Application of Flipped Classroom Teaching Mode Based on Ant Colony Algorithm in Higher Vocational Java Course

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Abstract. Under the Internet plus era, information technology has become an effective choice for classroom teaching innovation. Among them, flipped classroom, as a new teaching means and teaching mode, can not only change the traditional teaching links, but also make teachers change from their previous role to the guide of students' learning, and effectively highlight the dominant position of students. The application of flipped classroom teaching mode is also conducive to stimulate students' learning enthusiasm, effectively let students participate in teaching interaction, and create a good personalized learning environment for students. Therefore, based on the application of flipped classroom teaching mode under ant colony algorithm in Higher Vocational Java curriculum, this paper solves the problems existing in previous Java curriculum teaching, introduces a variety of teaching means and teaching resources through flipped classroom, highlights students' personalized learning needs in Java curriculum teaching, gives full play to the advantages of traditional classroom, and further improves students' enthusiasm for curriculum learning, Realize the innovative teaching of java course with students as the main body.

Keywords: Flipping classroom · Ant colony Java courses · Teaching strategy

1 Introduction

Today's society is an information age, with the rapid development of science and technology. The competition of national comprehensive national strength is mainly reflected in the competition of talent quality. Education is the key to cultivating talents. Receiving continuing education and lifelong education will be necessary for everyone in future life. Education is developing in the direction of popularization, lifelong and networking, which requires a wide coverage of education, multi-mode and all-round service [1]. The goal of future education development should ensure that anyone, anytime and anywhere can receive a good education. The imbalance of regional economic development in China leads to the imbalance of knowledge development. Excellent teachers are concentrated in cities, rural teachers and teaching resources are poor, and the gap between urban and rural education levels is gradually increasing. Therefore, under such

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a background, it is urgent to adopt a new technical means to make full use of various resources, strengthen the popularization of education, narrow the gap between urban and rural areas, and build a lifelong learning environment [2]. Network teaching provides a solution to the above contradiction. Although online education resources are rich, they are intermingled, disorderly, inconvenient to use and difficult to manage and maintain. So, how to build excellent teaching resources, ensure their quality, make them give full play to the advantages of network sharing, and carry out the exploration and Research on the standardization of teaching resources construction of modern network learning is very necessary [3].

For the learning of java course, the capacity of the course is large, and the students' knowledge level varies greatly. Relying on several face-to-face counseling courses alone, it is impossible for students to understand and learn thoroughly. The time for teaching discussion by using face-to-face counseling courses is even limited. Our students are all over the north and south of the motherland, but under this heuristic teaching mode, this discussion and communication is essential. The best choice to solve this demand is to use network teaching. Figure 1 below shows the Java structure function diagram.

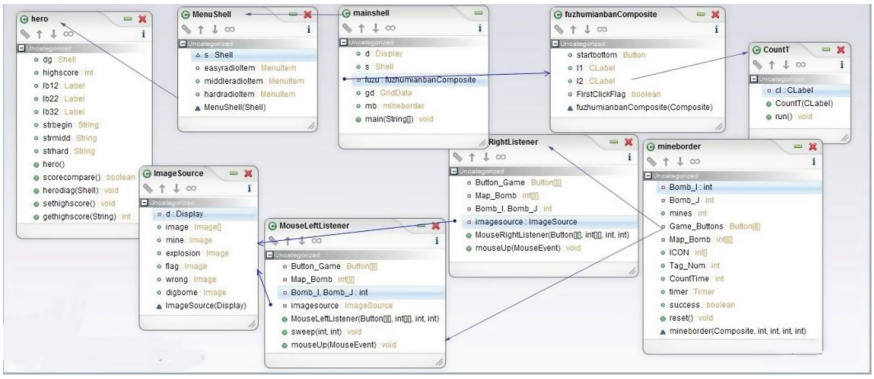

Fig. 1. Java structure function diagram

In short, it is our primary task to network the classroom teaching content and provide online communication function [4]. Moreover, teachers can independently manage and control the networked teaching and communication platform, and there is no need for system administrators. And the teaching system should be adjusted according to the classroom teaching situation at any time. At the same time, teachers play the role of system administrator and can fully control the whole system platform. Java course teaching based on flipped classroom teaching mode aims to ban the traditional teacher centered teaching mode, make rational use of learning ways inside and outside class, open up a new learning platform for students with the help of wechat and the Internet, and carry out java course teaching flexibly [5]. The application of flipped classroom teaching mode in java course teaching can use the existing network platform to design new teaching links, further improve students' practical ability and innovation ability, stimulate students' learning initiative, solve students' learning problems in classroom teaching, and give full play to the advantages of traditional classroom through students'

learning and interaction before and after class, Exercise students' ability of communication and independent thinking [6]. Taking the tank war of java course teaching as an example, this paper discusses how to apply the flipping teaching mode to java course teaching, explore how to give full play to the advantages of flipping classroom teaching, and solve the problems existing in Java programming. According to the characteristics of java course, the application of flipped classroom teaching mode based on Ant Colony Algorithm in Higher Vocational java course.

2 Ant Colony Algorithm

With the continuous expansion of the field of intelligent computing, swarm intelligence algorithms for solving optimization problems are pouring in, among which the most common are ant colony algorithm (ACO), particle swarm optimization algorithm (PSO), firefly algorithm (FA) and bat algorithm (BA). This kind of algorithm provides a better method to solve NP hard problem. Its design principle comes from the imitation of biological behavior in nature. Ant colony algorithm, as the earliest proposed bionic algorithm, has been concerned by experts and scholars. In recent years, many scholars have conducted in-depth research on ant colony algorithm, applied it to various fields, and successfully solved many NP hard problems [7]. Based on the improvement of ant colony algorithm, this paper uses it to optimize the flipped classroom teaching mode in order to achieve the expected effect.

2.1 Basic Ant Colony Algorithm

Ant colony optimization (ACO) was first proposed by Italian scholar Marco Dorigo in 1991. It is a bionic algorithm inspired by ant foraging process. The researchers found that ants will release a hormone called pheromone on the path, which will gradually volatilize over time. Later ants can feel the existence of pheromone, find a path with high pheromone concentration, move forward and release a certain amount of pheromone at the same time. There will be more and more pheromones on the selected path, and the ants will gather on the same path, The positive feedback mechanism is formed. The ant selects the next city that is not visited according to the probability formula (1) and adds it to the tabu list.

$$p_{ij}^{k}(t) = \begin{cases} \dfrac{\tau_{ij}^{\alpha}(t)\eta_{ij}^{\beta}}{\sum_{j \in N_j^k} \tau_{ij}^{\alpha}(t)\eta_{ij}^{\beta}} \\ 0 \end{cases} \tag{1}$$

The basic ant colony algorithm flow is shown in Fig. 2.

Although ant colony algorithm has been produced for more than 20 years, it still lacks the necessary theoretical framework, and most of them just rely on empirical experiments. Most of the understanding of the working mechanism of ant colony algorithm starts from quasi ecological scheduling, and the algorithm lacks mathematical model and analysis description. The following describes the theoretical research progress of ant colony algorithm in recent years from three aspects:

(1) Research on convergence of algorithm
Many domestic scholars have also made in-depth research on the convergence of ant colony algorithm. Zhang Feijun and others proposed an encounter ant algorithm. A complete travel path is completed by two encounter ants, which improves the running speed of the algorithm and expands the search space of understanding; Yang Yanqing et al. fixed the maximum and minimum of pheromone, which effectively avoided the difference of pheromone on the path; Mhuang et al. Introduced the 3-opt switching strategy for the vehicle routing problem, and the initial planning path has been further optimized; Zhang Qi et al. Adjusted and improved the local heuristic function of the algorithm for the path planning problem of mobile robot, introduced cross operation and adjusted the parameter values at the same time; Jiang Kunlin and others proposed a new city selection strategy based on roulette, and combined with the method of ending the task in advance to reduce the running time of the algorithm; Zhu Haodong improved the algorithm by selecting the next node transfer rule, which effectively improved the probability of selecting the optimal path; Hu Wei combines ant colony algorithm with tabu search algorithm to improve the local search ability of ant colony algorithm [8].

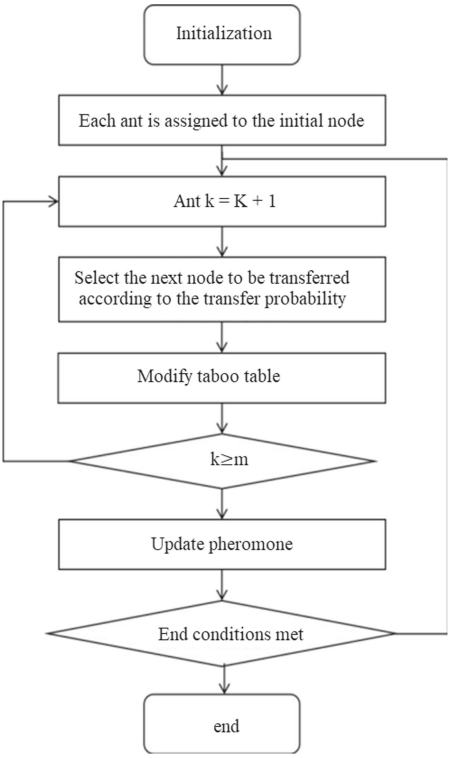

Fig. 2. Basic ant colony algorithm process

(2) Research on the relationship between algorithm and other optimization algorithms
The research of ant colony algorithm is not limited to the algorithm itself. With the rise of intelligent optimization algorithm, the combination of ant colony algorithm and other intelligent optimization algorithms to form a hybrid intelligent algorithm has become a research hotspot. For example, Gao Wei and others used ant colony algorithm in geotechnical engineering for the first time. In order to improve the solution accuracy, they combined immune algorithm with continuous ant colony algorithm to form immune continuous ant colony algorithm, which successfully overcome the shortcomings of analysis method; Zhang Yongheng et al. Proposed the solution of boundary layer differential equation based on particle swarm optimization algorithm and ant colony algorithm, and analyzed and compared with other optimization algorithms, which shows that it is feasible to combine the two algorithms to solve the differential equation; Zlochin et al. Applied a model-based search algorithm framework to ant colony optimization algorithm, explored the methods of two algorithms to update parameter model, and used these two methods to guide ant colony algorithm to update pheromone.

2.2 Ant Colony Optimization Algorithm

The basic ant colony algorithm has some defects in the selection of optimal path and convergence speed. In the following, a new improved method is proposed for the initial pheromone distribution and pheromone volatilization factor. Firstly, the initial pheromone is reset according to the global path, so that the algorithm does not search the pheromone path blindly in the early stage, so as to speed up the convergence speed of the algorithm; Then, the pheromone is volatilized twice to improve the accuracy and later convergence ability of the algorithm.

(1) Improvement of initial pheromone
In the basic ant colony algorithm, let the number of ants be m and the number of cities be n, The amount of pheromone at the beginning is m/C″, where C is the length of the path constructed by the nearest neighbor method. In the initial stage of the algorithm, when the pheromone concentration is small, the ability of ants to detect pheromones is relatively weak. It takes a period of exploration to find a relatively optimal path. In this process, it takes a lot of time and reduces the convergence speed of the algorithm. In order to improve this situation, consider The path distance resets the distribution of the initial pheromone to make the algorithm search in a direction to overcome the blindness of the search. The initial pheromone is improved as follows:

$$\tau_{ij}(0) = \begin{cases} \min(d_{ij})/d_{ij}, i \neq j \\ 0, otherwise \end{cases} \tag{2}$$

(2) Improvement of pheromone volatilization factor
In the basic ant colony algorithm, pheromone updating is only to update the pheromone on the better path. However, the sub path of the optimal path is not always the shortest path, and there may be a longer path, which will lead to the ant

choosing the wrong path from the beginning and missing the optimal path. In order to solve this defect, the path contribution is introduced. In the optimal path, the sub path whose contribution to the overall path is greater than the path contribution threshold is found.

In the basic ant colony algorithm, the pheromone volatilization factor is a certain value. Because the poor solution obtained in each iteration is not helpful to the final result, if the pheromone volatilization is relatively slow on the poor path, the more pheromones left will affect the speed of the algorithm to find the optimal solution. Therefore, it is necessary to appropriately slow down the pheromone volatilization of the better path, Accelerate the volatilization speed of pheromone on the poor path, so consider secondary volatilization for the pheromone after secondary updating of pheromone, so that the secondary volatilization coefficient is inversely proportional to the square of iteration times.

3 Basic Concepts of Flipped Classroom Teaching Mode

3.1 The Concept of Flipped Classroom Teaching Mode

Flipped classroom is translated from "f1ipped classroom". Domestic scholars have given different definitions of flipped classroom teaching mode from different angles. Zhang Yueguo and Zhang Yujiang (2012) of Chongqing Jukui middle school, combined with their own flipped classroom teaching experience, believe that flipped classroom is a means to increase the interaction and personalized learning time between students and teachers; It is an environment in which students are responsible for their own learning; It is a classroom in which all students study actively; It is to enable all students to get personalized education; Flipped classroom is not synonymous with online video. In addition to teaching video, there should also be face-to-face interaction time; Instead of replacing teachers with videos [9].

Zhang Jinlei, Wang Ying, Zhang Baohui and others (2012) analyzed the teaching structure and believed that the traditional classroom generally includes two stages: classroom knowledge transfer and after-school knowledge internalization, while the flipped classroom is "pre class knowledge transfer and classroom knowledge internalization", emphasizing the reversal of the teaching structure. In addition, Zhong Xiaoliu, song Shuqiang, Jiao Lizhen and others (2013) started with learning resources and information technology application, and believed that flipped classroom teaching is that in the information environment, course teachers provide learning resources in the form of teaching video, and students complete the viewing and learning of teaching video and other learning resources before class, It is a new teaching mode that teachers and students complete homework answer and interactive communication in class [10].

Whether emphasizing the reversal of teaching structure or focusing on the application of learning resources and information technology, we should reverse the core of the classroom, reverse the teaching structure, and promote the internalization of knowledge and the achievement of teaching objectives. Based on the above scholars' understanding of flipped classroom, the author believes that flipped classroom model is supported by information technology. Teachers provide teaching micro video, audio, animation, courseware, exercises and other learning resources. Students use these resources for

independent learning before class to complete the teaching of knowledge; Classroom teachers carry out learning activities such as doubt solving, cooperative exploration and interactive communication according to the problems existing in students' learning process and some difficult contents, so as to complete the internalization of knowledge and achieve teaching objectives.

3.2 Theoretical Basis of Flipped Classroom Teaching Model

(1) Constructivist learning theory
Constructivism theory rose in the 1990s. Its main representatives include J. Piaget, Bruner and vogotsky. Constructivist learning theory holds that knowledge is not imparted by teachers, but obtained by learners through meaning construction with the help of others (including teachers and learning partners) in a given situation, that is, social and cultural background. "Context", "construction", "caring", "competence" and "community" constitute the basic elements of constructivist learning theory. Meaning construction is the ultimate goal of the whole learning process. Its essential content is student-centered, emphasizing students' active exploration, discovery and construction of knowledge.

Flipped classroom teaching pays attention to the active construction of knowledge, which is in line with the learning concept of constructivism. In flipped classroom teaching, teachers not only provide learners with rich learning resources and individualized guidance, but also act as organizers, guides and learning promoters. At the same time, under the guidance of teachers, students establish a learning community, complete the internalization of knowledge through group cooperative learning and teacher-student interaction, and finally achieve the learning goal. In the whole teaching process, the acquisition of knowledge is the result of learners' active construction. At the same time, flipped classroom emphasizes that the classroom environment should be conducive to students' independent construction of knowledge and cooperative learning. Rich high-quality resources can provide learners with a support for the construction of knowledge meaning.

(2) Master learning theory
Mastering learning theory is a teaching idea put forward by American educational psychologist bloom. Bloom believes that 90% of All the students can master the teaching materials and get a pass grade or above. Any teacher can help all students learn well, help "stupid" students learn like smart students, and help "slow" students learn like "fast" students; Help "mentally retarded" students learn like talented students; The key is that teachers teach students in accordance with their aptitude and give different types of students enough learning time. "Its core content mainly includes two points:

① Teaching for mastery; Bloom believes that the vast majority of students in the class can reach the mastery level, and believes that all students can develop; In mastering learning, teachers must establish a correct view of students. The difference of students' learning ability is man-made, accidental and formed by the day after tomorrow. Flipping the classroom reverses the teaching structure.

Teachers have more time to care for students and provide individualized guidance to students with different learning foundations, so that the vast majority of students can master the teaching content.

② Learning for mastery; Bloom believes that every student is seeking recognition of his own value and needs to see himself as competent for learning. However, students often fail and will cause students to doubt their learning ability. Therefore, they should be guided to seek trust and competence in the experience of classroom learning activities. Bloom stressed that if the classroom can not give students more opportunities for success, they refuse to learn not only in class but also outside class. Flipped classroom teaching encourages teachers to use incentive evaluation mechanism, timely feedback, learning resource support and other strategies to stimulate students' self-confidence, help students obtain more successful experience and enjoy the joy of learning; At the same time, it is also necessary to learn for students to master and normalize the diagnostic examination before class. The effect of autonomous learning before class is related to the internalization of classroom knowledge, and then affects the overall teaching effect.

(3) Blended learning theory

Blended learning is a concept put forward by the field of educational technology. Professor he Kekang believes that blended learning basically includes three meanings: (1) the integration of traditional learning and online learning; (2) The combination of various media and tools in e-learning learning environment; (3) Combination of various teaching methods and learning techniques; In other words, in the design and implementation of the teaching system, we should not only give play to the leading role of teachers in guiding, enlightening and monitoring the teaching process, but also fully reflect the initiative, enthusiasm and creativity of students as the main body of the learning process. We should not only pay attention to the cultivation of innovative spirit and ability, but also pay attention to the teaching and mastery of systematic scientific knowledge, We should also pay attention to the design of learning environment and autonomous learning strategies, and try to use information technology to create an ideal teaching environment for learners, so as to realize the requirements of autonomous exploration, multiple interaction, cooperative learning, resource sharing and so on.

Therefore, in order to give better play to the dual role of "teacher leading and student main body", flipped teaching practice should pay attention to the flexibility of teaching methods and multimedia technology in the mixed learning environment, and adopt the methods of independent inquiry and cooperative learning to guide learners to participate in learning activities and actively construct knowledge; At the same time, it also emphasizes that learners need to communicate with each other, share experience, promote learners' active learning, innovate boldly, and cultivate students' innovative spirit and ability.

4 Application of Flipped Classroom Teaching Mode Based on Ant Colony Algorithm in Higher Vocational Java Course

The application of flipped classroom teaching mode in java course teaching should not only turn over the traditional learning process and allow students to complete independent learning of knowledge points and concepts outside class, but also redesign the course teaching content, reasonably arrange teaching links according to students' learning needs, and introduce classroom discussion, group communication, teacher Q & A and other methods into course teaching, Achieve better teaching effect, realize the new teaching structure of internalizing knowledge in the classroom and learning knowledge outside the classroom, so as to improve the effectiveness of students' learning.

4.1 Provide Students with Pre Class Learning Resource Support

Taking the tank war project as an example, when sharing learning resources before class, teachers must first develop corresponding video resources for students, consolidate and analyze knowledge points through the explanation of knowledge points and cases, so that students can complete independent learning before class. In the flipped classroom teaching mode, teachers should record and screen videos and learning resources before class, so as to sort out the learning resources needed for students' Preview. At present, students' favorite course learning resources are videos, reference learning and teaching courseware. They like to obtain resources, read and preview on the platform of wechat and QQ. Therefore, teachers should screen and re record corresponding micro videos and online learning videos on the Internet before teaching. They will share these resources to QQ learning group or WeChat official account homepage, which is convenient for students to subscribe and download, and confirm the learning trend of students through subscription and downloading.

4.2 Creating a Personalized Learning Environment for Students in Classroom Teaching

In classroom teaching, teachers should first analyze the teaching environment, take theory and practice as the basic teaching route, equip students with corresponding multimedia equipment and computers, provide LAN and Internet services, and distribute experimental contents and theoretical materials to students, as shown in Fig. 3. Because the tank project training involves many pilot courses, such as programming, advanced programming and database application. Before teaching, teachers should also analyze the students' previous learning subjects, let the students with good basic ability serve as the team leader, then share the micro video of tank war programming to the learning group, and share the corresponding enterprise software projects with the students, so as to start the design of experimental projects and theoretical knowledge exploration. The task driven teaching method carries out classroom practice teaching, completes knowledge teaching with the flipped classroom teaching mode, selects program driven tasks with moderate difficulty in the stage of comprehensive application and practical exercise, and studies in groups. Guide students to design tank war products and integrate app to further improve students' information screening and programming ability.

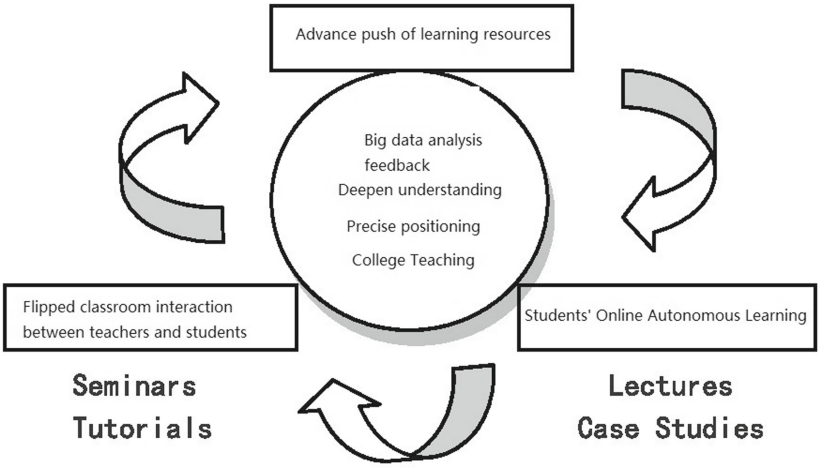

Fig. 3. Flipped classroom teaching mode

4.3 The Three Links of Theory, Practice and Experiment are Coordinated and Unified

Including the control program of tank war, which can integrate theory and practice. Teachers should guide students to complete the review of relevant pilot courses such as single chip microcomputer, analog electronics, digital electronics and communication before class, and some auxiliary teaching materials, through the project description, students' experimental guidance and program code, etc., Let students master some basic java knowledge before the design of tank war project, promote students to learn with problems after class, design a series of questions based on the characteristics of tank war project, guide students to complete independent learning and preview after class, and introduce the thinking results and sleepiness into the classroom, and study in groups through joint discussion in class, Develop students' learning career, complete problem analysis and discussion, and promote students to participate in teaching. In experimental teaching, teachers can also take some hardware design of tank war as practical training tasks, promote students to show their previous hardware works to students while learning programming design, and promote learning interaction through experimental internalization of knowledge, so as to strengthen students' practical ability.

Java's security checking mechanism stifles errors in many programs. In addition, the Java language also has many features to ensure the stability and robustness of the program (strong typing mechanism, exception handling, automatic garbage collection, etc.), which effectively reduces errors and makes the Java application more robust. Java is usually used in the network environment. Therefore, Java provides a security mechanism to prevent malicious code attacks, which can improve the security of the system. Java platform independence is realized by Java virtual machine. Java software can run normally in any computer environment without the constraints of computer hardware and operating system. There is no built-in multithreading mechanism in C++ language,

so the multithreading function of the operating system must be called for multithreading programming, while Java language provides multithreading support. Multithreading mechanism enables applications to execute multiple tasks in parallel at the same time. This mechanism enables programs to have better interaction and real-time.

5 Conclusion

Flipped classroom teaching mode can make rational use of existing teaching resources, change traditional teaching links, highlight students' personalized learning needs in teaching, build the classroom into a new platform for understanding, practice and exercise, carry out professional teaching around classroom teaching and pre class students' learning, and improve the efficiency of classroom teaching. Compared with the traditional teacher centered classroom teaching mode, flipped classroom not only subverts the traditional teaching links, but also changes the role of teachers and students. Students in flipped classroom teaching are the main body of learning and the leader of the classroom. Teachers are the organizers and guides of the classroom, and teachers and students are in an equal interactive position. Teachers teach according to students' problems and development, providing students with more independent thinking and knowledge strengthening practice time, so as to effectively improve the effect of classroom teaching. Based on the problems existing in the current java course teaching, in order to guide students to study more rationally, it is necessary to realize the common improvement of knowledge, ability and literacy. The application of flipped classroom in java course teaching must highlight students' learning needs and strengthen students' practical training, so as to strengthen the learning effect and ensure that students can realize the internalization of knowledge and Consciously carry out extracurricular learning.

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References

1. Shuang, L.I., et al.: Application of flipped classroom teaching mode taking osmotic pressure of dilute solutions as example. China Health Industry (2016)
2. Zhang, X.H., et al.: Application of flipped classroom teaching mode in college english teaching. Heilongjiang Researches on Higher Education (2016)
3. Wu, Y.: Application of flipped classroom teaching mode in the teaching of electronic information specialty in colleges and universities. Science and Technology & Innovation (2015)
4. Yang, Y.U., Liang, H.Q.: Research on the construction and application of flipped classroom teaching mode based on mobile learning platform. Education Modernization (2018)
5. Application of Flipped Classroom Teaching Mode to One of the Lectures of Automation for Students of the Training Program of Outstanding Talents for. (2017)
6. Zhang, F.: Research on the Application of Flipped Classroom Teaching Mode Based on Network in College Physical Education. J. Books Proceedings, 0
7. Sun, Q.X.: The Application of Flipped Classroom Mode in College English Teaching Based on MOOCs **10**(6), 4 (2020)

8. Zheng, L.: Application Research on “Flipped Classroom” Teaching Mode in Colleges and Universities (2016)
9. Li, C.: A study on the application of flipped classroom teaching mode in college english teaching. In: Proceedings of the 4th International Conference on Humanities Science, Management and Education Technology (HSMET 2019) (2019)
10. Feng, Y., et al.: Research on the Application of Flipped Classroom Teaching Mode in “Fruit and Vegetable Processing”. Education Teaching Forum (2019)