulnerable parts from new equipment, popularizing computer graphics technology, enabling students to use specialized software to view drawings, striving to "stay close to equipment and cutting-edge". We guide students to participate in "technology small production" and use drawings to convey their design concepts and solutions.

2.3 Teaching Mode Design

2.3.1 Taking learning as the main body and optimizing teaching mode

The entire teaching process utilizes the BOPPPS teaching mode, extending the teaching work forward and backward, focusing on cultivating students' self-learning ability forward, and expanding students' practical ability backward [5].

2.3.2 Integrating virtual and real, enriching teaching methods

Based on information technology, utilizing high-quality teaching resources, achieving full interactive and visual teaching, and enhancing students' sense of experience [6].

1. Network cloud disk, MOOC

By utilizing teaching resources such as publishing teaching tasks, preview assignments, MOOC, and micro courses, students can learn relevant content in advance and submit preview assignments to increase their participation and extend classroom teaching from class to extracurricular activities.

MOOC includes all the key knowledge in the course, which students can download through the internet and cloud disk, and use pre class time for preview. Teachers can check the number of students previewing and the preview time, and determine the key and difficult issues in teaching based on the browsing time of each knowledge point, and develop a teaching plan that is suitable for the

actual situation of students.

2. Instant messaging software

Before and after class, students and teachers can use instant messaging software to discuss and exchange difficult issues online, forming a good mutual learning and enhancing the relationship between students and teachers. Teachers use instant messaging software to track students' speaking frequency and support rate, in order to understand their online learning situation. The third is to establish a smart classroom and combine it with multiple all-in-one machines to instantly display the learning situation of each group of students, facilitating group discussions and displaying learning results, achieving teaching interaction.

3. Smart Classroom

The smart classroom has functions such as recording, interactive, and online answering. The recording function can help students review the teaching content, review the knowledge learned, help teachers review the teaching process, and reflect on the teaching effectiveness. Interactive software can help students interact through bullet screens, high-frequency vocabulary, and other methods. The classroom can instantly grasp students' learning status, adjust teaching status in real time, effectively stimulate students' interest in learning, and help students improve learning efficiency. Students can use the answering machine to answer online questions, and the answering software can display parameters such as student participation, duration, and accuracy. After class, teachers can use backend data to analyze teaching effectiveness and adjust teaching progress in a timely manner to improve teaching quality. Smart display screen display can facilitate students' group discussions, display learning results, and enhance their teamwork ability. Smart classrooms can use the internet to synchronously transmit the entire teaching process, achieving remote learning for students.

4. Virtualization Technology

Using AutoCAD and SolidWorks virtual software to simulate two-dimensional and three-dimensional models, showcasing the process of two-dimensional and three-dimensional transformation. Students increase their visual thinking by repeatedly rotating and viewing the model, reduce the difficulty of spatial thinking, and break through the key and difficult teaching problems. In the process of virtual technology assisted teaching, synchronous use of physical models enables spatial thinking to become visible and tangible objects, facilitating students to combine equipment and reducing the distance from theory to practice.

The use of the above four information technologies can create a "cloud on screen" remote learning mode, effectively improving the effectiveness of students' remote learning.

2.3.3 Multiple evaluations to improve teaching quality

The evaluation method is divided into two parts: students and teachers. Students comprehensively evaluate pre-test, participatory learning, post-test, and ability development through self-evaluation, mutual evaluation, and teacher

evaluation, measuring the learning effectiveness of students from three aspects: knowledge, ability, and literacy, and promoting their comprehensive development [7]. Teachers reflect on the teaching philosophy, content, methods, and effectiveness based on the actual teaching process and feedback from students, completing the summary and sublimation of teaching tasks, and improving teaching quality.

2.4 Implementation process of BOPPPS teaching mode

BOPPPS teaching is divided into three parts: Front, Middle, and Back. Front known as Phoenix's head, it consists of introduction, learning objectives, and pretest, aiming to

Pre class preparation:

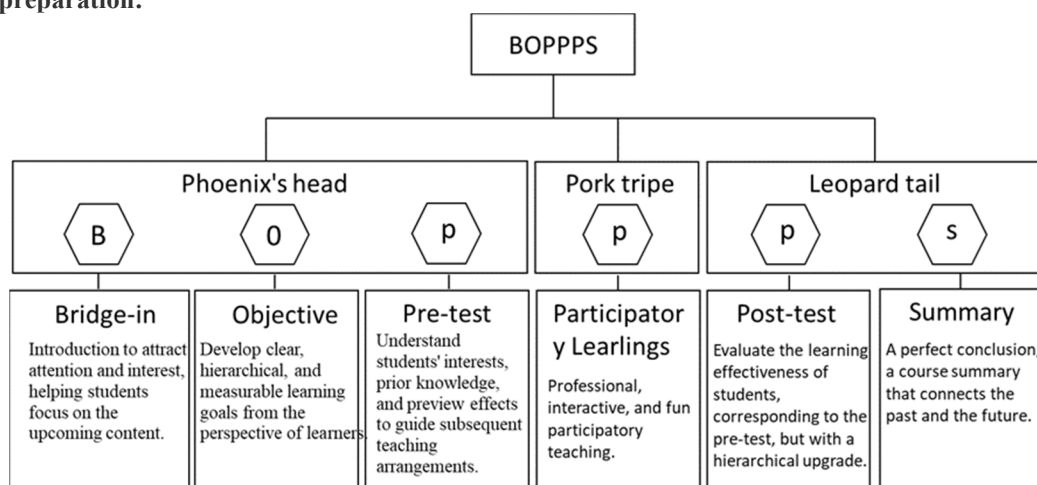


Figure 3: BOPPPS teaching mode

3.1 Bridge-in

Teachers import learning tasks and upload relevant materials in the form of preview lists through online cloud disks, including micro courses, MOOCs, and extended

set learning objectives, understand students' preview situation, and stimulate students' interest in learning. Middle known as Pork tripe, it focuses on participatory learning and emphasizes the role of students as the main body, with teachers playing a guiding role. Back known as Leopard tail, which consists of a post test and summary, and is a check on the overall learning effect and a sublimation of the teaching task, as shown in Figure 3[8].

3 The example

This article will take the part sketch mapping module in the course of "Mechanical Drawing" as an example to explain in detail the implementation process of the BOPPPS teaching mode.

knowledge. Students log in to the platform to check tasks and prepare for preview [9].

The introduction of teachers is guided by job tasks, helping students focus on the content they are about to learn. The methods for introducing different tasks vary, check Table 1.

Table 1 Import Method

Knowledge module	Import Method
Basic knowledge	Audio visual introduction method, thought-provoking introduction method
Basic theory	Analogy import method, suspense import method
Part drawing and Assembly drawing	Example introduction method, question based introduction method
Part sketch mapping	Target introduction method, motivational introduction method

3.2 Objectives

From the perspective of students, the teacher focuses on the teaching scope, formulates clear, achievable, and evaluable learning objectives. The learning objectives and

content should be detailed, specific, operable, and one-to-one corresponding, check Table 2. Teacher distributed to students before class to help them clarify their goals and learn with a targeted approach [10].

Table 2 Learning content and objectives

Learning content	Learning objectives
Structural Analysis of Timing Pins	Ability to analyze the results of shaft parts and select appropriate expression methods.
Dimensional analysis of timing pins.	Correctly label the dimensions of shaft parts.
Drawing steps for part sketches.	Able to sketch shaft parts.

3.3 Pre-test

Students review the old knowledge required in classroom tasks, preview new knowledge through watching videos, reviewing materials, etc., sort out new knowledge, discuss

problems encountered in the preview in groups, and complete the pre-test task^[11]. The instructor will understand the students' learning foundation based on their submitted assignments, develop the key and difficult teaching points and teaching plan for this class, as shown in Figure 4, select appropriate teaching methods and means to highlight the key points and break through the difficulties.

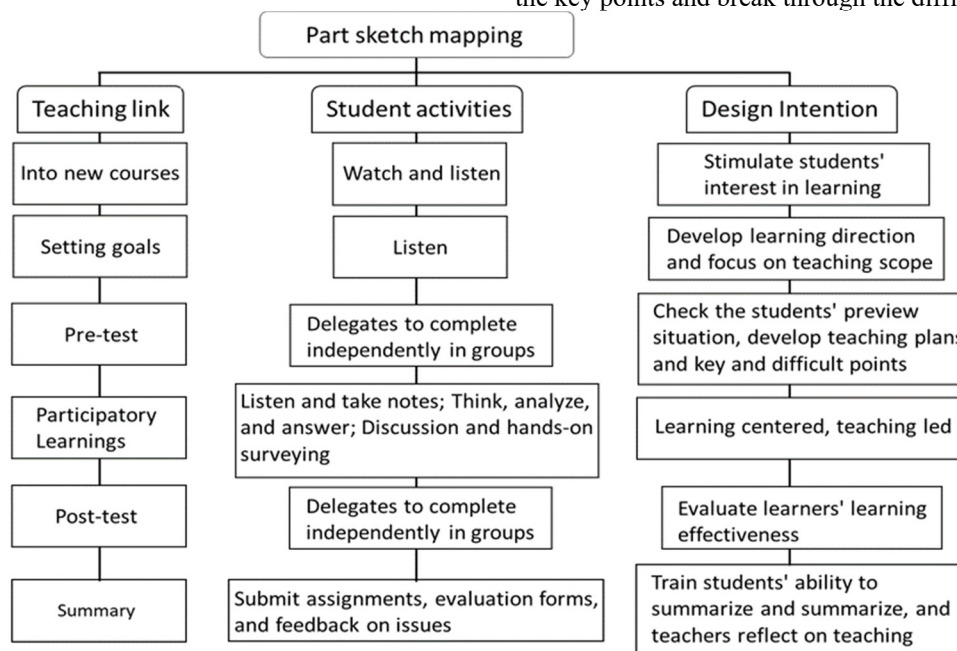


Figure 4: Planning

Classroom teaching:

3.4 Participatory Learnings

Classroom teaching adopts a participatory learning approach, where teachers and students work together to establish a democratic, harmonious, and enthusiastic environment. The teaching atmosphere provides opportunities for students at different levels to participate and develop^[12]. We divide the students into several groups. In the early stage, students with good theoretical and learning abilities serve as organizers responsible for organizing pre class previews, in class discussions, and task summaries. Additionally, we assign two roles: recorder and speaker to record and speak the results of group discussions, creating a good atmosphere of teamwork and mutual assistance. In the later stage, each task will undergo a rotation, striving to improve the organization, recording, and speaking abilities of each participant.

In the summary section of course teaching, students summarize the key points of classroom knowledge through methods such as induction, response, divergence, transfer, speculation, extension, suspense, and foreshadowing, discover the internal connection between theory

and practice, exchange task completion experiences, and achieve silent ideological and political nourishment in the course^[13]. Summarize the task completion process for practical application, to consolidate theoretical knowledge, cultivate practical abilities, and highlight the purpose of teaching and educating people.

3.5 Post-test

The post test is divided into two parts. Firstly, the theoretical test focuses on assessing students' understanding of theoretical knowledge. The theoretical test is mainly a written test, which measures students' mastery of theoretical knowledge points through their daily homework situation and mid-term and final exam scores. The second is ability expansion, which assesses students' practical abilities, with a focus on drawing and reading equipment drawings as the main means. By independently drawing and reading equipment drawings, students can help them master theoretical knowledge, strengthen hands-on practice, and implement basic skills for practice.

Summary after class:

3.6 Summary

The post class summary is divided into two parts: evaluation and reflection. The evaluation is conducted through three methods: student self-evaluation, mutual evaluation, and teacher evaluation, combining four evaluation points: pre test scores (theory+practice), participatory learning (theory+practice), post test scores (theory), and ability development (practice) to comprehensively evaluate the learning effectiveness of students in terms of knowledge,

ability, and literacy, check Table 3. Reflection is the process by which teachers review the teaching process and combine feedback from students to reflect on whether the teaching philosophy is implemented, whether the teaching content is appropriate, whether the teaching methods are appropriate, and whether the teaching effect has met expectations. It guides teachers to re understand and reflect on teaching practice, and summarizes experiences and lessons learned to further improve teaching level.

Table 3 Learning content and objectives

Name:	Class :	Team:	Score	Score
Project		Scoring Elements		
Pre-test		Completion status of preview checklist	10	
		Preview homework grades	10	
Classroom participation		Class discussion	15	
		Presentation	15	
Standard for cartographers		Line specifications and applications	2	
		Font	2	
		Is the content in the title bar filled in correctly	2	
		Are the dimensions correct	2	
Dimension		Is the drawing of dimension lines, extension lines, and arrows correct	2	
Post-test		View layout: Is the allocation of view positions reasonable	5	
	Drawing	View selection: sufficient to express part structure	3	
Is the drawing of the view accurate		15		
Is the drafting process reasonable		5		
Pattern effect		Are the drawings clean	2	
Capacity development		Is the ability development project completed	10	
Total			100	

4 Conclusion

This article focuses on the problems existing in the teaching of the "Mechanical Drawing" course for sergeants, and combines the characteristics of the BOPPPS teaching mode to design the BOPPPS teaching mode from four aspects: teaching content, teaching methods, teaching tools, and evaluation methods. The entire design can be summarized as "four new, four qualities, and one sense". Based on the principle of "practicality, adequacy, and effectiveness", the content system should be restructured for new equipment, highlighting the practicality of educating people for combat purposes; Fully introduce the BOPPPS teaching model, extend teaching work to pre class and post class, and emphasize the process of "learning as the main body and teaching as the leading role"; Fully utilize the existing online teaching platforms, virtual software, and other information technology tools in the school to build a student-centered self-learning platform and improve the interactivity of the teaching process; Student self-evaluation, mutual evaluation, teacher evaluation, and reflection are multiple ways to comprehensively measure learning effectiveness and teaching quality, reflecting the comprehensiveness of teaching evaluation; Ultimately, achieving

a sense of acquisition of students' knowledge, abilities, and value.

References

1. M. M. Raikar, P. Desai, M. Vijayalakshmi and P. Narayankar, "Upsurge of IOT (Internet of Things) in engineering education: A case study, "2018 International Conference on Advances in Computing, Communications and Informatics (ICACCI), Bangalore, 2018, pp. 191-197, doi:10.1109/ICACCI.2018.85545-46.
2. Janice B J. Instructional skills workshop handbook for participants [EB /OL]. 2016-10-20] .http: / /www.brocku.ca / print / 3354.
3. King C, Morrison D, Wils C. Instructional skills workshop manual [M]. Vancouver: Vancouver University of British Columbia Press, 2006:22- 37.
4. QingLi, design and practice of data structure teaching class based BOPPPS mode [J]. Computer Society, 2016, 503-506.
5. Yin Hongtao, Research on the Quality of College English Teaching Design Based on BOPPPS Model. Advances in Social Science, Education and Humanities Research (ASSEHR), volume 2 48 International

Conference on. Social Science and Education Reform (ICSSER 2018).

6. Gong,LJ(Gong,Lijing)1;Ma,C(Ma,Cheng)1;Zhang,J(Zhang,Jian)1;Lv,JK(Lv,JinKai)1;Wang,Y(Wang,Yu)1.Advice on Effective Teaching Design based on BOPPPS Model[J].PROCEEDINGS OF THE 7TH INTERNATIONAL CONFERENCE ON EDUCATION,MANAGEMENT, INFORMATION AND COMPUTER SCIENCE(ICEM 2017).2017.
7. Tim Goral, "Make Way for SPOC: Small, Private Online Courses May Provide What MOOCs Can't, "University Business, Vol.16.No.7.
8. Rolf Hoffmann, "MOOCs-Best Practices and Worst Challenges, "ACA Seminar Brussels, 2013,10.
9. Brandt,D,A. Constructivism: Teaching for understanding of the Internet [J],Communications of the ACM,1997,40(10):112-117.
10. Nasution Awal Kurnia Putra,Surbkti Andika Hariyanto,Zakaria Rahmanita,Wahyuningsih Sungkawati Kardi,Daulay Leni Agustina.Face to Face Learning vs Blended Learning vs Online Learning(Student Perception of Learning)[J].Journal of Physics:Conference Series,2021,1783(1).
11. Lapitan Lorico DS.,Tiango Cristina E.,Sumalinog Divine Angela G.,Sabarillo Noel S.,Diaz Joey Mark.An Effective Blended Online Teaching and Learning Strategy during the COVID-19 Pandemic[J].Education for Chemical Engineers,2021(prepublish).
12. Uskov V L,Howlett R J,Jain L C.Smart Education and e-Learning2017[J].Smart Innovation,2018,75.
13. Gou R,Jiang C,Liu W.A Research and Exploration of Blending Teaching[J].International Journal of Learning and Teaching,2019,5(1):83-87.