

# Feasibility Study of Visual Teaching Materials in Flipped Classroom Based on Network in Clinical Medicine Internal Medicine Education

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**Abstract:** In order to meet the needs of talent cultivation and education informatization in colleges in the era of “Internet +”, this study takes the visual teaching materials “Clinical Thinking of Internal Medicine” and “Nephrology”, based on the network flipped classroom as examples to explore the construction and application mode of new form teaching materials from the characteristics of undergraduate teaching in clinical internal medicine. This web-based visual teaching material for the flipped classroom fully integrates the basic knowledge of internal medicine with clinical applications, forming a new form of teaching materials with rich teaching content and flexible teaching methods.

**Keywords:** Flipped classroom; Visual teaching materials; Internal medicine; Education

The research on clinical teaching has always been a highly concerned with many contradictory issue in the undergraduate medical education in clinical teaching. Emerging online learning and teaching methods such as MOOCs and micro-courses have gradually shown their advantages in medical clinical education. The reform of visual teaching materials makes the content of textbooks visualized, thereby expanding the learning content of undergraduate clinical internships, improving the targeted, depth, and breadth of internship content, and further enhancing the integration of basic knowledge and clinical thinking of undergraduate medical students. However, visual teaching materials are mostly produced by individual teachers, lacking of unity, and homogenization. This study discusses the use of homogeneous visual teaching materials for clinical diseases and nephrology in flipped classroom teaching, comparing the differences in students’ knowledge mastery, clinical thinking, practical skills, teamwork, and student evaluations between flipped classroom (FC) and traditional lecture-based teaching (LBL). It will help students develop clinical thinking, cultivate practical skills, and establish teamwork. At the same time, in the practice of FC teaching, the visual teaching materials for common internal medicine diseases and kidney diseases were established according to the teaching outline, this study lay the foundation and accumulating experience and materials for conducting flipped classroom teaching based on visual teaching materials in clinical teaching activities.

## 1. Feasibility of Introducing Visual Teaching Materials as Flipped Classroom Materials for Undergraduate Internal Medicine Education

In 2022, the Ministry of Education listed “implementing the strategic action of digital education” as one of the key tasks and pointed out that we should actively develop the educational mode of “Internet plus education” and accelerate the transformation and intelligent upgrade of education; deepen the application of online learning space, improve classroom teaching modes and student assessment methods; deepen the integration of information technology and educational innovation, and promote education towards digitization, networking, and intelligence<sup>[1]</sup>. Therefore, the new form of visual digital teaching materials is an important way of teaching transformation at present. Establishing network-based teaching materials and using the new flipped education model to guide medical students to self-study is a teaching method that conforms to the characteristics of the times. With the advancement of medical science and technology, internal medicine undergoes rapid changes in etiology, diagnosis, and treatment. The content of textbooks is relatively outdated, while visual teaching materials produced by clinical teachers based on the latest and most closely connected to clinical practice provide students with a clearer understanding of internal and kidney diseases. Visual teaching is a way to present teaching content more intuitively, guiding students to form clear representations of all aspects of the diseases they are learning about, and has the intuitiveness required in clinical medical education.

The flipped classroom is an emerging teaching form that can organically combine the learning of network visual materials and classroom teaching. In the past two years, the flipped classroom has flourished abroad and has gradually begun to be used in medical education, with explorations and practices<sup>[2, 3]</sup>. The students learn and check their own learning effects on the network. Then, in the classroom, students master

and internalize knowledge under the guidance of teachers, achieving the reverse of learning and teaching. Using visual teaching materials in the teaching of clinical internal diseases and nephrology and using the flipped classroom learning method is conducive to promoting active learning and enhancing students' enthusiasm for classroom participation, improving their mastery of disease knowledge. Educational workers in medical colleges and universities have adopted flipped classroom teaching in basic medical education and found that students can make careful and sufficient preparations before class, and actively participate in classroom activities<sup>[4]</sup>. Therefore, the flipped classroom can effectively promote the basic medical education of medical students. Because the flipped classroom effectively promotes students' independent learning, thinking, and strengthens classroom communication, it meets the requirements of undergraduate clinical medical internal medicine education and provides new ideas for the reform of undergraduate clinical medical education.

## 2. Curriculum Content and Teaching Materials Construction

Based on the undergraduate teaching outline and the development of clinical medical knowledge, the teaching team conducted content setting and video-based teaching material writing for the diseases of clinical internal medicine and nephrology. The course content covers the etiology, clinical manifestations, diagnostic criteria, treatment, etc., of common diseases in internal medicine and kidney diseases, covering the needs of 4th-year clinical medical intern students. The course content is closely integrated with clinical practice, with good representativeness and practicality.

The teaching group established the video-based MOOC teaching materials for Clinical Thinking in Internal Medicine and Nephrology, which were published on the Zhishi Shu platform and can be viewed and studied synchronously with the Zhida mobile app. It can meet the online teaching before flipping the classroom more conveniently and quickly. The visual teaching materials published on the network platform realize the hybrid teaching model of online and offline flipping classroom, greatly facilitating teachers to conduct online or hybrid teaching, and providing students with a more convenient and quick learning path. Currently, these two sets of visual teaching materials, Clinical Thinking in Internal Medicine and Nephrology, have been used by tens of thousands of students at ten universities, including Zhejiang University, for the study of internal medicine, including nephrology, in clinical medical undergraduate students, and have received good evaluations and feedback. The video teaching materials not only include the explanation of disease content but also include pop-up questions related to the knowledge points to inspire students' thinking during pre-class preview, enhancing their participation in subsequent classroom teaching.

## 3. Design and Establishment of Teaching Methods

This study established visual teaching materials and implemented the flipped classroom (FC) in the undergraduate nephrology internship teaching. A comparison was made between FC and traditional lecture-based teaching (LBL) in the course of internal medicine and nephrology. The comparison encompassed students' knowledge mastery, clinical thinking, practical skills, teamwork, and student evaluations of the courses. Unlike the traditional face-to-face teaching method, this advanced online teaching model breaks the boundaries of the traditional 45-minute classroom and divides the learning into two parts: in-class and out-of-class. It fully utilizes students' out-of-class time for autonomous learning. The teaching team transformed the teacher's explanatory PPT into interactive visual teaching materials in the form of videos, emphasizing disease definitions, pathogenesis, clinical features, and treatment principles. At least one week before class, teachers provide visual teaching materials including video images, text, pictures, and MOOC lectures, and pop-up task sheets on the online platform, which students must study independently. Additionally, students are encouraged to search and expand content through the Internet, providing students with materials to test their knowledge mastery. Tasks in the visual teaching materials are designed for students and student groups to be self-taught and discussed in class, and video quizzes are conducted afterward. In-class teaching then focuses on interactive learning and in-depth analysis through the discussion of clinical cases, with an emphasis on clinical thinking, analytical application, and comprehensive management. The blended learning model is created by independent study and group discussion, enabling the online flipped classroom teaching model.

## 4. Effectiveness Evaluation of Visual Teaching Materials in Flipped Classroom Based on Network in Clinical Medicine Internal Medicine Education

The effectiveness evaluation of the flipped classroom with visual teaching materials for internal medicine should include the evaluation of pre-class learning, in-class teaching, and teaching outcomes. The evaluation methods should include student and teacher evaluations of the appropriateness and effectiveness of teaching materials, the effectiveness of in-class processes, the mastery level of knowledge points, and improvement suggestions for overall evaluations. Both students and teachers should provide feedback through questionnaires, covering the adequacy of teaching materials, the interactive effect of classroom teaching, and the resolution of problems encountered by students through self-study. The evaluation is graded as strongly recommended, recommended, neutral, or not recommended, and feedback is collected for the main reasons for not recommending. After the completion of the teaching process, ten teachers and 28 internal medicine interns completed a questionnaire survey on the flipped classroom teaching of internal medicine. The feedback data is automatically collected through the ques-

tionnaire survey.

Most students recommend the application of the flipped classroom in the teaching of clinical diseases, but due to changes in learning and assessment methods, some students express concerns about their assessment grades, resulting in some students holding a neutral or opposing attitude. Most teachers recommend the use of the flipped classroom for the course reform of internal medicine diseases, believing that the flipped classroom can increase students' interest in learning clinical diseases, clearly improve the enthusiasm for independent learning, and positively promote clinical thinking. In general, students (78.6%) and teachers (80%) acknowledge the effectiveness of the flipped classroom with visual teaching materials based on web platforms for internal medicine.

## 5. Sharing of Experience in the Construction and Use of Visual Teaching Materials for Network-based Flipped Classroom

The combination of students' autonomous learning ability and knowledge application ability realizes the internalization of knowledge from external to internal. Both knowledge delivery and internalization are included in medical internal medicine education. In the traditional teaching mode, the transmission of professional knowledge is completed in the classroom, which often is a teacher's one-way output and transmission to the students. Under the advanced online teaching model of the flipped classroom based on the network, the transmission of knowledge is mainly pushed to outside the classroom, achieving autonomous learning before class, during class, and after class. The construction of visual teaching materials for the flipped classroom for undergraduate internal medicine education in clinical medicine keeps pace with the times, explores new teaching methods, and builds a new course material system, providing new ideas for classroom teaching reform in the new era of Internet +.

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