

Meta synthesis design for entrepreneur engineering education using flipped classroom based on m-learning

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ABSTRACT: With the development of mobile technology and the popularity of smartphones, tablets and so on, m-learning has started to become popular around the world and a hot spot of education research. M-learning has greatly satisfied the personalised demands of learners. Studying the effective integration of m-learning and flipped classroom plays a positive role in improving the teaching effect. Using mobile Internet and information technology education, combined with the characteristics of the flipped classroom, meta synthesis was introduced to design the mobile platform for entrepreneur engineering education and classroom teaching modes. The authors designed a heuristic classroom learning arrangement to realise the personalised service for students' entrepreneur engineering education. Empirical studies show that the flipped classroom based on m-learning has a positive role in improving students' learning motivation and cooperation ability, learning efficiency and satisfaction in class.

INTRODUCTION

Entrepreneurial engineering education is promoted as a national strategy for improving talent development in China. It is important for higher education from the perspective of students' comprehensive ability, and even in the discipline of management science. University students' entrepreneur engineering education aims to promote entrepreneurship and the all-around development of university students. The education content should revolve around ...*awareness and psychology, knowledge basis and structure and entrepreneurship practical abilities* [1]. Therefore, entrepreneur engineering education should not be limited to knowledge transmission, but should also emphasise the cultivation of students' practical abilities. This puts forward a higher requirement for students to be subjects during the teaching process and to obtain personalised guidance. Flipped classroom offers a new strategy for the design of entrepreneur engineering courses.

Traditional education procedures are as below: teachers transmit knowledge through class-room instruction and promote knowledge internalisation through homework. Flipped classroom is an inverted arrangement of traditional teaching procedures [2-5]. It moves knowledge transmission procedures from the classroom to outdoors, enabling students to complete their knowledge acquisition independently and collaboratively by watching teaching videos, courseware or Internet resources made by teachers. In this way, the classroom becomes the place where teachers solve students' puzzles, guide them to finish homework and discuss questions and give individualised guidance to students. Therefore, in the flipped classroom, the role and position of teachers and students have undergone dramatic changes.

Teachers turn from being teaching leaders and controllers to becoming teaching organisers and guides, while students turn from passive receivers into knowledge builders and subjects of the whole teaching process, independently or collaboratively exploring and building knowledge and achieving personalised learning. Therefore, it can be seen that the flipped classroom is a new-type teaching model, which achieves knowledge internalisation for students through students' independent or collaborative learning of teaching videos, courseware, texts and other teaching resources before class; and problem solution, collaborative discussion and interaction in class. It can promote the realisation of personalised teaching and the cultivation of students' learning abilities, contribute to teaching students in accordance with their aptitude, and respond to the development requirements of the learning society in the information era.

M-learning is a new digital learning form generated by the combination of mobile techniques and e-learning developments [6-7]. Smartphones, tablet PCs and other mobile electronic devices have provided a solid foundation for sound development of m-learning. As a learning model, m-learning has become a favourable supplement and the advanced form of the e-learning model. With the rapid development of mobile Internet techniques, when the flipped classroom encounters m-learning, its teaching innovations and learning experiences are injected with brand-new vigour.

Therefore, further innovation and improvement of the flipped classroom can promote the reform of entrepreneur engineering education courses.

FUNCTIONS AND STRUCTURES OF M-LEARNING PLATFORM

The study platform of the flipped classroom based on m-learning aims at providing students with an instructive learning route by scientific re-planning and systematic design. The flipped classroom creates a mobile class that is easy for teachers and students to possess, manage and maintain, regarding the combination of functional integrity and operational feasibility. It incorporates *mobile micro-lectures, mobile micro-assessment, off-line learning, micro-files, interaction and communication, project groups, mobile micro-simulation, outcome micro-display, entrepreneurship information, and statistics reports* by integrated teaching function design.

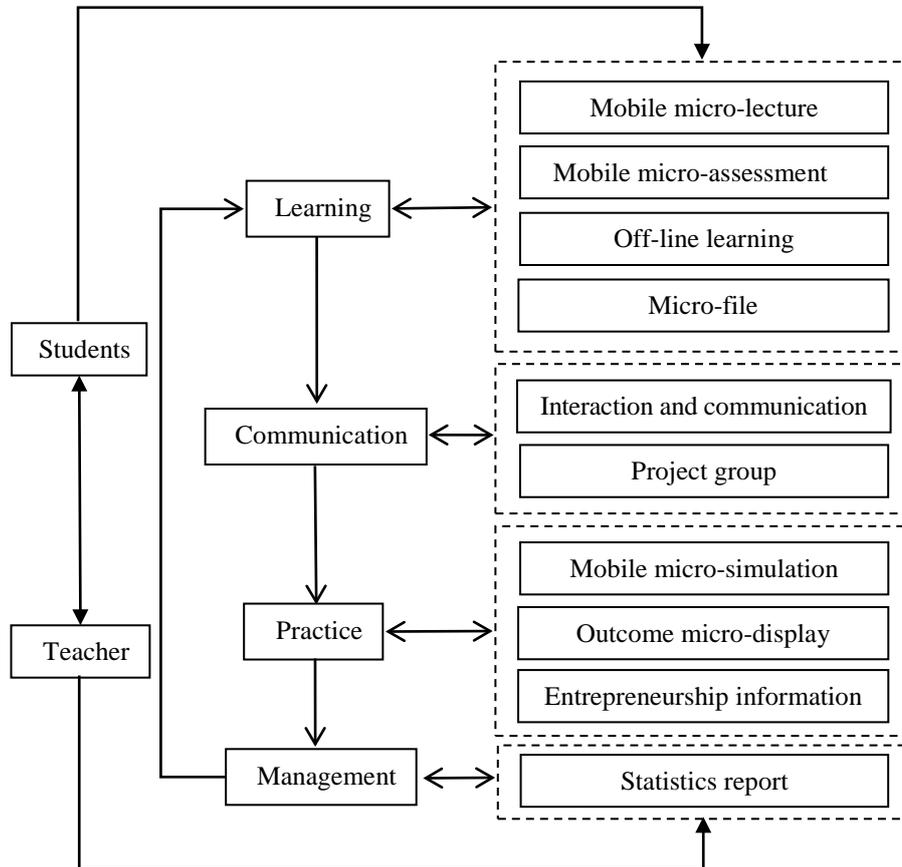


Figure 1: Functions and structures of m-learning platform.

Mobile Micro-lectures

Teaching resources, such as basic theories of entrepreneurship, analysis of successful entrepreneurship cases and entrepreneurship videos are included. Three requirements have to be met: 1) being suitable for self-learning without real lecturer who is standing aside; 2) being able to interpret more than one full piece of knowledge by established teaching logic; and 3) the learning progress and results can be tracked and managed.

Mobile Micro-assessment

Functions, such as class voting interaction, class quizzes, off-line tests and entrepreneurship-associated psychological tests are included. It enables mutual feedback between students and teachers by class voting interaction, solving problems that limit teachers in assessing their students if taught in the traditional way and acting as an inspirational tool. Class quizzes should be limited to 10 minutes and the purpose of class quizzes is to help teachers learn about their students instead of testing them. Off-line tests broaden the space and time for testing students, facilitating students' completion of their assignments efficiently and making use of more resources. Entrepreneurship-associated psychological tests target the mentality and awareness of students, assist teachers in understanding the efficiency of the course content.

Off-line Learning

Off-line learning has been designed because of the low coverage of the Internet in China compared with Western countries, facilitating students' capacity to download interesting teaching resources and achieving off-line learning without the limitations of space and time.

Micro-file

Chinese students tend to take notes during learning. Micro-file realises the function of taking study notes, setting privacy permissions and sharing notes for students.

Interaction and Communication

The flipped classroom for entrepreneur engineering education requires smooth communication between students and teachers, otherwise it will be hard to achieve the purpose of the flipped classroom. However, influenced by Chinese traditional culture, Chinese students do not usually speak up in class, reducing the potential impact of communication. The function of interaction and communication will solve this problem as students can choose to speak up anonymously, achieving the unlimited communication between students and teachers.

Project Group

It is common to have group discussions and group practice sessions in entrepreneur engineering education classes, aimed at cultivating the group awareness and communication abilities of students. To meet the teaching aims, teachers can assign group tasks through project groups.

Mobile Micro-simulation

ERP (entrepreneurship resources planning) and table imitation is an experimental platform of role play designed for ERP, which represents advanced modern business operation and entrepreneurship management technology. Table imitation divides functions centres according to functional departments of manufacturing entrepreneurs, including a planning centre, production centre, logistics centre and financial centre. It is a mature technology for the simulation of entrepreneur engineering education with the design concept based on the combination of theory and practice and the incorporation of post experience and role play. This enables trainees to obtain scientific management rules, cultivate team spirit and improve management ability. By extending the off-line simulation to on-line simulation, it provides students with a more convenient way of gaining experience.

Outcome Micro-display

Practical training is the key link in the entrepreneur engineering education course. Based on past experience, many students of entrepreneurship education have been working on business-related work. Outcome micro-display serves as a presentation platform for those students, motivating others and inspiring students who are about to start up their own businesses.

Entrepreneurship Information

Entrepreneur engineering education is a dynamic advanced process and ordinary study resources cannot meet students' demands. Entrepreneurship information provides students with more abundant information and knowledge, including the latest policies of entrepreneurship, the latest analysis of market prospects and released information of entrepreneurs seeking cooperation, etc.

Statistics Report

Teachers and administrators can access students' school completion data, to know about students' learning status.

FLIPPED CLASSROOM TEACHING MODE BASED ON M-LEARNING

Combined with mobile Internet teaching, traditional face-to-face teaching can bring the superiority of mobile teaching into full play, and achieve the best results. As Gerstein puts it, a lesson is divided into four sections; namely, experience and study, explore the concept, construct the meaning, and show the application in the flipped classroom teaching mode [8]. The flipped classroom, which is based on mobile teaching and combined with traditional face-to-face teaching, needs continuous internal reactions and progress to get the best results. Based on this, this article puts forward design ideas for the flipped classroom.

On-line teaching has priority before and after classes, while off-line teaching has priority during classes. Students prepare lessons before the class, as well as experiencing the progress of learning and exploring the concept, then try to solve problems. After the class, they can have further reviewing and consolidation according to the present situation of their study. Students can also exchange learning outcomes and feedback about classroom teaching results on-line. Meanwhile, teachers mainly focus on the curriculum design, resources construction and on-line instruction. In addition, teachers analyse the teaching results and learning needs through data reports. As to off-line teaching, teachers mainly focus on case discussions, learning guides, problem support, imitational instruction and technical assistance. The flipped classroom, which is based on mobile teaching, perfectly integrates knowledge transfer and consolidation, team

collaboration, behaviour data tracking, quantitative evaluation, and so on. For this reason, students achieve well-segmented study, exchange information and receive personalised guidance, which reflect the feature of simple and quick collaboration. The above teaching modes mix the four sections of the flipped classroom together into three links: before class, during class, after class, and combines the flipped classroom teaching mode based on mobile teaching.

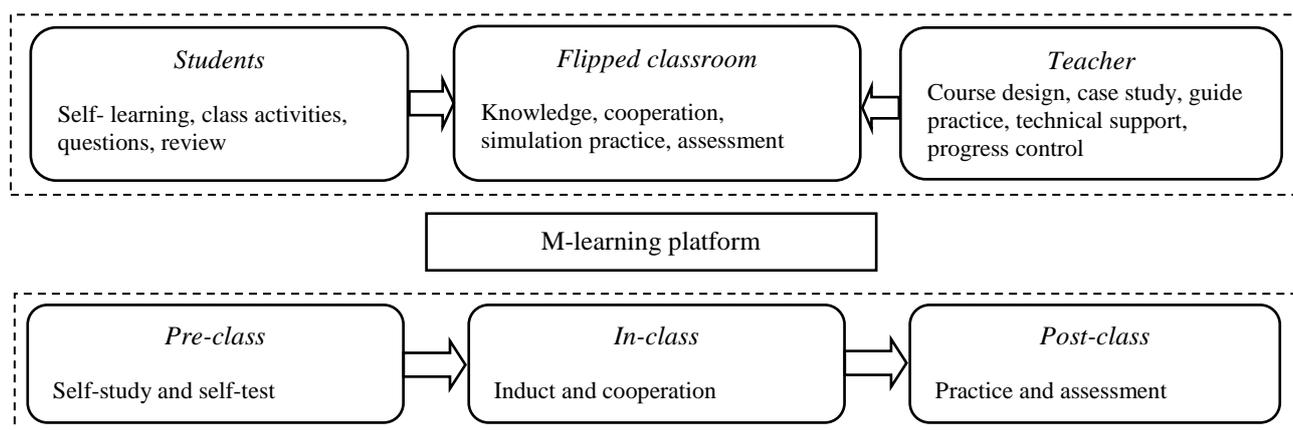


Figure 1: Flipped classroom teaching mode based on mobile learning.

DESIGNING THE FLIPPED CLASSROOM

Development of Curriculum

The design of guidance: the purpose of guidance design is to help students get clear goals, content and tasks of study. Students need to accomplish pre-lecture self-study after the implementation of the flipped classroom, thus, if the teachers cannot provide correct and proper guidance, the students will be directly impacted, leading to poor results. The characteristics of this guidance are as follows:

- The study goal, improving the ability to identify the entrepreneurial opportunity, cultivating the mode of thinking that will help to identify the chance of venture success.
- The content of study is the connotation of entrepreneurial opportunity, classification of entrepreneurial opportunity, source of entrepreneurial opportunity, and how to identify the entrepreneurial opportunity.
- The study tasks, mastering the key points after reading the guidance design carefully, and completing the exercises of how to identify the entrepreneurial opportunities through micro-classes.

The design and production of micro-classes: teachers have to learn to utilise professional office software like Adobe Captivate to help improve micro-classes, if long term micro-classes are needed for teaching assistance. This software can achieve professional electronic teaching content fast, which includes advanced interactive software, simulation of a scenario, Q&A sections and other attractive experiences, without requiring other programming and multi-media software skills. Identifying entrepreneurial opportunities is a more practical form of teaching content, thus, it should not include too much speech. In that case, 10-15 minutes micro-class should be enough. The content should include connotations of entrepreneurial opportunity, classification of entrepreneurial opportunity, sources of entrepreneurial opportunity and identification of entrepreneurial opportunity.

Uploading study materials to the study platform: normally, the materials need to be uploaded to the platform include multimedia and text materials. Multimedia materials include the micro-classes and courseware made by teachers, and micro-classes, courseware, videos, sound tracks downloaded from other study Web sites. Lectures about identification of entrepreneurial opportunity are not complicated, therefore, the practice is more important than speech giving. In this case, only one piece of video needs to be uploaded. For text materials, design guidance, entrepreneurial opportunity identification case studies and exercises for entrepreneurial opportunity identification are required.

Knowledge Lecturing

Remote supervision: teachers can send messages to every student to remind them of the need to accomplish the tasks on time. Teachers should interact with students on the mobile platform and give instructions to them, in order to be aware of their learning process. Teachers should keep a record of the questions that students ask and make inductive arrangements. For the more commonly asked questions by students, teachers should make special arrangements in the classroom to answer them all, whereas for questions from a minority of students, teachers can respond individually on-line. Another important task for teachers outside the classroom is to design class activities. The goal of class activity design is to, first, make sure the flipped classroom's implementation is based on pre-lecture self-study, then, to extend the class hours more and more, thus, improving the teaching effect and maximising students' mastering of knowledge. In the light of entrepreneurial opportunity, teachers should follow three principles when designing class activities:

- Design the activities based on the questions from students.
- Make sure practice is taken into consideration.
- Be helpful for the cooperative studying.

Self-study: in the flipped classroom, the process of lecturing has been put outside the classroom. Therefore, students can control the study process by themselves, and choose when and where to study a micro-class. All they need is a smartphone, which enables them to take the micro-class as they choose, and even enables them to search for courses that interest them on the Internet. After the exercises, students can interact with classmates and teachers on-line, if time allows. They might propose the questions they encounter in the process of opportunity identification or can they introduce the own experience in opportunity identification. The communication can be totally anonymous, so students will be more willing to voice their opinions and thoughts, leading teachers to receiving more thorough feedback.

Knowledge Internalisation

Teachers' instructions: the first task that a teacher has to complete is to answer the questions that students have encountered in pre-lecture study; that is the way to make sure that other study goals can be accomplished. But, group teaching should not be too long; 10-15 minutes would be enough for a brief exemplification. After a lecture, teachers might give out assignments. As explained before, teachers should already have designed class activities according to the feedback and features of study content, leaving teachers with only the need to announce tasks and requirements in the classroom.

Tasks relating to the identification of entrepreneurial opportunity: solve all the difficult points in the pre-lecture process, review basic theory of entrepreneurial opportunity identification, carry out group discussions focusing on more complicated tasks, present results from discussions and accomplish reciprocal evaluation of team members. After assignments, the teacher should give priority to the students, and make the students complete the tasks on their own. In the process of cooperative study, teachers should master the overall situation, giving due attention to each team's different stages in study. Teachers should correct them when a problem occurs, give the teams instructions when students need them, thus, ensuring that the students complete their tasks efficiently.

Students' collaborative learning: in the flipped classroom, study tasks are mainly accomplished by collaborative learning. Collaborative learning cultivates students' cooperative thinking, innovation spirit and communication skills, helping them to focus on communication and collaboratively assisting in the learning process. The ultimate goal of entrepreneur engineering education is to improve students' competence in entrepreneurship. A major factor in this is team cooperation. Thus, enlightening the collaborative learning in the teaching of entrepreneurship should be given priority. Solving pre-lecture problems can occur through group discussion. The revision of entrepreneurial opportunity identification can be accomplished through in-team Q&A sections. When discussing complicated questions about the identification of entrepreneurial opportunity, brainstorming can be used after the tasks of entrepreneurial opportunity identification, inter-team communication, study and corrections have been made.

Evaluation and Feedback

Teachers' summary: post class summaries can be classified into two parts: the evaluation of students' study condition, and evaluating how the tasks have been accomplished. In the entrepreneurial opportunity identification, each team will show a different situation. Teachers should, thus, analyse each group's answer discretely, provide an analysis of the advantages and drawbacks of different students and give feedback to each student. The two ways of achieving this are through students' feedback, and through the evaluation of the teaching effect and observation of the teaching process.

Students' revision: students should revise according to teachers' instructions and achieve specific goals. If a student feels that their basic knowledge is invalid, he or she can check the micro-class twice or more. If students feel the thinking of identification of entrepreneurial opportunity is not enough, they can give assignments to themselves and do relating exercises on the mobile platform.

ACTUAL RESULTS

In order to examine the effects of the teaching mode, the authors divided 90 students from different majors into the experimental group and the control group. The experimental group had their classes according to the innovation teaching mode, while the control group had their classes according to the conventional knowledge infusion mode. The following is what has been found: 1) students in the experimental group were more motivated in discussions. According to the statistical results, the percentage of speaking in classes was 46.7% in the experimental group, while 17.8% of the control group did so. Moreover, students in the experimental group discussed much more on the mobile platform and the topic was not restricted to tasks assigned by the teacher; 2) the experimental group had an active attitude to participating in the business simulation training and were willing to spend time on it, while the other group was willing to spend time on reviewing the knowledge; 3) the experimental group had higher efficiency in learning, which could be attributed to the reduction of 10% in completion of the teaching task. In the final examination, their average scores were

4.8% higher than the control group; and 4) students in the experimental group had higher class satisfaction, which averaged 89%, compared with 78% for the control group.

CONCLUSIONS

The flipped classroom based on m-learning embodies the idea that ...*students are the main body of teaching, teachers are not dominant* [9]. In entrepreneurship training, the use of mobile Internet and educational information technology, combined with the characteristics of the flipped classroom, creates an m-learning platform for teachers and students to use and maintain the entrepreneur engineering education.

The classroom teaching mode was also redesigned, which improved students' learning motivation, cooperation ability and learning efficiency. This new teaching model can further improve classroom satisfaction and also embodies the learning wisdom of the times.

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