The Mechanism of Flipped Classroom Based on Cognitive Schemas

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ABSTRACT
The flipped classroom has achieved great success in Europe and America. This study aims to provide theoretical basis for the flipped classroom in the perspective of cognia theoretical. It reviewed a large amount of literature, induced, and analyzed the developmental mechanism of flipped classroom, providing theoretical and practical references for teaching renovation in China. It was concluded that through brief teaching videos, courseware, and online communicative platform, the flipped classroom facilitates self-directed learning, and constructs cognitive schemas to pave solid foundation for connection between updated and outdated information, and assimilation and adaptation of cognitive schemas, leading to success in learning and teaching. The flipped pedagogical model also facilitates the construction of individualized cognitive schemas by highlighting discussion rather than written assignment after class. Nevertheless, the preview prior to class and in-class lecturing in the traditional classroom fails to function in this way.

KEYWORDS
Adaptation, Assimilation, Cognitive schema, flipped classroom, traditional classroom

INTRODUCTION
With the continuous demand for student-centered learning environment, flipped classroom has attracted a large number of researchers from domestic and foreign countries. As a new teaching mode, flipped classroom is gradually applied in teaching practice (Li & Ren, 2017; Yu, 2019), assisted with social media such as WeChat (Yu, 2020). In recent years, the flipped classroom teaching mode has attracted attention in American universities and has been widely used (Qian & Chen, 2015). As an emerging teaching method, flipped classroom has essential differences with traditional classroom. The essence of flipped classroom lies in returning to the logical starting point of teaching activities - students’ learning (Wang, 2016; Chen, 2019). Flipped classroom reflects the localized teaching wisdom and educational thoughts of frontline schools under the guidance of student-centered concept (Wang, Luo & Jiang, 2018). In contrast, traditional classroom emphasizes the process of teacher lectures and student note-taking. Students have fewer opportunities to participate in learning discussions, and they cannot receive timely teacher guidance and explanation during the process of completing
homework after class. Unlike traditional classroom, flipped classroom means moving the teaching part of the teacher’s preaching outside the classroom. Students can learn course content independently before class through videos (Yu & Gao, 2021), courseware, textbooks, and other materials. In this way, class time can be used for active learning, such as cooperative learning and applied teaching case learning. In the flipped classroom, students can control their own learning progress according to their learning needs. Teachers can interact with students meaningfully, provide necessary help, guidance and evaluation when needed, play the role of learning facilitators, and are equal to students in the classroom, rather than lecturers who are looked up to by students in traditional classrooms.

In the wake of the advent of the flipped classroom model, extensive academic research has been conducted to scrutinize the underlying process of this innovative pedagogical approach. Subsequently, numerous empirical studies have been carried out in a diverse array of academic fields, attesting to the considerable efficacy of the flipped classroom model in enhancing student learning outcomes and stimulating learning enthusiasm. Recent academic inquiry still primarily revolves around classroom practice, with the majority of empirical findings endorsing the deployment of the flipped classroom model. Yet, despite its substantial positive outcomes, only a paucity of scholarly analyses have systemically articulated the cognitive schema theory underpinning the success of the flipped classroom model.

Cognitive schema theory is a knowledge representation form that the brain organically combines new things with existing knowledge and experiences to facilitate information storage and processing. It is a complete information system composed of interrelated knowledge (Zhao, 2001). The process of classroom teaching and student learning ultimately involves the process of students combining existing cognitive schemas to fill in new information and make the schemas more concrete. The entire learning process is guided by cognitive schemas, which activate or construct appropriate cognitive schemas and fill them with new information. This process changes with changes in the teaching mode. Existing and newly constructed cognitive schemas not only provide information frameworks for assimilating new information, but also connect information to activate readers’ existing cognitive schemas. Therefore, cognitive schema knowledge plays a decisive role in learning. Many scholars use cognitive schema theory as a theoretical basis to guide practical teaching, but few have explained the flipped classroom from this perspective. This article explains the reason for the success of the flipped classroom model from the perspective of cognitive schema theory, which has certain theoretical and practical significance.

**METHODS**

This study used a thematic analysis method. Thematic analysis is a well-established method for identifying and analyzing themes or patterns within qualitative data. It involves a systematic approach to reviewing the data, identifying recurrent patterns or themes, and interpreting their meaning. One of the key advantages of thematic analysis is its flexibility, which allows researchers to apply it to a wide range of qualitative data including interview transcripts, focus groups, and written documents.

The process of thematic analysis involves a series of iterative stages, including data familiarization, code generation, theme identification, theme revision, and theme definition. The first stage of data familiarization involves reading and re-reading the data, to gain an overall sense of the data’s content, and to identify any patterns that emerge. The second stage involves generating codes, which may be descriptive, interpretive, or a combination of both, to capture the meaning of the data. The third stage involves identifying themes by grouping the codes into meaningful patterns, and refining these through comparison across the data. The fourth stage involves revising and refining the themes in light of the data, and ensuring consistency and coherence across the analysis. Finally, theme definition involves reporting the key themes, and their meanings, in a clear and concise way that is supported by relevant data.
The Flipped Classroom and Cognitive Schema Theory

The etymology of the term ‘flipping the classroom’ is grounded in its fundamental deviation from the customary learning paradigm. Traditional classrooms are largely characterized by a didactic mode of instruction, where learners are primarily passive recipients of the instructor’s lectures. However, the flipped classroom model upends this conventionality by assigning students the task of assimilating lecture content independently, through the viewing of instructional videos, thus enabling them to employ class time for interactive learning and skill-building activities.

In 1932, British psychologist Bartlett introduced cognitive schema to psychological research. He asked students to read a religious and obscure folk story, and then asked them to freely retell it in order to explain why people are able to reconstruct stories based on their past experiences and knowledge when recalling them. He believed that the story itself had been assimilated into the cognitive schema constructed by people’s past knowledge and experience (Chen, 2002). Cognitive schema is a skill that exists deep within people’s minds and serves as a link between concepts and perception. Since concepts are associated with personal known information, cognitive schema falls within the category of prior knowledge (Zhao, 2001). Cognitive schema is also a type of intermediary, a dynamic and variable cognitive structure in the human brain. People can utilize this intermediary to achieve an elevation from concrete experience to abstract concept (Wadsword, 1979). Experts in artificial intelligence have developed the theory of cognitive schema more systematically and comprehensively, defining it as “a data structure that represents the universal concepts stored in memory,” and pointing out that when people understand new things, they must connect the new things with existing knowledge and experience, and their existing knowledge structures play a decisive role in cognitive activities (Rumelhart, 1980). Cognitive schema is how learners’ existing knowledge is stored in their minds. It is the process by which the brain organizes and reconstructs past experiences, reflects the influence of information stored in memory on the processing of new information, and integrates new information into the learners’ knowledge base (Howard, 1987). As the basis of cognition, cognitive schema is the result of prior knowledge, background knowledge, or long-term memory in the brain, and it is also the process of reorganizing, understanding, and memorizing information obtained later (Cook, 1994). Later, cognitive schema was developed as background knowledge associated with language understanding (Huang, 1998).

The cognitive schema theory has been widely applied in foreign language classroom teaching, especially in the teaching of reading, listening, vocabulary, translation, and interpretation. The cognitive schema theory associates new and old information, and the association of new and old information is an indispensable part of the teaching and learning process. In reading teaching, the cognitive schema theory provides a framework for assimilating new information in reading comprehension, making it easier for students to choose and remember key information, facilitating their deduction of implied meanings, and making it easier for them to remember and recall (Zhao Yanfang, 2001). Mandler divides cognitive schema into two parts: gaps and default values. Reading comprehension difficulties can be attributed to gaps in cognitive schema. As long as the gaps are filled in, the reading can be completed smoothly. Therefore, reading teaching can be subdivided into teaching of gaps in vocabulary, grammar, idioms, rhetoric, etc. (Duanmu Qingyi, 2004). There are three main cognitive schemas that determine reading ability: language cognitive schema, content cognitive schema, and structural cognitive schema. In reading teaching, teachers should adopt various methods and strategies to help students form, activate, and apply various cognitive schemas related to reading (Wang Yaomei and Zhang Xueguang, 2009). Teachers have the responsibility to construct and activate students’ cognitive schema knowledge, be good at judging and solving different problems that students encounter in reading, guide students to construct more cognitive schemas, and develop their language and application abilities (Cui Yaping, 2002).

The cognitive schema theory applied in listening teaching is not only effective in enhancing students’ understanding of listening materials, eliminating mishearings and ambiguities, but also in focusing students’ attention and predicting subsequent listening materials (Chen Pin, 2010); to improve
the English listening comprehension of non-English majors in China, it is necessary to start with rich cognitive schema, followed by the guidance, supervision, and checking of teachers (Li Wenying, 2005). Teachers can use the two ways of assimilation and accommodation in the cognitive schema theory to promote vocabulary learning for students (Yang Haining, 2009); systematically studying the polysemy phenomenon with the intentionality cognitive schema theory can explain the internal cognitive mechanism of a generated semantic dimension, and thus help students grasp the semantic extension of polysemous words and understand the inherent connections among different semantic dimensions in the polysemy network of prepositions (Wu Yinbainana, 2012). The cognitive schema theory also has a significant impact on translation and interpretation teaching. In the translation process, when decoding the source text, the translator not only needs to activate the cognitive schema related to the text, but also needs to enrich their own knowledge and cultural cognitive schema; when decoding the target language, the translator not only needs to activate the cognitive schema of the reader, but also needs to help establish new cognitive schema for the target language reader (Wang Xueming, 2006). The cognitive schema theory also has great inspiration for interpretation, as cognitive schema can not only accelerate the process of interpretation comprehension, but also simplify the process of memory and improve memory speed (Yang Xianming and He Mingxia, 2007).

The Flipped Classroom Based on Cognitive Schema Theory

Before Class

Owing to notable divergences in the preparatory phases of the flipped classroom model vis-à-vis the conventional classroom approach, their respective underlying conceptual frameworks display distinct dissimilarities. Notably, cognitive schema theory provides a more comprehensive account of the contrasts and potential benefits between these two pedagogical methodologies.

Pre-Teaching Stages of Flipped Classroom

Existing cognitive schemas in the brain play a decisive role in students’ learning activities. Cognitive schema, as a set of organized concepts, constitutes the internal activity of students’ perception of the world, forming a network system of longitudinal and transverse connections in the brain. Each student is an independent individual, and their personal experiences and perspectives on problems are different, which means that their cognitive schemas in the brain are also different. According to the cognitive schema theory, when students learn a new set of concepts or knowledge system, they need to link the input information with known information or background knowledge, so that the input information interacts with known knowledge, resonating with each other and promoting the absorption and understanding of new knowledge.

The important criterion for determining whether flipping a class is successful is whether the pre-class learning achieves the same effect as traditional classroom teaching, and whether students have internalized the content of the course during class (Zhang Jinlei, 2013). In the pre-teaching stage of flipped classroom, teachers typically complete two teaching activities. Firstly, teachers need to perform effective instructional design, conduct student analysis, and design teaching objectives accordingly based on teaching goals, taking into full consideration the existing cognitive schema of different students. Therefore, flipped classroom emphasizes the refinement of teaching objectives, breaking down complex teaching objectives into smaller objectives to facilitate different students to link old and new information together. Secondly, teachers need to select and create teaching content. Based on the design of micro-courses, teachers should choose teaching content that corresponds to refined teaching objectives and focuses on knowledge points and test question banks. The presentation of teaching content is mainly through videos and courseware, which can be obtained from online public courses or made by teachers in advance. Designing hierarchical teaching content according to the characteristics of students is conducive to continual activation and construction of students’ cognitive schema.
As the teaching content is the material for students’ autonomous learning, teachers should not only reproduce simple textbook knowledge or create difficult collections of points that students cannot understand, but also design materials that are conducive to the association between old and new information and the understanding of new cognitive schema. Teachers should also design pre-class learning tasks based on the selected teaching content, such as quizzes and questions, to promote and help students absorb knowledge and solve problems. Piaget’s cognitive schema assimilation theory defines assimilation as the filtering and changing of stimulus input, which is the process by which the subject incorporates external stimuli into their existing or forming cognitive schema. Piaget’s cognitive schema accommodation theory refers to the adaptation and adjustment the subject makes when their existing cognitive schema is unable to assimilate new information to adapt to the reality of the phenomenon (Brown, 1979). Therefore, in the pre-teaching stage, students’ cognitive schema undergoes assimilation and corresponding accommodation for comprehensible difficult knowledge. New information that is difficult to master and assimilate occurs in-class with the guidance of the teacher. With the development of students’ cognitive schema, their understanding of the learning content also deepens. With the emergence of new learning content and new problems, students’ assimilation and accommodation also become richer, and their cognitive structures are constantly updated.

Before the flipped classroom, students’ main activity was to use information technology to understand learning tasks and watch videos or other learning materials (Yu et al., 2022). Students need to self-learn the detailed teaching objectives, clarify learning tasks, and choose appropriate learning content based on their characteristics. According to cognitive schema theory, when people understand and absorb input information, they need to associate input information with background knowledge. The decoding and encoding of input information depend on existing cognitive schema, frameworks, and networks in the brain. Input information must match these cognitive schemas to complete the process of information processing (Liu Shaolong, 1996). Carrell (1983) also pointed out that when we understand new information, we interpret it based on our existing background, cognitive schema. Therefore, students can choose appropriate learning content and understand new content schemas based on their existing cognitive schemas. Through watching teacher-provided learning videos and other materials on the network, when students cannot assimilate new content, they can not only choose pause, playback and other functions but also ask questions on the communication platform to facilitate thinking and reunderstanding, activating existing cognitive schemas, and continuing to construct new cognitive schemas, thus achieving autonomous learning smoothly. It is not enough to have only certain cognitive schemas in mind. What is more important is to activate them at the appropriate time, making them assimilate and accommodate. In this way, activated cognitive schemas can awaken details at the core of cognitive schemas, making full preparations for constructing new cognitive schemas, accepting new content, and completing in-class learning tasks. The learning process before the flipped classroom and constructivism, which advocates that “learning is the process of acquiring knowledge, but knowledge is not imparted by teachers, but rather is obtained by students through meaningful construction, utilizing relevant learning materials, with the help of others, including teachers and learning partners, and is realized through interpersonal collaborative activities” are basically consistent (He Kekang, 1997).

**Pre-Class Activities in Traditional Classrooms**

Traditional classroom teaching rarely involves pre-class autonomous learning activities. Even if there are corresponding preparations, the results are not satisfactory due to the lack of necessary understandable learning materials. Students’ existing cognitive schemas are different, and the pre-class activities in traditional classrooms ignore these individual differences of students. The teaching preparation done by the teacher before class only gives guidance and explanation to the students during class, and cannot directly or indirectly affect or participate in the students’ pre-class previewing. The materials that students can obtain before class are mainly based on the unified textbook, which cannot
be associated with their existing cognitive schemas in a targeted manner, leading to a poor effect of pre-class previewing. However, in the flipped classroom, due to the subdivision of learning objectives, students can smoothly choose learning content that can interact with their existing cognitive schemas, effectively completing pre-class learning activities.

If cognitive schema is richer, correct and realistic, the recognition is accelerated and understanding is deepened; if cognitive schema is deficient or incomplete, the recognition is slowed down, and understanding is biased (Huang Zidong, 1998). This viewpoint explains the differences and advantages and disadvantages of pre-class activities in flipped classrooms and traditional classrooms well. Understanding and memory are not simply repetitions, but a reconstruction. In an experiment, the subjects read an English original text of a story one day before retelling the story, and when retelling the story based on an abbreviated version they read on the day of the experiment, they still mentioned many details that appeared in the English original text they read one day before, even though they were asked to retell based on the abbreviated version. This indicates that the content read one day before has been deeply stored in the existing cognitive schema, forming a new cognitive schema that affects the subjects’ understanding, memory and retelling of the abbreviated version of the story (Bao Liying, He Miaobo, 2004). This study fully demonstrates the importance of pre-learning activities and appropriate pre-learning materials. Flipped classrooms can improve learners’ learning engagement, achieve high-level skill cultivation and deep learning of learners (Bu Caili, Zhang Wenlan, Zhang Baohui, Zhu Miao, 2017), and lay a good foundation for in-class and post-class learning.

During Class

The theory of cognitive schemas possesses the capacity to delve into the varied instructional outcomes ensuing from in-class instructional activities implemented in flipped and traditional classrooms. Furthermore, explication of the underlying theoretical mechanisms underpinning these effects can be facilitated by this framework, thereby providing impetus for the advancement of in-class instructional practices. (Zhang Xiaoyan, 2018)

In-Class Activities in Flipped Classrooms

After the activation and construction of cognitive schema in the pre-class stage, the learning activities in-class already have a new cognitive schema foundation. As schema is the foundation of cognition, once it forms in the brain, it will re-understand and remember subsequent information. When people absorb and input information, they need to relate it to existing information. The organization and understanding of new knowledge rely on the cognitive schema network that has already formed in the brain. Input information must match these information networks, so that the cognitive schema can function and complete the information processing process from input to understanding and memory, thus completing the process of understanding new information. The in-class part of the flipped classroom has already had one more cognitive schema construction and improvement compared to traditional classrooms, which provides a solid learning foundation.

During the in-class session, the teacher’s main task is to create an environment, divide students into learning groups, and promote peer discussion. In mutual discussion, students can promptly realize their knowledge gaps and errors, make adjustments, and complete the assimilation and adaptation of cognitive schema. Group inquiry-based learning considers each student, enabling each student to become the master of the learning activity, which helps to actively construct their own unique cognitive schema. Secondly, the teacher should serve as the organizer and guide of teaching activities, help students develop learning plans and use learning tools, help students discover and solve problems, provide guidance and explanations when necessary, and improve the construction of students’ cognitive schema. Since schema can be grown, adjusted, and newly created, students can expand their cognitive schema based on the pre-class schema they have constructed by adding new content to it. When they find that the existing schema is incorrect or inappropriate for new situations, they can modify the existing schema. When encountering completely new things or
experiences, they can construct new schema (Ni Rong, 2004). Therefore, based on the new cognitive schema constructed before class, students can further improve their existing cognitive schema during class with the help of teacher correction and expansion, which deepens their memory and understanding of the learning content.

During class, students can independently explore small problems, receive timely guidance from the teacher, complete the adaptation of knowledge content and cognitive schema, improve their autonomous learning ability, and build their own independent knowledge system and unique cognitive schema. Students can also participate in collaborative learning, developing individual thinking skills and personal cognitive schema through active learning methods such as competition, debate, design, cooperation, and role-playing, and enhancing communication and exchange abilities among individuals, forming critical and innovative thinking. Piaget believed that objects can only be recognized by subjects through the transformation and processing of subject cognitive structures. In a flipped classroom, each student can participate in the learning process as a subject and process and transform the learning content as an object, forming their unique cognitive schema with the assistance of educational technologies such as augmented realities (Yu, 2023). The degree of subject understanding of the object depends entirely on the subject’s cognitive schema. After transforming and sorting the appropriate stimulation of new information, the subject can transform it into a form that the cognitive structure can absorb and effectively assimilate new information (Brown, 1979).

In the flipped classroom, students already have the cognitive schema foundation to understand the content in class beforehand, and the in-class process is the process of transforming and sorting new information for students, ensuring their understanding and absorption of the learning content.

**In-Class Activities in Traditional Classrooms**

Every understanding of knowledge requires the involvement of learners’ existing knowledge (Anderson, 1977). Students in traditional classrooms have not established a complete cognitive schema for in-class learning content, resulting in a failure of new and old information matching and affecting their understanding of in-class knowledge. In traditional classrooms, teachers mainly teach through language, which is an information system. Language information systems are carried in the brain’s neural network. To generate or understand information carried in language, the brain must have corresponding information. The lack of corresponding cognitive schema for the knowledge being taught will result in the failure of information transmission (Cheng, Q. L., 1999). If students lack corresponding cognitive schema for the knowledge being taught, their understanding and memory abilities will be quite poor, and they will not be able to discern the true meaning of the knowledge being taught, and even attempt to modify the details “to tell a more coherent, accurate, and undecorated story,” resulting in understanding deviations (Bartlett, 1932).

Not only the lack of cognitive schema affects the understanding ability of students in traditional classrooms, but the failure to successfully activate cognitive schema is also a significant factor. There are two main reasons for the failure to activate cognitive schema in traditional classrooms. In some cases, students may have appropriate cognitive schema, but activating the corresponding cognitive schema is often influenced by social and psychological factors, such as exam pressure, anxiety, distress, embarrassment, and even biases against teachers, which prevent students from focusing on learning and activating their existing cognitive schema to accommodate new knowledge. However, this deficiency can be remedied in flipped classrooms. The main form of in-class activities in flipped classrooms is cooperative learning, where teachers only play a guiding role, and student-to-student communication is the leading mode. Students learn from each other and solve problems together. In traditional classrooms, the teacher is the dominant voice, and it is difficult for teachers to consider each student’s prior knowledge of new concepts, and it is challenging for students to passively receive the content taught by the teacher. Students with different cognitive schema cannot receive the same new information stimuli, making it difficult to process and transform new knowledge and assimilate or adapt it into the form they can absorb.
Even if students in traditional classrooms have corresponding cognitive schema and can receive appropriate stimuli, it cannot guarantee smooth understanding. Students with different cognitive schema will process the same input information differently, leading to different conclusions (Bao et al., 2004). For the same sentence or knowledge point, students will draw different conclusions from their own experiences. For example, in physics, although students have a basic cognitive schema of buoyancy from daily life before class, and the teacher has made corresponding explanations in class, when analyzing the force on objects with the same weight, students often only analyze the gravity of the stone and ignore the buoyancy it receives; or for objects with the same volume, students will mistakenly think that the buoyancy force on the iron block is greater than that on the gold. In the cooperative interactive learning of flipped classrooms, the probability of misunderstanding information will be significantly reduced.

**After Class**

The teaching methodologies employed in flipped classrooms and traditional classrooms diverge substantially with regard to the provision of post-class instructional content. Additionally, the theoretical underpinnings and pragmatic outcomes emanating from these pedagogical strategies can be elucidated via the framework of cognitive schemas.

The objective of flipped classrooms in the aftermath of instruction is to engage in critical introspection and to deepen the acquired knowledge. The purpose is to facilitate a personalized network construction of cognitive schemas and their consolidation amongst the students. Pre-class activities such as self-study, problem-solving and interactive discussions enable learners to establish certain cognitive schemas. The post-class learning phase comprising of homework is designed to bolster the development of critical thinking and promote reflection and introspection. The assigned tasks post-class are primarily focused on interactive discussions with written requirements serving as a supplementary approach. In so doing, cognitive schemas characterized by apparent individual differences can be incessantly enhanced, sustained, and refined.

On the contrary, the teaching goal of traditional classrooms is to consolidate and improve the content taught during face-to-face classes. Face-to-face classes often impose knowledge on students, even if their cognitive schema have difficulty accepting and integrating it into their knowledge framework, they must make difficult adaptations. As a result, a uniform cognitive schema is forcibly constructed. Learners who can adapt have constructed cognitive schema that are suitable for the teacher’s teaching, and may continue to stumble forward. Those who cannot adapt have changed their original cognitive schema characteristics while forcibly adapting, but still cannot construct cognitive schema suitable for accepting taught knowledge, resulting in low learning efficiency. Homework that focuses on written assignments and is supplemented by discussion also erases the principle of personalized teaching, neglects individual differences in cognitive schema, and reduces learning efficiency.

Even if students in traditional classrooms have corresponding cognitive schemas and can accept appropriate stimuli, there is no guarantee that understanding will proceed smoothly. Students with different cognitive schemas process the same information input differently, leading to different conclusions. For the same sentence or knowledge point, students will draw different conclusions based on their own experience. For example, in physics, the concept of buoyancy, although students have basic cognitive schema for buoyancy in daily life before the class and the teacher has explained it correspondingly in class, students often only analyze the weight of stones and ignore their buoyancy when analyzing forces, or incorrectly believe that the buoyancy of an iron block with the same volume is greater than that of a gold block. In flipped classrooms and interactive learning between classmates and teachers, the probability of students misunderstanding significantly decreases.
CONCLUSION

The reason why flipped classrooms can achieve success in practice is that, compared with traditional classrooms, two effective cognitive schema constructions have been carried out, emphasizing that knowledge imparting should be placed before the class, and students can independently learn the course content in a relaxed learning atmosphere. The learning material is concise and powerful teaching videos, which can achieve various functions such as pause, replay, and fast forward through media players. Therefore, students with different cognitive schemas have more time to establish a relationship between the course content and their existing cognitive schemas, build or improve cognitive schemas, and complete the understanding of the learning content. Traditional classrooms emphasize imparting knowledge first, and teachers are owners and disseminators of knowledge, ignoring differences in students’ cognitive schemas and neglecting students’ individual needs. Students are in a passive position to receive knowledge and must be on high alert to prevent missing knowledge points. Once they fail to establish a relationship between new content taught by teachers and their existing cognitive schemas in time, students cannot grasp new content, their emotions are affected, their ability to build cognitive schemas weakens, leading to a vicious cycle. However, based on students’ pre-class cognitive schema improvement, flipped classrooms organize and guide students to further assimilate and adapt to cognitive schemas through forms such as Q&A, group exploration, and collaborative learning, avoiding the compulsory nature of learning content and the dependency of thinking processes in traditional classrooms. As a platform for consolidating knowledge, the classroom provides sufficient time for classroom interaction and student-student collaboration, providing the possibility for students to supplement, modify, and improve cognitive schemas.

Although flipped classrooms have achieved great success and attracted widespread attention at home and abroad, they also face some constraints and challenges. One limitation is the networked teaching environment. The reason why flipped classrooms have not been widely promoted in a larger scope is that not every teacher can produce pre-class teaching videos. In China, currently only some schools in developed areas in the eastern region and a few large cities have a networked teaching environment, while schools or students in the central and western regions are still lacking in support of a networked teaching environment. Another limitation is the scope of application of flipped classrooms. Due to the weak knowledge and self-learning ability of primary school students, flipped classrooms are not suitable for compulsory education (Wang Xiaobo & Mu Yanna, 2014). One of the challenges is the development and production of teaching resources. The teaching content and knowledge system of each subject are significantly different. To comprehensively promote this new model of flipped classrooms, numerous micro-videos are required, but currently, China still lacks institutions similar to “Khan Academy”. Another challenge is teachers’ educational concepts and teaching ideas. Traditional teaching emphasizes “teacher dignity”, with teachers at the center and as the main role in the student learning process. However, flipped classrooms focus more on students’ autonomous exploration and collaborative learning under teacher guidance to promote the internalization of cognitive schemas. To carry out flipped classrooms well, teachers need to combine the advantages of traditional teaching and networked teaching and learning modes, both playing a leading role in guiding the teaching process and reflecting the autonomy of students as the learning subject.

One implication of cognitive schemas for flipped classrooms is that they can affect students’ ability to comprehend and construct meaning from the pre-class material. If the content presented in the pre-class material does not align with students’ cognitive schemas, they may struggle to understand it and fail to make connections with their existing knowledge. As such, flipped classroom instructors may need to identify and address potential mismatches between students’ cognitive schemas and the pre-class material to ensure effective learning.

Another implication of cognitive schemas is that flipped classrooms can facilitate schema refinement and integration. By using class time to work on problems or discuss cases that apply the pre-class material, students can refine their cognitive schemas and integrate new information...
with existing knowledge. This can lead to deeper understanding and better retention of the material. Finally, the use of cognitive schemas can support student-centered learning in flipped classrooms. By allowing students to bring their own knowledge and experiences to the classroom, instructors can leverage these cognitive schemas to facilitate learning. Instructors can draw on students’ cognitive schemas to foster discussions, debates, and collaborative problem-solving activities that promote critical thinking skills.
REFERENCES


He, K. (2014). The future development of “flipped classroom” in China: An analysis from the essence of the “flipped classroom”. Distance Education Research, 7, 5–16.


