Received: November 25, 2017
Revision received: July 15, 2018
Accepted: July 20, 2018

www.estp.com.tr
DOI 10.12738/estp.2018.6.245 ♦ December 2018 ♦ 18(6) ♦ 3392-3399

Research Article

Innovation Method of Architectural Physics Teaching Based on Flipped Classroom Idea*

Ying He[1]
Chongqing University

Xinshuo Zhang[2]
Chongqing University

Jing Wu[3]
Chongqing University

Jingfeng Xu[4]
Chongqing University

Abstract

Architectural physics is not only the basic course of architecture major, but also the support of architectural technology science. The suitable teaching method is the key to improve the teaching effect of architectural physics. This study takes the teaching innovation method of architectural physics as the goal, introduces the teaching idea of flipped classroom, and constructs flipped classroom teaching model of architectural physics. The basic photometric unit in the basic knowledge of architectural optics and its application are taken as an example to carry out empirical research. The result shows that, compared with the traditional classroom, flipped classroom is inclined to the deep learning, and the student's comprehensive ability is significantly higher than the traditional class. This study provides a reference for enriching the teaching methods of architectural physics and improving the teaching quality of architectural physics.

Keywords

Flipped Classroom • Architectural Physics • Teaching Model • Teaching Design

---

* This work has been supported by Chongqing basic science and frontier technology research project, Research on the influence of air pollution on daylight environment in Chongqing. CSTC 2015jcyjBX0121; Project supported by the National Natural Science Foundation of China (Grant No. 51878089) Research on the daylight environment impact of air pollution -A case study of Chongqing.

[1] **Correspondence to:** Ying He, Faculty of Architecture and Urban Planning, Chongqing University, Chongqing 400045, China; Key Laboratory of New Technology for Construction of Cities in Mountain Area, Chongqing University, Chongqing 400045, China. Email: he_ying@cqu.edu.cn

[2] Faculty of Architecture and Urban Planning, Chongqing University, Chongqing 400045, China. Email: Zhangwer@126.com

[3] Faculty of Architecture and Urban Planning, Chongqing University, Chongqing 400045, China; Key Laboratory of New Technology for Construction of Cities in Mountain Area, Chongqing University, Chongqing 400045, China. Email: Wujing234@sina.com

[4] Faculty of Architecture and Urban Planning, Chongqing University, Chongqing 400045, China; Key Laboratory of New Technology for Construction of Cities in Mountain Area, Chongqing University, Chongqing 400045, China. Email: Xujingfeng@126.com

Citation: He, Y., Zhang, X. S., Wu, J., & Xu, J. F. (2018). Innovation Method of Architectural Physics Teaching Based on Flipped Classroom Idea. *Educational Sciences: Theory & Practice, 18(6),* 3392-3399. http://dx.doi.org/10.12738/estp.2018.6.245

Along with the continuous improvement of economic and material living standards in recent years, the functions of buildings have become complicated and diverse. However, whether buildings can provide a comfortable, safe, healthy and energy-saving environment to reflect the people-oriented idea is still the concern for buildings and one of the criteria for judging outstanding architectural works (Dobrogowski, Maziewski & Zablotskii, 2007). Architectural physics is to make architectural acoustics, optics and thermotics meet people's material and spiritual requirements by means of engineering technology from the point of view of people's physiology and psychology, creating a comfortable environment for people (Gröber & Jodl, 2010). It is the key and difficult point of architectural physics teaching to adopt what kind of teaching method to make students master the basic knowledge of architectural physics and improve the comprehensive design ability.

At present, most of the teaching methods for architectural physics in colleges and universities are mainly teaching style supplemented by experimental teaching of relevant teaching contents. In the teaching method, interaction between teachers and students lacks, students are in a passive learning state and teachers are in the dominant position. Students don't know how to put what they have learnt into practice even if they master the knowledge (Critz & Knight, 2013). In the 1990s, in order to promote the absorption and internalization of students' learning, Mazur created a teaching model of helping each other. Is also the rudiment of flipped classroom teaching model (Galway, Corbett, Takaro, Tairyan & Frank, 2014)? In 2007, two chemistry teachers, Aaron and Jonathan Bergmann, subverted the traditional teaching model by uploading recorded videos of their teaching. This has received the unexpected teaching result, thus promoting the popularization of flipped classroom instruction teaching model. In 2011, the speech of "let us use videos to recreate the education" made flipped classroom popular around the world (Mclean, Attardi, Faden & Goldszmidt, 2016). At the beginning of 2012, the researches on flipped classroom model begun to appear in China. The research content also developed from the single theoretical research and teaching model research to the integration with the specific subject. The typical examples are Zhang Xinlei's "Study on Flipped Classroom Teaching Model", Sun Aiqing's "Ten Cases of Flipped Classroom" and Zeng Mingxing's "Study on flipped Classroom Teaching Model of Software Development Course" (Smith & McDonald, 2013). However, it is found that there are few papers on flipped classroom in China at present and the researches on the integration of architectural physics and flipped classroom are even fewer.

Based on the above analysis, this study tries to explore the teaching innovation methods of architectural physics on the basis of the concept of flipped classroom through reading the relevant references of flipped classroom at home and abroad. This study first expounds the relevant concepts and basic teaching model of flipped classroom, and constructs flipped classroom teaching model of architectural physics combined with the actual situation of the courses of architectural physics. The basic photometric unit and its application in the basic knowledge of architectural optics are taken as an example for course design. The method of contrastive analysis is adopted to verify that the teaching method of architectural physics based on the idea of flipped classroom is conducive to improving the classroom teaching effect.

Relevant Theoretical Basis of Flipped Classroom

Concept of flipped classroom

Flipped classroom (Pillay, Buffler, Lubben, & Allie, 2008) is based on the theory of zone of proximal development, the theory of constructivism, the theory of humanism and the theory of discovery, breaks the traditional teaching model of teachers' teaching and students' exercises after class, and turns into the students' self-learning through the tasks sent by the teachers and the teaching materials uploaded in advance. Then the related learning tasks are completed together by the teachers and students in class. The essence of flipped classroom is the flipping of teaching ideas and thoughts. It is the teaching method to increase teacher-student interaction and turn teaching from teacher-centered to student-centered (Edelson, 1996).

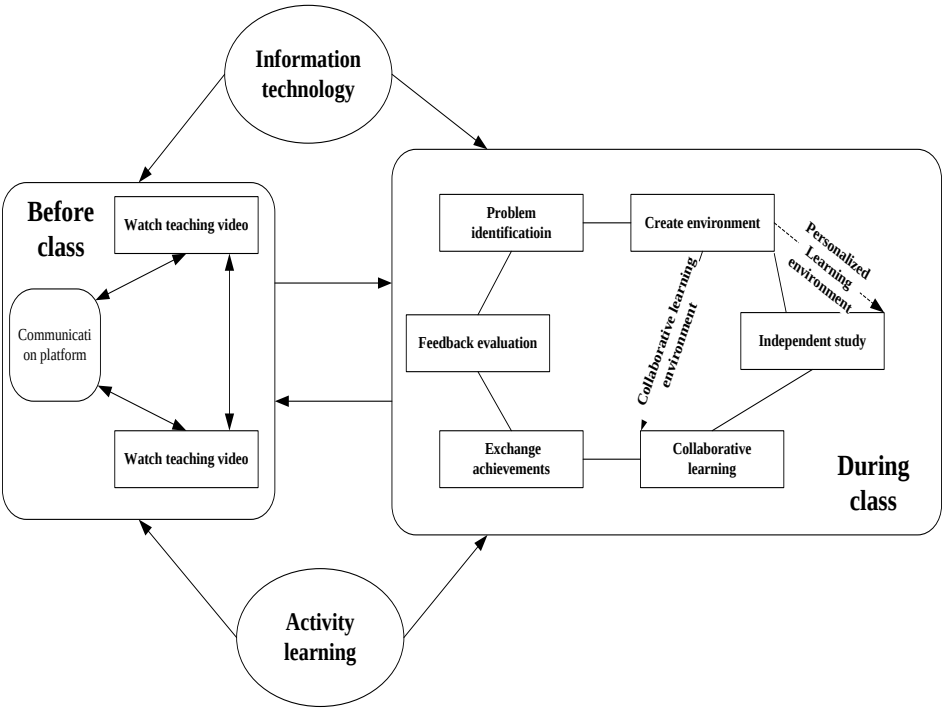

Figure 1. More perfect flipped classroom model.

Flipped classroom teaching structure model

Different scholars at home and abroad have designed different flipped classroom teaching structure models, among which a typical four-stage model composed of experiential learning, concept exploration, meaning construction and display application was put forward by Gerstin. Professor Robert Talbert proposed a two-stage, five-step flipped classroom teaching model (Attoe & Mugerauer, 1991). Zhang Jinlei *et al.*, constructed

a relatively perfect flipped classroom teaching model on the basis of referring to the foreign flipped classroom teaching model (Livingston, 2000), as shown in Figure 1.

Design and Implementation of Architectural Physics Teaching Based on Flipped Classroom Concept

Flipped classroom teaching model of architectural physics

In combination with the concept of flipped classroom teaching and flipped classroom teaching model put forward by experts and scholars in the past, this study puts forward a architectural physics flipped classroom teaching model composed of three stages of before, during and after class combined with the actual situation of architectural physics course, as shown in Figure 2.

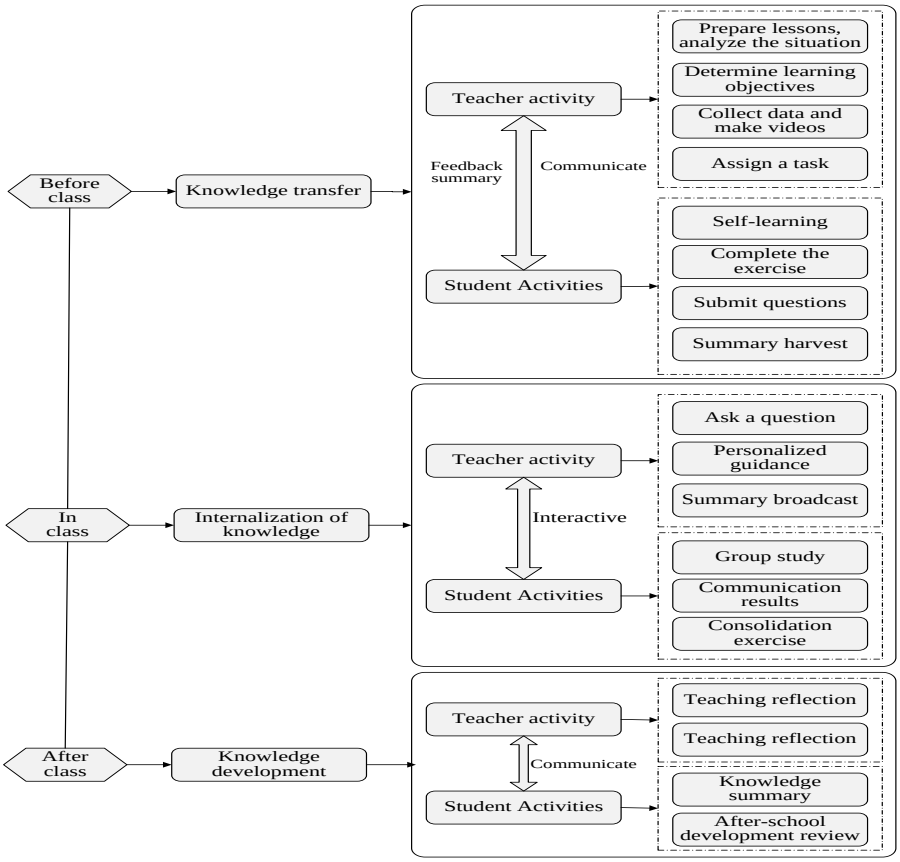

Figure 2. Architectural Physics Flipped Classroom Teaching Model.

Design and implementation of architectural physics teaching based on flipped classroom concept

Design and implementation of architectural physics teaching based on flipped classroom concept: In this study, the basic photometric unit and its application in the basic knowledge of architectural optics are chosen as an example, and the teaching design is carried out according to the teaching model of architectural physics flipped classroom. The specific contents are as follows:

(1) Before class: The teacher prepares lesson according to the actual conditions of the students, and determines that the main content of this lesson is to master the basic concepts and calculation methods of luminous flux, luminous intensity, illuminance and brightness and to understand the relationship between luminous intensity and illuminance, as well as the relationship between illuminance and brightness. Then the teacher will upload the prepared video and courseware for students to learn. Figure 3 shows video screenshots made by the teacher. Then the teacher arranges relevant learning tasks, as shown in Figure 4. Illuminance of point 1 and point 2 under a 40 w incandescent lamp will be drawn. Before class, students carry out self-learning according to the teaching materials and learning tasks provided by the teacher, complete relevant exercises, record the problems encountered in the learning process, and summarize the learning results.

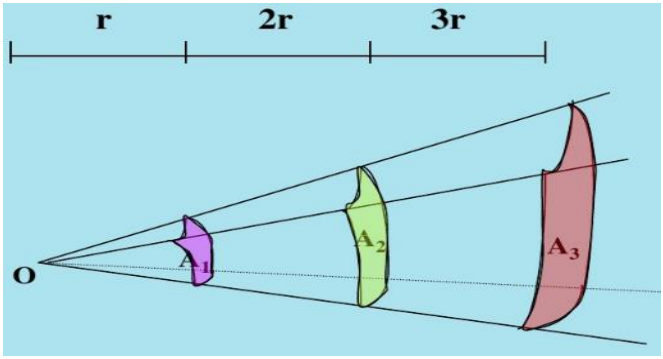

Figure 3. Point source forms the concept of illuminance.

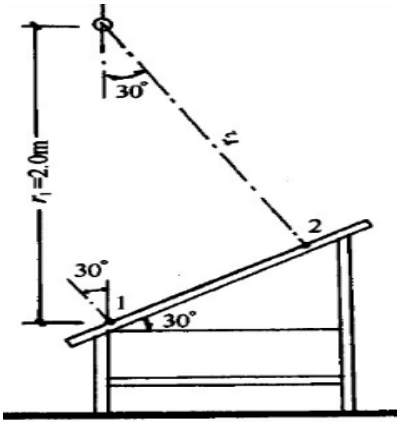

Figure 4. Teacher-arranged tasks.

(2) During the course: The students report the learning situation in groups, and exchange and discuss the problems with each group of students, and the teacher checks the self-learning of the students. According to the problems that students encounter in the learning process and the group cooperative learning, the teacher provides guidance explanation and personalized guidance while summing up the course content. In the whole process, students change from passively accepting knowledge to actively exploring knowledge, which improves students' enthusiasm for learning and makes them complete the internalization of knowledge.

(3) After class: According to the teaching situation of this lesson, the teacher will reflect on the teaching, find out the deficiency in the teaching process, adjust and improve the teaching plan and teaching method. On the basis of group cooperative learning and teacher's explanation, students summarize the learned knowledge, and finish the corresponding after-class review and knowledge expansion so that the learned knowledge is further sublimated.

Investigation on the teaching effect of architectural physics based on flipped classroom idea: To improve the learning effect is the main focus of the innovation and reform of teaching methods. Therefore, this study chooses the students of School of Architecture in a university to make a contrastive analysis of the learning effect between the teaching reform class and the traditional class.

(1) Flipped classroom learning model is inclined to deep learning

The learning style can be divided into four dimensions: deep motive and strategy, shallow motive and strategy. From the statistical analysis of the learning style of the two classes, it is found that there are significant differences between the two classes' deep motive. The deep motive is generally adopted by the flipped classroom class, and the deep strategy score of flipped classroom class is 0.287 higher than that of the traditional teaching class.

(2) The comprehensive ability is significantly higher than that of traditional class

This study mainly evaluates and examines the learning effect of students from six aspects except academic achievement: good learning habit, problem analysis, problem solving, team cooperation ability, professional academic ability and overall satisfaction. The results are shown in Table 1.

Table 1
Flipped Classroom and Traditional Classroom Learning Results

Dimension	Flipped classroom		Traditional classroom		t
	Average value	Standard deviation	Average value	Standard deviation	
Good study habits	3.826	0.754	3.341	0.967	2.336**
Analyse problem	4.125	0.876	3.448	0.859	3.406**
Solve the problem	4.016	0.822	3.612	0.819	2.248*
Team work	4.000	1.000	2.708	1.065	4,678*
Professional academic ability	3.801	1.049	3.314	0.873	2.258*
Overall satisfaction	4.08	0.957	3.314	0.699	4.449**

It can be seen from the table that in the survey result of students' satisfaction with the classroom, the flipped classroom is significantly higher than that of the traditional class and the difference of the students' ability of problem analysis and team cooperation under the other two teaching models is also significant. It shows that

flipped classroom teaching model can arouse the enthusiasm of students to study, improve the comprehensive quality of students, and achieve better teaching effect.

Conclusions

(1) This study introduces the concept of flipped classroom and explores the innovation methods of physics teaching based on the concept of flipped classroom. The concrete conclusions are as follows:

Based on the analysis and research on the concepts and teaching model of flipped classroom, a flipped classroom teaching model of architectural physics based on the flipped classroom concept is constructed.

(2) The basic photometric unit and its application in the basic knowledge of architectural optics are taken as an example and the course is designed and implemented in detail according to the flipped classroom teaching model of architectural physics designed in this study.

(3) Through the contrastive analysis, it is found that the students who adopt the flipped classroom teaching method are inclined to deep learning, and their comprehensive ability is significantly higher than that of the traditional class. It shows that the teaching method of architectural physics based on flipped classroom plays an important role in improving teaching effect.

References

Attoe, W., & Mugerauer, R. (1991). Excellent studio teaching in architecture. *Studies in Higher Education, 16*(1), 41-50. http://dx.doi. org/10.1080/03075079112331383081

Critz, C. M., & Knight, D. (2013). Using flipped classroom in graduate nursing education. *Nurse Educator, 38*(5), 210-213. http://dx.doi. org/10.1097/NNE.0b013e3182a0e56a

Dobrogowski, W., Maziewski, A., & Zablotskii, V. (2007). Remote teaching experiments on magnetic domains in thin films. *European Journal of Physics, 28*(1), 71-71. http://dx.doi. org/10.1088/0143-0807/28/1/008

Edelson, D. C. (1996). Learning from cases and questions: The Socratic case-based teaching architecture. *Journal of the Learning Sciences, 5*(4), 357-410. http://dx.doi. org/10.1207/s15327809jls0504_3

Gröber, S, & Jodl, H. J. (2010). A collection of problems for physics teaching. *European Journal of Physics, 31*(4), 735-739. http://dx.doi. org/10.1088/0143-0807/31/4/004

Galway, L. P., Corbett, K. K., Takaro, T. K., Tairyan, K., & Frank, E. (2014). A novel integration of online and flipped classroom instructional models in public health higher education. *BMC Medical Education, 14*(1), 181. http://dx.doi. org/10.1186/1472-6920-14-181

Pillay, S., Buffler, A., Lubben, F., & Allie, S. (2008). Effectiveness of a GUM-compliant course for teaching measurement in the introductory physics laboratory. *European Journal of Physics, 29*(3), 647.

Livingston, K. (2000). When architecture disables: Teaching undergraduates to perceive ableism in the built environment. *Teaching Sociology, 28*(3), 182-182. http://dx.doi. org/10.2307/1318988

Mclean, S., Attardi, S. M., Faden, L., & Goldszmidt, M. (2016). Flipped classrooms and student learning: not just surface gains. *Advances in Physiology Education*, *40*(1), 47-55. http://dx.doi.org/10.1152/advan.00098.2015

Smith, C., & McDonald, K. (2013). Flipped classroom for professional development: Part ii. making podcasts and videos. *Journal of Continuing Education in Nursing*, *44*(11), 486-487. https://dx.doi.org/10.3928/00220124-20131025-93