

# Design of the Relation Model of Learning Adaptability Based on the Influencing Factors Analysis in Flipped Classroom

Jingjing Xu, Jing Du, Wenqian Bai, and Ronghuai Huang

**Abstract**—The flipped classroom is one of the innovative teaching modes supported by the information technology, which has received extensive attentions and recognitions in recent years. Due to the unique teaching and learning methods, the higher demand for the learning adaptability is presented in the flipped classroom. The learning adaptability affects directly the learning effect in the flipped classroom. However, there is little research on the learning adaptability in the flipped classroom. This paper analyzes comprehensively the influencing factors of learning adaptability by using the open interviews and the observation method in the flipped classroom. We discover the influencing factors are composed of the cognitive and non-cognitive aspects. The cognitive factors include the learning style, the learning environment, the teacher and student roles, the design of learning activity, the quality of learning resources, etc. The non-cognitive factors involve the learning motivation, the self-efficacy, the learning interest, the self-controlled, etc. Based on the above-mentioned factors, we propose the relation model of learning adaptability including the teacher, the student, the learning resource, the environment, the technical support and the evaluation. In the model, the effective measures to improve the learning adaptability level are proposed and the operating mechanism of learning adaptability is formed. The research can provide a reference for teachers which aim to improve the learning adaptability in flipped classroom.

**Index Terms**—Learning adaptability, flipped classroom, influencing factors, the relation model.

## I. INTRODUCTION

In recent years, with the integration between Information and Communication Technology (ICT) and education deeply, there are emerging some innovative teaching modes supported by ICT. As a learning method of student-centered and promoting active learning, the flipped classroom (FCM) is the typical representative which has aroused more and more attentions and recognitions among researchers and educators around the world. According to the 2017 NMC Technology Outlook for Chinese Higher Education released recently, FCM will be accepted globally within a year in the future [1]. Compared with the traditional classroom, FCM possess significant differences in terms of the roles between teachers and students, teaching forms, class activities,

technology application and evaluation mode, which leads to the learning adaptability in FCM is different from the traditional one. The paper analyzes systematically the influencing factors of learning adaptability in FCM hoping to provide reference for education researchers and practitioners.

## II. FCM

With the application of FCM gradually, it is experiencing from its beginning and exploring stage to the depth of the application stage. FCM is an innovative teaching mode supported by ICT which reverses the traditional teaching sequence and restructures the learning time between in-class and after-class. According to the Wikipedia, it is an instructional strategy and a type of blended learning which reverses the traditional learning environment by delivering instructional content, often online, outside of the classroom. In FCM, what is traditionally done in class and as homework are switched or flipped [2]. The information-transmission component of a traditional face-to-face lecture is moved out of class time. In its place are active, collaborative tasks. After class they follow up and consolidate their knowledge [3]. The teachers provide the learning materials for students before class including video, courseware and other relevant learning resources. Pierce [4] points out that student's perceptions of the flipped classroom experience also were determined. The students need to involve self-learning before class, and discuss with the peers or the teacher online. The multiple active classrooms learning strategies are used to engage students, including answering questions, student presentations, small-group problem solving, self-and peer-evaluation and group discussions in class [5]. The designing of learning activities transferred from "teacher-centered" to "student-centered" in FCM. Many scholars at home and abroad have built the FCM model which provides the valuable reference and guidance for FCM practitioners. The Professor Robert Talbert from Franklin college puts forward the FCM structure based on years of teaching experience [6]. The model reflects the basic activities simply according to his teaching of linear algebra. He divides teaching activities into two stages: before class and during class. It may be diagrammatically represented as in Fig. 1.

This study built a more comprehensive FCM model based on the experience in teaching practice of modern educational technology course. The model consists of three phases: before class, in class and after class. 1) The superficial cognition is arranged before class. The characteristic of this level is the recognition or recall of knowledge, requesting

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students can remember the main points of the knowledge and understand the meaning of learning materials. 2) The deep understanding and assimilation are scheduled in class. The characteristic of this level is deeply understand the intrinsic logical connection of knowledge and apply it on the basis of understanding. 3) Consolidation and absorption are scheduled after class. Students are mainly to consolidate and absorb knowledge through deep application and self-reflection. In addition, teachers and students could communicate through online and offline before class, in class or after class at any time. It may be diagrammatically represented as in Fig. 2.

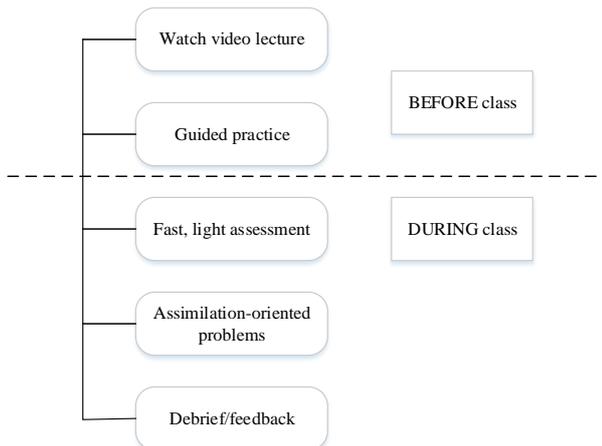


Fig. 1. Robert Talbert's flipped classroom structure.

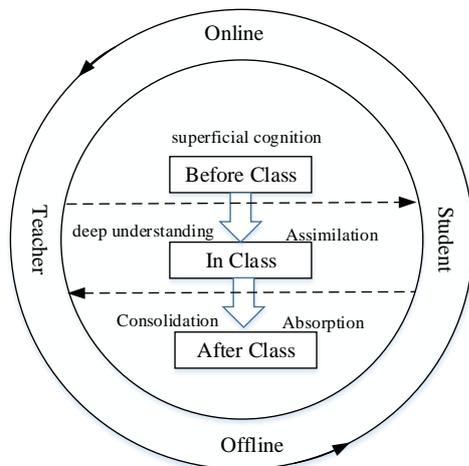


Fig. 2. Flipped classroom structure.

### III. LEARNING ADAPTABILITY

#### A. The Connotation of Learning Adaptability

The concept of adaptation has become a crucial issue of research for learning in last few years. The cognitive-developmental theory puts forward that cognitive development includes three basic aspects: assimilation, accommodation and balance, while the assimilation and accommodation is the two process of adaptability. The balance between assimilation and accommodation is the formation and development process of cognitive structure. Actually, adaptability is a feature of a system or of a process [7]. Lin, CH. D [8] mentions adaptability is the process of object changes through enrichment and development the action.

With the change of learning environment and learning style, learning adaptability has become one of the hot issues that researchers focus on. Feng, Y. Y [9] presents that learning adaptability is the psychological and behavioral process formed by finishing the learning task to achieve the balance according to the learning environment and learning requirements in the specific learning situation. It is the aptitude which the student achieves the good learning effect through overcoming the learning difficulties. Cole [10] points out that learning adaptability directly affects the students 'study achievements. At present, FCM has been received widely attentions and has become an important learning method in the information age. More and more scholars also begin to pay attention to the learning adaptability with the purpose of adjusting the teaching strategy and improving the learning effect. It should be noted that exploring and clarifying the influence factors of learning adaptability in FCM possess the significant theoretical and practical significance.

#### B. The Influencing Factors of Learning Adaptability in FCM

There are various factors of learning adaptability influencing the learning effect in FCM due to its special teaching organization form. Many researchers have been studied the classification of learning adaptability. For example, Jing, N [11] presents the main factors of learning adaptability involve learning attitude, learning technology, learning environment, health of body and mind, etc. Chenglong, Z. [12] points out the adaptability factors of blended learning refer to gender, age, grade, age, surf the Internet every day time, self-learning, learning attitude, teaching management, teachers teaching, learning support, learning platform, learning environment, curriculum. Ming-gui, G. [13] considers that the main reason of learning inadaptability is the teaching method, learning attitude, curriculum and learning methods, while the differences between different gender, major and grade be existed.

This research analyzes the influencing factors of learning adaptability in FCM according to the influencing factors of learning adaptability above mentioned and teaching practice of modern educational technology course. The participants in the research were 52 sophomores from different disciplines enrolled in a compulsory course on modern education technology at central China normal university. (12 boys, 40 girls and 1 teaching assistant included). The course last one semester and apply FCM mode (total of 32 class and two classes a week). This paper uses the methods of open interviews and interviewed 15 people randomized. In order to observe student classroom behavior carefully and accurately, the study also use method of observation to record the students' classroom learning situation aiming at analysis the students' learning adaptability. Eventually we get 15 valid records of interviews and 16 records of classroom observation. In order to ensure the reliability, two researchers be asked to encode the record interviews and classroom observation at the same time. Finally, the two researchers negotiate for the different coding unit and unify coding opinion. Through qualitative analysis the records of observation and interview, the study puts forward that the

influencing factors of learning adaptability in the FCM. It may be diagrammatically represented as in Table I.

TABLE I: THREE-LEVEL CODING TABLE (PARTIAL ENCODING)

Raw Material	Open encoding	Axis Code	Select encoding
This semester's modern educational technology curriculum using the teaching mode of FCM, greatly mobilize our enthusiasm for learning. Compared with the traditional way of learning, we now have a heavier learning task. We need to learn relevant knowledge before class and discuss with teachers and students in class. The quality of learning materials, such as micro-video and PPT, will directly affect my study.	Motivate learning	Learning: Positive/Negative	Learning motivation Student role
	Now the task of learning is heavier	Learning tasks: heavy/light	Learning method
	Self-Study before class Discussion in class	Self-Study: Yes/No Discussion: Active/Passive	Learning style.
	The quality of learning materials is very important	quality of Learning resource: High/Low	Learning resource

According to the Table I, we found that the influencing factors of learning adaptability can be divided into two aspects of cognitive and non-cognitive. The cognitive factors include 8 attributes and the non-cognitive factors involve 6 attributes in FCM. It may be diagrammatically represented as in Table II.

TABLE II: THE FACTORS OF LEARNING ADAPTABILITY IN FCM

Dimensions	Attributes
The cognitive factors	<ul style="list-style-type: none"> <li>● Teaching method</li> <li>● Learning style</li> <li>● Teacher role</li> <li>● Student role</li> <li>● Learning environment</li> <li>● Design of learning activity</li> <li>● Quality of learning resources</li> <li>● Evaluation method</li> <li>● .....</li> </ul>
The non-cognitive factors	<ul style="list-style-type: none"> <li>● Learning motivation</li> <li>● Self-efficacy</li> <li>● Learning interest</li> <li>● Self-controlled</li> <li>● Personality factors</li> <li>● emotional factors</li> <li>● .....</li> </ul>

The cognitive factors are internal to each person and serve to modulate behavior and behavioral responses to external stimuli [14]. It is the basic elements of learning adaptability, which can be interfered by teaching strategies.

Non-cognitive factors were first proposed by the American psychologist Alexander in 1953. It requires teacher to penetrate into the inner world of cognitive subject and to cultivate indirectly in the teaching process.

#### IV. THE RELATION MODEL FOR THE INFLUENCING FACTORS OF LEARNING ADAPTABILITY IN FCM

According to the above influencing factors analysis of learning adaptability and the characteristics of the teaching mode in FCM, the paper proposes the relation model of learning adaptability in FCM which is consisted of six factors:

the teacher, the student, the learning resource, the environment, the technical support and the evaluation. It may be diagrammatically represented as in Fig. 3.

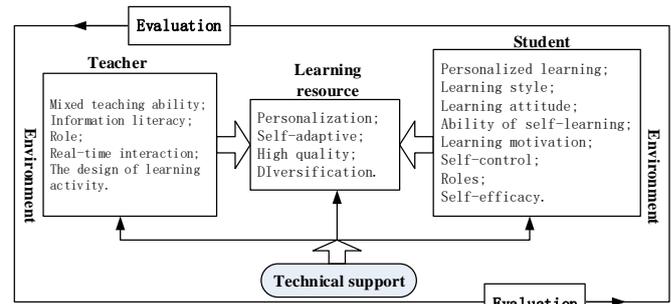


Fig. 3. The relation model of learning adaptability in FCM.

##### A. Teacher

Teachers have indirect effects on learning adaptability who are the mainly conductor to improve learning adaptability. Compared with the traditional classroom, the higher requirements for teachers' ability are presented in FCM. They need a diverse range of skills to coordinate class activities, ensuring active participation, communication and learning among all students in the class. Through interviews and observations of students, we found that there are some issues worth noticing for teacher: firstly, they need to master teaching strategies in FCM and possess the mixed teaching ability of online and offline in digital learning environments. Secondly, they should improve information literacy. A great deal of learning activities occurred online through discussion among peers and teachers. Elmaadaway [15] points out that discussion may be initiated by students who have grasped certain content independently to assist peers. They need to build and manage the online learning community, interacting with students and providing feedback timely to keep the learner's learning enthusiasm. Thirdly, teachers need to change and reshape their roles; they mainly act as organizer, guide and facilitator in FCM. Lastly, they need to design the learning activity carefully to stimulate students' learning interest of self-learning in FCM. The teacher plays a significant role in the process of flipped Learning. They should understand timely learners' difficulties in FCM and communicate with the learners to ensure all students interact with one another and with the teacher, which enhance their communication skills and increase their desire to learn. Ultimately, heightening the learning self-confidence and reducing the inadaptability of learning.

##### B. Student

The student factor is the direct cause of learning inadaptability, including personalized learning, learning style, learning attitude, ability of self-learning, learning motivation, self-control, roles and self-efficacy. Firstly, several studies have shown that the learners' performance and behaviors are influenced by the learning style [16], [17]. The learners need to enhance their learning adaptability through improving the personalized learning ability according to their learning style. Secondly, the flipped classroom model is student-centered. Each student need to have a basic understanding of the material when they come to class, so that they can fully

participate and engage in class discussion [18]. They should improve their internal motivation and enhance their consciousness and ability of self-learning. They need improve their self-control to avoid external the interference of other factors. Thirdly, they become the leader of learning, they decide freely when, where, what and how to learning out-of-class. Lastly, the self-efficacy plays an important role in self-learning in the meantime. They should cultivate learning self-confidence and self-efficacy by regulating the inertia of thinking in the process of self-learning. They need communicate with others when encounter problems and acquire personalized learning support through network platform.

### *C. Learning Resource*

The FCM model redesigns the traditional lecture-style classroom into a blended learning model, then students use online resources to learn content ahead of class and use class time for discussion [19]. The quality and the form of presentation of learning resource will directly affect the study effect and they are also the indirect reason resulting in learning inadaptability. There are many kinds of learning resources while the micro video is one of the most common and important resources. In addition, the teacher need provide other kind of resources such as audio, slides, documentation and readings materials to meet the need of the student' diversified requirements in FCM. There are four basic requirements for learning resources: personalization, self-adaptive, high quality and diversification. The personalized learning resource is the foundation of achieving the personalized learning. According to the student' characteristic, demand and the actual learning situation, the personalized learning is an important learning mode in the information era which emphasize student-oriented and promote the students' ability and individuality development. Self-adaptive is the typical service mode supported by information technology. It can transmit timely valuable and suitable resources to meet the needs of learners according to their cognitive habits and preferences for improving the learning efficiency. High quality is an urgent demand of the student in FCM which can help learners to understand knowledge and put forward questions. It is directly affect learning motivation and enthusiasm. The diversification of learning resource can meet the various learning need of learners, not only including the basic and advanced knowledge, but also involves different type such as text, images, video, etc. The learners can choice the different levels of learning resources at different stages of learning.

### *D. Learning Environment*

A successful flipped class approach should consider effective student learning that importantly improves student engagement, both within and outside the class [20]. As we known, the learning occurs in a wide variety of context in FCM, and the student should adapt such diversified learning setting. The learning environment in FCM is a type of blended learning, which consisted of traditional physical space and the virtual network space based on problem-solving learning [21]. The traditional physical space is mainly the face-to-face classroom teaching which is to

solve perplexities for students. Compared with the online classroom, the virtual network space happened in cyberspace, while the learning activities include online learning, collaborating in online discussions, searching for information and so on. Actually, the virtual learning environment in FCM is the learning community which is made up of students and teachers aiming at achieving the common learning tasks through network platform. Timely interaction, individuation and collaboration are the main characteristics of this virtual learning environment in FCM. The teacher should share various learning resources and collaborate knowledge building with students. During this process, teacher should provide timely interaction and offer personalized learning support and service.

### *E. Technical Support*

With the development of information technical, such as internet, cloud computing, big data, etc., the information technology has gradually changed the learning and teaching method. The degree of dependence on technology has continuously strengthened in FCM. Technical support embodied in every aspect of teaching activities which provides the convenience to teachers, students and learning resource. Teachers need to build learning support systems through information technology to provide personalized and collaborative learning environments for students before and after class. The teacher also needs to design the learning activities and build learning community through network platform. The student communicates and discuss with each other based on their learning community. During this process, the teacher can provide timely feedback or adjust the teaching strategy according to the network background data to increase learning adaptability in FCM. In addition, as one of the most important learning resources "teaching video", the quality of it also can't be separated from the support of technology. The FCM break the limit of time and space of the traditional teaching methods through using the information technology. It can provide all valuable learning materials to student in anytime and anywhere. It really creates a real open and shared learning environment supported by information technology.

### *F. Evaluation*

Appropriate evaluation is a central tenet of the course redesign [22]. The evaluation exists in the whole process of learning in FCM, including the diagnostic, the formative and the summative evaluation. The diagnostic evaluation is to predict the whole situation of students to understand the knowledge base and preparation condition before class, such as knowledge, skill and learning capacity, etc. The diagnostic evaluation plays an important role in FCM which provides the guidance and reference for the subsequent learning activities 'organizations and design. The formative evaluation is to observe and record the whole process of learning in the virtual classroom or physical classroom. The main purpose is to discover the problems existing in the process of learning which provide feedback and adjust the teaching strategy in time for teacher. The formative evaluation stimulates the learning interest and enthusiasm, while strengthen the learning adaptability in FCM. The summative evaluation aims to understand the final effect of

teaching activities such as examination at the end of semester. As we all known, the higher requirements of students' self-learning ability are put forward in FCM. The student needs highly autonomous participation throughout the learning process. The effect of students' autonomous learning requires timely and correct evaluation from teachers, but the traditional evaluation method cannot meet the need of student 'requirements which only focus on learning outcomes. The scientific evaluation directly affects the learning effect. The FCM attaches great importance to learning initiative, individuation and diversification, the teacher need to evaluate students' classroom performance, interaction and learning difficulties timely. Evaluation processes should address the various aspects of the flipped classroom [23].

In the proposed relation model of learning adaptability in FCM, we found that the improving of learning adaptability in FCM need to consider above six factors primarily. The teacher needs to provide the learning resource to the student to ensuring the efficiency of flipped learning. During the process, the information technology will offer essential support for teacher, student and learning activities. The key issues for teachers and students must be improve their information literacy and learn to use information technology to support teaching and learning. At the same time, the evaluation should be implemented in the whole process of flipped teaching. Additionally, learning adaptability in FCM rely on the learning environment. The teacher should create personalized learning environment to improve learning adaptability in FCM.

## V. CONCLUSION AND FUTURE WORK

FCM has become a hot topic in recent years for its unique teaching form. In order to improve the effectiveness and efficiency of the FCM, it is crucial role to clarify the influencing factors of learning adaptability. This study divided the factors into two dimensions of cognition and non-cognitive factors. The relation model of learning adaptability in FCM is proposed based on the above influencing factors. The teacher and student are the two basic elements in the learning process of FCM. The teacher is organizers, guiders, promoters, and server of teaching activities, while the student is the really leader of learning because the content acquisition is self-paced and self-guided, enabling students to control when and how much content they view. Meanwhile, learning resource, learning environment and technical support have indirect influence on learning adaptability in FCM.

At present, the research about learning adaptability in FCM is still in the initial exploration stage at home and abroad. It needs to arouse researchers' more attention. In terms of further direction, note that the future research should consider continuously investigate into the learning adaptability in FCM. The researchers will pay more attention to the following aspects. Firstly, we should make the learning adaptive assessment scale relevant the FCM through empirical research and measure the reliability and validity of the scale through the factorial analysis. Explore the status quo and characteristics of learning adaptability in FCM. And then put forward the effective measures to improve the learning adaptability. Secondly, based on the learning adaptive

assessment scale, the structural equation model of learning adaptability in FCM will be established which can verify the correlation of each influencing factors, aiming to provide reference for the design of learning activities in FCM. Furthermore, it must be noted that studying the learning adaptability in terms of the different learning groups or different subjects may be of particular valuable, which can be generalized on a larger scope and a wider range of contexts.

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