

In depth analysis of typical models and cases of flipped classroom

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Abstract. Nowadays, computer technology is changing with each passing day and developing rapidly. The deep integration of education and computer has become a major trend. In this case, flipped classroom came into being, bringing new ideas for educational reform. The article tries to use the literature research method, on the basis of reading a large number of high-quality documents, sort out and outline the evolution and development history of flipped classroom, summarize and refine the core connotation of flipped classroom and the innovation of successful development, and summarize and sort out the multifaceted significance and multiple challenges of flipped classroom mode. It also focuses on the in-depth analysis and comparison of the typical theoretical models of flipped classroom carefully designed by domestic and foreign scholars and the classic cases of successful practice in schools, and summarizes the similarities and differences between the typical models and successful cases of flipped Classroom: Although the typical models have differences in complexity and specific process, they all pay attention to the integration of information technology and the cultivation of students' comprehensive quality; The emphases and links of successful cases are different, but they are the results of the efforts of schools, teachers, students and so on. This paper aims to provide reference and guidance for the deepening research and innovative application of flipped classroom at home and abroad.

Keywords: flipped classroom; typical model; successful cases.

1. Introduction

With the vigorous development of computer technology, computer technology began to slowly penetrate into all aspects of people's real life, changing people's lifestyle from a multidimensional perspective. In this case, the deep integration of technology and education has become a trend. The state has successively issued a number of reform policies and measures, such as the ten year development plan for ICT in Education (2011-2020) and the 13th five year plan for ICT in education.[1] It points out the direction for China to speed up the reform of educational informatization. In recent years, with the dual support of policy and technology, China has launched a series of research, development and practical application of flipped classroom. However, at present, the research and application of flipped classroom in China is still in the preliminary stage, and there is a lack of in-depth analysis and horizontal comparison of typical models and successful cases of flipped classroom. Based on extensive reading of high-quality education literature at home and abroad, this paper attempts to sort out and outline the development and evolution of flipped classroom teaching mode, summarize and reveal the basic connotation, characteristics and innovations of flipped classroom, summarize the value and challenges of flipped classroom, and analyze and compare the typical models and successful cases of flipped classroom at home and abroad, It aims to provide guidance for China's teaching reform.

2. The origin, connotation and innovation of flipped classroom

2.1 The origin and development of flipped classroom

The emergence and evolution of flipped classroom has gone through many stages. The educational concept of flipped curriculum was first born in the early 19th century. At that time, general sylvanus Thayer, a teacher at West Point, distributed preview materials to each student before starting teaching, so that students could prepare for the new curriculum first; In class, he organized students to think

critically and discuss in groups. [2]In the early 1990s, Eric Mazur, a professor in the Department of physics at Harvard, initiated the peer teaching method. He divided learning into two processes: knowledge transmission and absorption and internalization. [3]In the autumn of 1996, maureenj, a professor at Miami college in the United StatesLage and glennjPlatt clearly put forward the preliminary idea of "flipped classroom". [4]In 2004, Salman Khan began to make audio and video teaching materials and uploaded them on YouTube video sharing website. His teaching guidance materials have been wildly sought after by many people. Salman Khan also often received feedback and information from users in the United States and even around the world. [5]In 2007, two teachers, Jonathan Bergmann and Aaron SAMs, carried out teaching reform experiments in the "Woodland Park" middle school in the United States. They used their time in class to answer students' questions and guide students to practice in groups. After class, they asked students to learn the course video. [6]

2.2 Connotation and essence of flipped classroom

After in-depth research, many scholars have put forward the understanding of the connotation of flipped classroom. Although the emphases of scholars are slightly different, they are highly unified in essence. Zhong Xiaoliu believes that flipped classroom is a new teaching method in which teachers provide educational resources in the form of teaching videos in an information environment, students complete the viewing and learning of teaching videos and other learning resources before class, and teachers and students complete Q & A, cooperative discussion, interactive communication and other behaviors in the classroom. [7]Liu Rong proposed that flipped classroom is a classroom form in which teachers first make teaching videos, students watch video explanations outside class, and then realize face-to-face sharing and interaction with teachers and students in class, so as to achieve good classroom teaching results. [8]

Based on the views of many famous scholars, it can be roughly concluded that the flipped classroom is basically supported by the application of information technology, and students independently complete the learning of basic knowledge after class, while professional teachers are responsible for organizing and guiding students to complete the internalization of knowledge in the classroom, providing students with a space for independent learning and independent exploration. From the essence of classroom teaching, flipped classroom is a technology promoting teaching. It uses network technology to enhance the interaction and communication between teachers and students and between students, creating a good learning environment in which every student is the master of learning activities.

2.3 Innovation of flipped classroom

Compared with the traditional classroom, flipped classroom can be described as a major breakthrough in the teaching mode, and has made innovations in many aspects. The author combs the relevant literature at home and abroad, and gives an analysis and comparison table of the two teaching modes from the perspective of multiple Majors:

It can be seen from the above table that compared with the traditional classroom, the flipped classroom has made great breakthroughs from many angles, and is an innovative education model that keeps pace with the times. From its essence, flipped classroom is different from traditional classroom in two main points:

Flipping teaching embodies the deeper combination of computer technology and teaching reform. Compared with traditional classroom, flipped classroom can better reflect the characteristics of technology empowerment. In the flipped classroom, teachers make micro classes with reasonable design and detailed content to guide students' autonomous learning. Students can arrange their own learning place, learning time and learning progress. Micro class teaching not only meets the personalized needs of students, but also provides clear guidance for students' autonomous learning, which is conducive to improving students' learning efficiency.

Table 1 multi dimensional comparison between traditional classroom and flipped classroom

| | Traditional classroom | Flipped classroom |
|---|---|---|
| Teaching methods | Mainly teachers' professors. | Give priority to students' independent inquiry. |
| Content of courses | "Fragmentation learning" of knowledge dismemberment | "Holistic learning" to solve problems |
| Teacher's role | Knowledge giver and classroom manager | Instructor, facilitator |
| Student role | Passive learner | Self-paced learners |
| Teaching management | School management | Family education |
| Classroom time allocation | It is mainly used for teachers' knowledge teaching. | Used for independent inquiry of main students. |
| Knowledge transmission carrier | Teachers, books | Teachers, books, electronic products |
| Knowledge dissemination mode | Give priority to teachers' explanation. | Mainly teaching videos and online teaching resources. |
| Technology application | Content display | Self-study, exchange and reflection, and collaborative discussion |
| Evaluation method | Pen test | Formative evaluation and summative evaluation |
| Communication between teachers and parents | Poor pertinence and actual effect. | Good pertinence and practical effect. |

Flipped teaching focuses on cultivating students' comprehensive quality, which helps to build a stable, harmonious and equal relationship between teachers and students. Flipped classroom embodies the characteristics of student-centered from in class to out of class. After class, students watch wechat videos, learn purposefully and organized under the guidance of videos, and record their existing problems and puzzles. Compared with the traditional preview, the direction of micro class learning is more clear and the learning efficiency is more efficient. In class, students think independently, communicate in groups, show their achievements, and communicate with teachers one-on-one. Teacher student interaction and student student student interaction have been

strengthened, and students' cooperation ability and innovation ability have been better improved. In addition, in flipped classroom teaching, students carry out personalized independent exploration and interactive research, while teachers carry out one-on-one puzzlement, students become the main body of learning and exploration, and teachers become the participants and organizers of teaching. In this way, the relationship between teachers and students tends to be fair and harmonious, reflecting the people-oriented ideology.

3. The significance of flipping classroom

3.1 The significance of flipped classroom to teachers

Flipped teaching creates an excellent platform for teachers to improve their ability, which can quickly improve their overall teaching ability. [9]As a new teaching method, flipped teaching puts forward higher requirements for teachers. First of all, teachers should break through traditional ideas, be brave to accept new teaching models, and establish the idea of constantly improving themselves. At the same time, teachers should strengthen their understanding of knowledge and skills, learn advanced information technology, and be able to design and produce high-quality micro classes and online exercises. In addition, teachers should constantly improve their classroom organization ability in practice, be able to lead students to think independently, discuss in groups and display results in an orderly manner, timely answer students' puzzles, and be good organizers and guides of students' learning.

Flipped teaching can make teachers understand students more deeply and help to establish a more equal relationship between teachers and students. [10]Flipped classroom places the learning of basic knowledge outside the classroom, providing sufficient time and opportunities for students and teachers to communicate in class. Teachers can observe each student's learning situation in the classroom, have a more comprehensive and profound understanding of students, and answer students' questions in time. At the same time, in flipped classroom teaching, students are explorers with independent ability, while teachers become guides and promoters of students' learning, no longer the master of the classroom, and the relationship between teachers and students is more harmonious and equal.

3.2 The significance of flipped classroom to students

Flipped teaching is suitable for students' cognitive development and can realize students' personalized teaching. [11]Flipped teaching adopts the classroom management method of "teaching after class + internalization in class". Students carry out extensive and comprehensive independent learning outside the classroom, and realize the interactive communication of knowledge and experience in the classroom, so as to deepen the understanding of knowledge. This new classroom management form that focuses on learning before speaking and guides children to explore independently is more suitable for students' cognitive development and can strengthen students' understanding of knowledge. At the same time, learners can flexibly adjust the specific time of watching teaching videos, learners with strong ability can choose courses with higher difficulty, and learners with weak ability can learn teaching videos with their own problems for many times. After autonomous learning, students can put forward their own problems and ideas and communicate with teachers and classmates in a timely manner.

Flipped classroom is helpful to cultivate students' ability of communication and teamwork. [12]In flipped teaching, teachers can not only directly carry out face-to-face interactive communication with each student on the scene, but also gather students with the same difficulties or similar doubts and give a small interactive teaching lecture or on-site demonstration. At the same time, students carry out group interactive discussions, jointly explore problems and display results, and constantly promote each other. It can be seen that the flipped interactive classroom model not only increases the communication and interaction between teachers and students and students, but also puts forward

higher requirements for students' cooperation ability and brings opportunities for students to improve their comprehensive ability.

3.3 The significance of flipped classroom to education and teaching

Flipped teaching shows the advantages of mixed teaching. [13]Flipped classroom creatively integrates traditional classroom and online video classroom. It is a hybrid teaching method, which combines the advantages of offline traditional classroom and online classroom learning. Students can not only independently adjust the time, place, times and progress of watching videos to achieve personalized learning, but also fully communicate with teachers and classmates to seek answers and broaden their horizons. Flipped classroom not only provides students with rich learning resources, but also provides a good platform for students and teachers to fully communicate, enhances the interaction between students and teachers, and mobilizes the classroom atmosphere.

Flipping teaching brings ideas to the work of "reducing the burden". [14]In flipped classroom, teachers can usually answer students' puzzles on the spot and give them targeted homework guidance. Such a teaching mode can not only effectively reduce the pressure on students to complete their homework, but also improve the efficiency of students' classroom learning and reduce the energy and time spent by students dealing with their own problems after class. In addition, learners can independently arrange the time, method and place of micro class learning, and flexibly adjust the practice progress according to their personal conditions, so as to fully grasp the teaching content, which undoubtedly brings more free space for students.

3.4 The significance of flipped classroom to educational institutions

Flipped classroom provides reference for teaching in educational institutions. At present, there are various forms of educational institutions in China, including quality education, vocational education and so on. Although these training institutions have different teaching contents and training standards, their teaching methods are basically the same, mainly taught by teachers of traditional courses. The emergence of flipped classroom provides reference and guidance for the teaching of educational institutions, especially for adult education, vocational education and other training institutions, whose teaching objects have strong self-learning ability, can complete the learning of micro class video and teaching content within the specified time, and have strong adaptability to the flipped classroom teaching mode. This kind of educational institutions are likely to achieve better teaching results by implementing the flipped classroom teaching mode.

4. Typical model and analysis of flipped classroom

In recent years, many researchers at home and abroad have carried out research on the theory of flipped classroom, and have developed a variety of flipped classroom teaching models. The author combs and analyzes the relevant literature on building flipped classroom models at home and abroad, and summarizes the tables that record the details of typical models:

Table 2 summary of typical models

| Model name | Model proposer | Put forward the time | Model diagram | Key links |
|-----------------------------|----------------------------------|----------------------|---------------|--|
| Explore-explain-apply model | Robert Karplus | 1977 | | <p>① Exploration stage: teachers ask basic questions, and students ask questions based on prior knowledge;</p> <p>② Explanation stage: teachers introduce and explain concepts;</p> <p>③ Application stage: Students apply concepts to new fields and expand their application scope.</p> |
| Khan college model | Salman Khan | 2006 | | <p>① Instructional designers create learning environment and teaching content, and make micro-videos and online exercises;</p> <p>② Teachers determine the subjects and contents they teach, formulate specific learning tasks, track and urge students to learn online, provide necessary guidance and help, test and evaluate students' learning results, and finally give feedback to students;</p> <p>③ Students watch teaching videos, learn teaching content, communicate on the platform, complete group cooperation, practice after class and consolidate their knowledge.</p> |
| Woodland high school model | Jonathan Boehlmann Aaron sams | 2007 | | <p>① Watch teaching videos and take study notes before class;</p> <p>② Discuss problems, do experiments, complete exercises and homework in class;</p> <p>③ Give feedback and summary after class.</p> |
| Explore-Flip-Apply Model | Ramsey Musallam | 2011 | | <p>① Exploration stage: teachers assign tasks, students collaborate in groups, and show research conclusions;</p> <p>② Flipping stage: students watch teaching videos and submit video feedback;</p> <p>③ Application stage: teachers test students and evaluate them in order to provide information on the extension and application of knowledge.</p> |

| Model name | Model proposer | Put forward the time | Model diagram | Key links |
|---|---|----------------------|---------------|---|
| <p>Jackie Gerstin's four-stage model</p> | <p>Jackie Gerstin</p> | <p>2011</p> | | <ol style="list-style-type: none"> ① Experiential participation stage includes experiential learning activities, scientific experiments, simulations, games and artistic activities. ② Concept exploration: Learners will be exposed to the concepts involved in experiential participation at this stage. ③ Meaning construction: This stage means that learners should reflect on the understanding of the content in the concept exploration stage. ④ Application of demonstration: Learners should demonstrate what they have learned and apply it in some way to make what they have learned meaningful. |
| <p>Robert Taubert linear model</p> | <p>Robert Taubert</p> | <p>2011</p> | | <ol style="list-style-type: none"> ① Watch the teaching video before class and complete the guided homework exercises; ② In class, complete the test, solve the problem and summarize the feedback. |
| <p>Zhang Jinlei's teaching model</p> | <p>Zhang jinlei Wayne Wang Zhang baohui</p> | <p>2012</p> | | <ol style="list-style-type: none"> ① With the support of information technology and the smooth development of learning activities, students can watch teaching videos before class to learn; ② In class, the teacher determines the problem, the students conduct independent exploration, group collaboration and achievement exchange, and the teacher finally gives feedback and evaluation. |

| Model name | Model proposer | Put forward the time | Model diagram | Key links |
|--|---|----------------------|---------------|--|
| <p>Turnover classroom teaching model based on QQ group +TabletPC</p> | <p>Zhang Xinming he wentao Li Zhenyun</p> | <p>2013</p> | | <p>① Curriculum development: while introducing the "e -home education" e-book package, teachers make courseware, record audio and video, and develop localized courses that meet the conditions and subject characteristics of our school.</p> <p>② Pre class knowledge transfer: in flipped classroom, knowledge transfer is completed through teaching videos or e-book packages provided by teachers.</p> <p>③ Internalization of classroom knowledge: teachers encourage students to explore independently in class and use the knowledge they have learned to analyze and solve problems.</p> |
| <p>Two-stage, four-step and ten-link flipped classroom teaching model</p> | <p>Liu Xiangming</p> | <p>2014</p> | | <p>① "Two-stage" refers to two classes: Self taught questioning class and training demonstration class;</p> <p>"Four Steps" refers to four steps for teachers to prepare lessons: textbook integration → difficult point selection → instructional design → micro-lesson recording;</p> <p>③ "Ten links" refers to the ten links of students' classroom learning.</p> |

It can be seen from the above table that although these models differ in specific content, they all have the same characteristics.

Each model reflects the characteristics of applying information technology to teaching. Teachers need to record high-quality teaching videos for students to learn new knowledge before class and consolidate after class. The micro class teaching in flipped classroom breaks through the traditional face-to-face teaching and provides sufficient independent exploration space for all students. Moreover, wechat videos can be watched repeatedly at any time, which not only helps each student to carry out independent exploration before class and review after class, but also helps to achieve the maximum utilization of resources.

Each model pays more attention to cultivating students' cooperative learning ability and innovation ability. Flipped classroom mode is a teaching organization mode with students as the main body. Students can watch micro class videos freely after class, record their own questions, complete autonomous learning, think independently, discuss in groups and display results in class, and ask teachers or classmates for questions. The orderly progress of classroom teaching is based on each student's efficient completion of Extracurricular Autonomous Learning. From extracurricular to in class, students always maintain the state of autonomous learning, communication and cooperation, and exploration and development. Teachers become the organizers and guides of classroom activities. Compared with the traditional classroom in which a single knowledge point is instilled, flipped classroom teaching is more helpful to promote students to form an active learning attitude and inspire their innovative ability.

In addition, these flipped classroom teaching models also have the following differences:

The complexity of each model is different, and the evolution of the model shows a trend from simple to complex. Flipped classroom teaching model is gradually improved in the process of evolution, and its content is gradually enriched. The early teaching model is mainly composed of three cyclic steps. Based on the early teaching model, the later teaching model modularizes the whole teaching system, which is divided into pre class, in class and after class parts, and makes a detailed and in-depth exposition of the specific teaching activities of each part. These models, which are constantly improved and innovated, provide a clearer direction for the school's teaching reform.

Most models put students' micro class learning before class, and a few models specifically set aside micro class learning time for students in class. For example, Jackie gerstin's four stage model, Robert Taubert's linear model and Woodland Park High School model all require students to watch teaching videos and complete autonomous learning before class. The two-stage, four step, ten link flipped classroom teaching model divides the course learning into self-study questioning class and independent training and demonstration class. Students can freely watch micro class videos and complete basic exercises in the self-study questioning class, and carry out group cooperation and results display in the independent training and demonstration class. The author believes that putting the teaching activities of video learning in front of the classroom has higher requirements for each learner's consciousness, can test the learner's self-discipline level and independent learning ability, and is more conducive to promoting the cultivation of students' active learning ability. In the classroom, each student is left with time to learn micro classes. In this way, through the supervision of teachers, the joint promotion of students and a benign learning atmosphere, students can further improve their learning efficiency, so as to achieve good teaching results. These two teaching modes have advantages, which can be selected according to the actual situation in the implementation process.

Most models will practice before class, and a few models will practice in class. Put the exercises in front of the classroom, and each student can practice after the autonomous learning micro class, so as to test their autonomous learning achievements. The practice platform will uniformly reflect the answer of each student to the teacher, so that the teacher can more directly and clearly grasp the daily learning situation of students, and then prepare lessons for the common confusion of students. Put the exercises in the classroom, and the students will carry out appropriate exercises after discussing problems and completing the experiment. At this time, the students will have a more in-depth and

comprehensive understanding of knowledge, and then they can complete some difficult exercises. Such exercises can reflect the effect of students' autonomous learning and cooperative learning with their classmates. It can be seen that there are differences in the purpose and effect of these two teaching methods, which can be selected according to the teaching objectives.

5. Typical cases and characteristics of flipped classroom

In recent years, many schools have implemented the flipped classroom teaching mode and achieved great success. The author has read a lot of materials on flipped classroom teaching research, and summarized typical successful cases, their characteristics and implementation effects, as shown in the following table:

Table 3 summary of successful cases

| Case name | Major feature | Implementation effect |
|---|---|---|
| Muscho Prairie High School, Saskatchewan, Canada | Teachers usually distribute some short clips to students to build their curiosity and inspire their thinking. Only when students really need new information, they adopt the flip mode. | Students are more free in their study time and like to explore and think more. |
| Usa gaudi village primary school | The school has established a "Starbucks-style classroom", with round tables, comfortable sofas, cushioned chairs and computer terminals to replace the neat desks and chairs in traditional classrooms. | Students prefer to study in a comfortable and relaxed environment, and their performance is getting better and better. |
| Riverside Union School District | The school has used the digital interactive textbook based on iPad, which combines text, pictures, 3D animation and videos, and has the functions of taking notes, communicating and sharing. | 78% of the students who use interactive teaching materials get the grade of "excellent" or "good". |
| Clinton high school | Teachers use screen recording software to record teaching videos, so that students can watch videos, take notes and record problems before class. Teachers teach most students' questions in class, guide students to practice and give feedback on students' performance. The open computer room of the school provides students with convenient conditions for watching videos. | The failure rates of the students in the experimental class were reduced to 33% in English language arts, 31% in mathematics, 22% in science, and 19% in social studies (which had always been above 50%). Students' frustration is reduced, their self-confidence is enhanced, and incidents of violating discipline are also greatly reduced. |
| Chongqing jukui high school | The school introduced the "flipped classroom" teaching mode, and made appropriate adjustments according to the actual situation of the school, and summed up the "3456" mode. | Chongqing Jukui Middle School has come to the forefront of the whole country, and has become a banner of classroom teaching practice in the field of basic education in China. |

These cases have successfully applied the teaching mode of flipped classroom, reflecting the significance and value of flipped classroom. The author summarizes the common points of the above successful cases as follows:

The school highly recognizes and vigorously promotes flipped classroom. The school leaders who successfully implemented the flipped classroom teaching mode have relatively open ideas and act decisively. They are brave to break through the traditional teaching concepts, actively study the new flipped classroom teaching concept, and make reasonable improvements and innovations in teaching time arrangement, teaching methods, assessment forms, etc., so as to lay the foundation for the implementation of the flipped classroom teaching mode.

Teachers actively respond to the call of the school and strengthen their information technology ability and classroom organization ability. With the encouragement of school leaders, the teachers in the successful cases accepted the teaching concept of flipped classroom with an optimistic attitude, actively studied courseware making, micro class recording and other technologies, strengthened the understanding and application of knowledge and skills by watching high-quality videos recorded by others, obtained inspiration, and designed and produced their own micro classes. In addition, teachers guide students to cooperate and communicate in an orderly manner in class, and constantly improve teaching management ability and classroom organization ability in practice.

Students' learning initiative and enthusiasm have been fully mobilized, and the quality of knowledge has been steadily improved. Comfortable and wide multimedia classrooms, rich and diverse teaching materials, and scientific and efficient personalized interaction methods provide each learner with a perfect and unique interactive learning experience, and fully mobilize their learning interests. When students are interested in learning, their self-confidence naturally increases, their sense of rebellion slowly decreases, various disciplinary violations gradually decrease, and their social and cultural quality naturally improves. [15]At present, the achievements of middle school students in successful cases have been significantly improved.

The school has explored the best model suitable for students in the teaching reform. Copying others' teaching mode without thinking may not achieve the expected effect, or even backfire. These successful cases are based on the flipped classroom teaching mode of others, combined with the school's own situation to innovate and think, and explore a teaching mode with local characteristics.

In addition, the author also makes an in-depth analysis of the differences of each successful case, and summarizes the following points:

The reform priorities of each case are different. Some schools focus on the flexible application of flipped classroom teaching mode, and adopt the method of combining traditional classroom teaching with flipped classroom teaching. When students' actual needs, they uniformly distribute micro class videos to all students, adopt flipped classroom teaching mode, and usually use traditional classroom teaching mode for teaching. This practice gives full play to the advantages of traditional teaching and flipped classroom at the same time, and reflects the unique educational thought. Some schools focus on changing the classroom atmosphere and building the original classroom into a warm and loose learning environment, which can reduce students' anxiety and tension, stabilize students' mentality, and then improve students' learning efficiency. Some schools also focus on using new learning resources. They use e-book bags, interactive textbooks and other interactive teaching tools to bring students a more unique and efficient learning experience and stimulate students' interest in learning.

There are differences in the subjects applied in each case. Some schools apply the teaching mode of flipped classroom to English, mathematics and other courses, while others apply flipped classroom to social research and other subjects. English, mathematics and other courses have relatively clear knowledge points. Teachers can choose a certain concept or knowledge point to make micro courses for students to learn. Social research and other courses are closely related to other disciplines. The micro courses made by teachers should not only choose reasonable content, but also stimulate students' thinking, which is more difficult for teachers.

6. Challenges brought by flipped classroom

6.1 The challenge of flipped classroom to school

The implementation of flipped classroom requires the school to adjust the schedule on a large scale. Due to the pressure of the college entrance examination, the competition among schools in China is more intense. Most schools are eager to strive to improve the academic performance of each student, so as to improve the school entrance rate and social popularity. Therefore, they do a good job in learning planning for all students and formulate schedules of various learning activities. Under this learning condition, students have less time for autonomous learning and lack a lot of time to watch teaching videos. Therefore, when the school carries out teaching reform and implements the flipped classroom teaching mode, it is necessary to reschedule the work and rest time for students to leave sufficient autonomous learning time for students.

The successful implementation of flipped classroom still needs the further exploration of the school. At present, schools at home and abroad have implemented the flipped classroom teaching model, and achieved some success. Obviously, these schools can provide reference and guidance for the teaching reform of other schools. However, schools eager for the success of educational reform still need to combine their own actual situation, continue to carry out innovative experiments and research and exploration, and explore a teaching reform model suitable for the development of the school. Otherwise, blindly copying may not only be ineffective, but even counterproductive. Such exploration will undoubtedly bring greater challenges to schools.

6.2 The challenge of flipped classroom to teachers

There are differences in the applicability of flipped classroom to different disciplines. At present, the type of subjects taught by the flipped teaching method in schools tends to be science. Science knowledge points are clear and well-defined, and teachers can choose to record videos with certain knowledge points. However, liberal arts courses are closely linked, and the knowledge points of liberal arts are often not isolated. Moreover, micro courses should stimulate students' thinking and arouse emotional exchanges between teachers and students, which puts forward higher requirements for liberal arts teachers to record videos.

Flipped classroom challenges teachers' teaching concept, method system and professional ability. Flipped classroom is novel and flexible, which is quite different from traditional classroom in many aspects. If teachers want to successfully implement flipped classroom, they must first accept the educational concept of flipped classroom psychologically and carry out comprehensive and in-depth study of flipped classroom. At the same time, teachers should improve their abilities in many aspects, absorb the essence by watching a large number of high-quality micro courses, and learn information technology, so as to be able to design and produce high-quality micro courses. In addition, the flipped classroom is more open and active than the traditional classroom. Students will carry out interactive communication, achievement display and other activities in the flipped classroom. Teachers play a role in organizing classroom activities in an orderly manner, which requires teachers to improve their teaching organization ability through a lot of teaching practice.

6.3 Challenges of flipped classroom to students

Flipped curriculum has a greater demand for students' awareness of autonomous learning and information quality. In this new teaching mode, students watch micro class videos before class to record problems in their own learning. This process is not supervised by teachers, and the realization of students' learning goals completely depends on their consciousness. In other words, flipped classroom is more suitable for students with strong self-discipline. Due to the lack of teachers' supervision and low self-consciousness, some students' unions cannot effectively complete the learning of micro class videos within the specified time, which is a gap with the students who study hard. At the same time, flipped classroom requires students to have strong information technology

skills, be able to skillfully operate mobile phones, computers and other electronic devices to watch micro class videos and complete online exercises.

Flipped classroom challenges students' cooperative inquiry ability and innovation ability. Compared with traditional teaching, flipped classroom increases the communication between students and deepens the feelings between students. In class, students explore cooperatively, answer questions to each other, seek answers to difficult problems, and show their achievements. This provides a platform for students to improve their ability of unity and cooperation, and also challenges students' ability of unity and cooperation. In addition, flipped classroom is a learner centered innovative teaching mode. Students need to independently construct theoretical knowledge and improve practical operation skills. This relatively independent and open teaching environment can fully mobilize learners' independent thinking, stimulate learners' innovation ability, and also pose a great challenge to students' innovation ability.

7. Summary

To sum up, flipped classroom originated from the United States has a development history of decades. In the process of evolution, the educational concept, connotation and model of flipped classroom have been gradually improved. Compared with the traditional classroom, flipped classroom has made great breakthroughs in many aspects, such as the form of teaching presentation, the role orientation of teachers, the role orientation of students, and the way of assessment, reflecting the characteristics of technology enabled education and student-centered. Flipped classroom is an innovative product of the information age, which provides direction and ideas for China's teaching reform. At present, scholars at home and abroad have conducted in-depth research on flipped classroom, designed and developed a variety of flipped classroom teaching models, and provided clear and feasible guidance for school teaching reform. On the whole, the complexity of flipped classroom teaching model is gradually increasing, showing a trend of gradual improvement. Although there are some differences in the specific teaching process and complexity of these teaching models, they all reflect the essential characteristics of applying information technology directly to classroom teaching activities, and attach great importance to cultivating students' ability of autonomous learning, cooperative research and innovation. In addition, many schools have put the teaching model of flipped classroom into practice, innovated and thought, and finally achieved success. They have provided a model for the teaching reform of other schools with their own practice. For example, highland village school in the United States has built the teaching environment into a "Starbucks classroom", and the riverside United School District has introduced multimedia digital teaching resources using iPad. At the same time, the emergence of flipped classroom has brought certain significance to teachers, students, educational teaching and educational institutions. For teachers, flipped teaching undoubtedly creates a platform for teachers to improve their own ability, and can make teachers more comprehensively and deeply realize the potential of students in practice; For each student, flipped classroom really achieves comprehensive personalized guidance for students, promotes benign interaction between teachers, and can cultivate students' ability of communication, unity and cooperation; For education and teaching, flipped classroom reflects the advantages of blended learning, and also provides a new idea for reducing the burden; For educational institutions, flipped classroom can provide reference and guidance, which is conducive to achieving better teaching results. Of course, flipped classroom will not only bring meaning, but also bring certain challenges to teachers, students and schools. For teachers, flipped classroom requires teachers to change their classroom ideas and improve their subject literacy. At the same time, the adaptability of flipped classroom to various subjects is different. Liberal arts teachers often encounter greater difficulties when shooting micro class videos; For students, flipped classroom teaching requires them to have stronger autonomous learning ability, research ability and creative consciousness; For the school, flipped classroom requires the school to make appropriate changes to the teaching schedule, give full play to the advantages of flipped classroom teaching method, and solve the problems and difficulties it brings.

On the basis of summarizing the classic model and excellent practice, according to the current situation of the school, find out a flipped classroom method suitable for itself. In addition, the article also has some shortcomings. The research of flipped classroom in this paper originates from high-quality literature, and lacks the specific practice of flipped classroom teaching mode. Therefore, the exploration of flipped classroom in this paper is not comprehensive and in-depth. The author believes that the in-depth exploration of flipped classroom still needs more researchers to invest in research and experiments, construct a more perfect theoretical system of flipped classroom, and deeply explore the teaching effect of flipped classroom through practice.

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