Flipped Classroom Teaching Method of Computer-Aided Design Course for Art Design Specialty

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Abstract. Computer aided design course is an important basic course for art design majors. According to the characteristics of specialty, students and course content, two flipped classroom teaching methods suitable for cultivating students' conception and creativity are designed, and their application is analyzed. The results of computer aided design show that the two flipped classroom teaching methods are beneficial to reduce the pressure of students' centralized learning and fragmented learning, which is in line with the professional cognitive characteristics of art and design students.
Keywords: Computer aided design; art design specialty; flipped classroom; teaching method
DOI: https://doi.org/10.14733/cadaps.2022.S8.86-95

1 INTRODUCTION

Art design majors include art design, visual communication design, environmental design and other majors. The knowledge system covers professional subject knowledge, modern tool use ability, professional practice ability and so on. Among them, the ability to use modern tools mainly is the ability of computer aided design. The formation of students' general knowledge, design and painting ability is based on the accumulation of junior high school and high school education, and they continue to study in depth at the undergraduate stage [1,2]. The cultivation of computer aided design ability mainly comes from the stage of undergraduate education. The author investigated art and design graduates. From the feedback results, the knowledge system of computer-aided design course lags behind the employment needs in the design field, the renewal range of course content is small, and the teaching methods are far away from the cognitive characteristics of students at this stage [3].

Creativity is the soul of design, which is especially evident in art and design majors. Art design is different from pure art. It is an art that integrates art with technology, aesthetics, modeling, color, and design. It enables students to innovate in art design through the cultivation of art design thinking ability, design methods and basic training of design skills [4,5]. Basic quality of

design, the popularization of multimedia network makes computer a good helper for art design, and makes science and art design combine more closely and perfectly.

As a new teaching mode, flipped classroom is suitable for the teaching of computer courses and conforms to the cognitive characteristics of art and design students. Flipped classroom refers to that students use the network to complete online learning of knowledge, take the offline classroom as a space for teachers and students to communicate, and complete the links such as proposing questions or doubts of the knowledge, which can achieve good educational goals [6]. By flipping the classroom and transferring the decision-making power of learning from teachers, students can like the classroom learning. MOOC and micro-lesson are two different ways to realize flipped classroom, which are suitable for different teaching contents. Asiksoy and Zdamli [7] adopted the flipped classroom teaching method based on MOOC, and discussed in detail the learning thinking method of art design majors under computer aided design, which is significant and important. For art design majors, Sohn et al. [8] improved the self-learning and innovation ability of students based on computer aided design and micro-lesson flipped classroom teaching method. Aiming at the problems of poor learning initiative and weak logical thinking ability of students majoring in art and design, Whelan et al. [9] adopted the computer-aided design teaching resource library course, which improved the students' learning enthusiasm. Adams et al. [10] fully combined the artistic concept and computing operation technology, and explored a teaching method suitable for art and design majors based on the flipped classroom teaching method, which greatly increased the learning efficiency of the classroom. Zhang et al. [11] compared the learning enthusiasm and classroom effect of students majoring in art and design based on the two flipped classroom teaching methods of MOOC and micro-lesson, which has good positive significance. In general, this paper explores the flipped classroom teaching model of computer aided design course from the characteristics, student characteristics, course characteristics and teaching method design.

2 ART AND DESIGN MAJORS AND THEIR COMPUTER AIDED DESIGN COURSES

This paper studies the implementation of flipped classroom teaching in the computer-aided scientist course for students majoring in art. From the perspective of students' characteristics and curriculum characteristics, it is suitable for the implementation of flipped classroom.

2.1 Characteristics of Students Majoring in Art and Design

(1) The cultural foundation is relatively weak, and the specialty of art specialty is prominent

Art majors began to study art courses independently at the middle school stage. Their artistic professional ability and artistic thinking ability have been strengthened in design practice, showing that they have stronger independent consciousness, richer social experience and stronger social practice ability than college students of other majors. Teachers should tap students' learning interest, learning initiative and learning efficiency.

(2) Attention persistence is weak, which is suitable for multiple knowledge acquisition

In the Internet age, students are more accustomed to multi-dimensional stimuli such as images, sounds and videos. In addition to paper media, students' knowledge acquisition is also an important way of knowledge acquisition, such as moke, microblog and circle of friends. Knowledge acquisition presents a diversified trend. In this context, the self-discipline of students majoring in art and design is not strong, and the phenomenon of sustained and short attention is more obvious. Therefore, we should combine students' attention characteristics and technological development to promote multimedia teaching or flipped classroom teaching in art and design majors.

2.2 Characteristics of Computer-Aided Design Course

(1) Overview of computer aided design course

Computer aided design refers to the course of using computer tools to complete the training of composition or drawing and realize the rapid performance of design. The main task of the course is to practice computer painting creation in the field of art design, use computer painting methods to carry out creation, and realize the combination of multimedia technology and art. The series of courses include "computer drawing", "computer aided design and manufacturing", "computer aided design practice" and other courses. Among them, "computer drawing" mainly teaches the operation of two-dimensional drawing AutoCAD software, "computer-aided design and manufacturing" mainly teaches the basic principles of computer-aided design, "computer-aided design practice" mainly teaches Three-dimensional Software Solidworks.

Computer aided design courses have changed the traditional art design, which has a large amount of drawing and low efficiency. There are problems that the design inspiration loses the original creativity due to the long creation time, which restricts the quality and quantity of works. In addition, the software is convenient for designers to express their abstract thinking in two-dimensional, three-dimensional and other planes and spaces. The improvement of the efficiency of course practice teaching can well show students' art skills and completely reproduce the design idea of works.

(2) Computer aided design course is suitable for flipped classroom

The completion of computer aided design course can be the realization of artistic creativity, which requires not only students' in-depth thinking, but also a high level of computer operation. Talent training programs in the universities generally require reducing class hours and credits. In many cases, classroom teaching can only complete one of two-dimensional or three-dimensional drawings. The situation faced by students majoring in art and design is that the software is constantly upgraded, and the learning content needs to increase the depth and scope of application. For example, dynamic blocks in the advanced application part of AutoCAD, user interface customization and related contents of secondary development. Using platforms such as "China university MOOC" and "geek college", combined with online courses, micro courses or video courses developed by teachers themselves, we can timely impart innovative design concepts, exchange learning experience, realize unlimited shared resources, diversified forms of graphic information, and rapid performance of homework drawings. Therefore, the efficiency of classroom teaching will be greatly improved.

3 FLIPPED CLASSROOM TEACHING METHOD OF COMPUTER AIDED DESIGN COURSE

3.1 Implementation Path of MOOC based Flipped Classroom

Flipped classroom changes the essence of students' passive learning by changing students' learning methods. In the implementation process, teachers usually organize the knowledge system and knowledge points in advance. Students learn before class through the Internet and reference materials, deduce, verify and construct knowledge around the knowledge points, and make ppt micro courses for display in class. Teachers answer questions in class or after class, guide students to study independently and stimulate students' innovative spirit. Make use of the breadth of the Internet and the depth of classroom inquiry to cultivate students' "active inquiry" and better get the absorption. The implementation path of flipped classroom is as follows. Figure 1 is the flipped classroom method based on MOOC.

(1) Teachers prepare before class, make MOOC or micro-lesson and complete knowledge point solution, and students study before class.

(2) Communication between teachers and students during or after class. Teachers control the learning process and participate in discussions.

(3) Classroom teachers should manage the curriculum system, analyze the key knowledge points deeply, and assign the learning content of the next stage.

(4) After class evaluation, summarize students' excellent achievements, evaluate and share them.

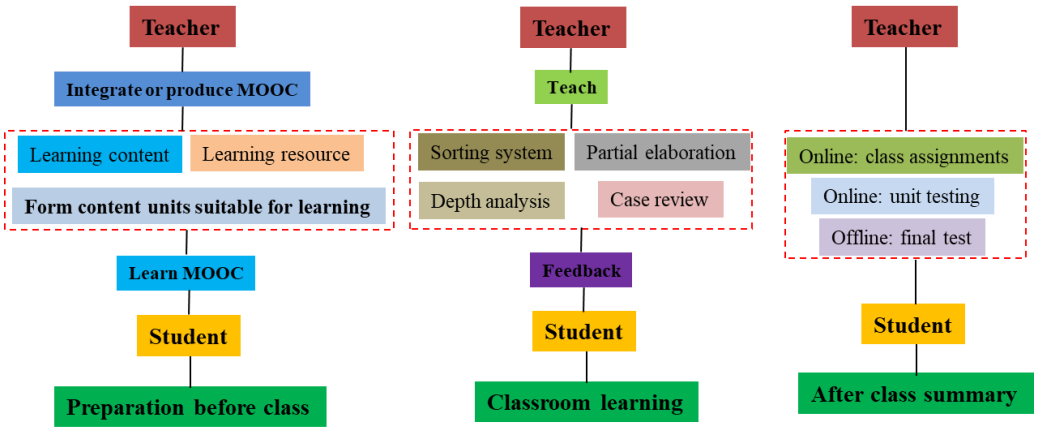

Figure 1: The flipped classroom method based on MOOC.

3.1.1 *Preparation before class*

Before class, teachers need to carefully integrate learning contents and learning resources to form teaching units suitable for MOOC learning. We can learn from the MOOC of Chinese universities using the "love course" network, or develop MOOC by ourselves. For achieving good learning results, we need to understand students' learning motivation, cognition and learning requirements, in order to analyze students' learning style, the integration of learning content should be based on the teaching objectives, refer to the teaching materials used in teaching classroom.

3.1.2 *Classroom learning*

According to the knowledge units integrated before class, refine the good teaching objectives of the knowledge, determine the specific teaching form, and carefully design the classroom teaching content. In the MOOC based flipped classroom teaching model, teachers focus on four aspects. First, sort out the knowledge system. Students' online MOOC learning is usually difficult to grasp the whole picture of the course. It is a macro work in teaching to strengthen students' understanding of the course through the clarification and deepening of the knowledge system. Second, part of the intensive talk is important. For the difficult, key or wonderful parts of the course, teachers further internalize the core knowledge through intensive lecture and analysis, which is the micro work in teaching. Third, deep learning is necessary. Online MOOC learning more reflects the width of knowledge. Classroom explanation is deepened on the basis of width to realize the unity of depth and breadth of teaching content. Fourth, case reviews. This case can come from MOOC, or it can be a case completed by students or collected and sorted by teachers. Through comments, the teaching content can be completed from theory to application practice.

3.1.3 *After class summary*

After teachers publish their homework online or offline, students complete it with the help of MOOC platform. For some difficult or valuable questions, students can complete them through video learning, discussion group communication and teacher Q & A. Gain or experience in the learning process, and share with other students through online forum groups.

Another task after class is learning evaluation. Students' learning effect can be combined with formative evaluation and summative evaluation. Formative assessment covers the completion quality of homework, the score of course test and the performance in the discussion group. Students' summative evaluation is realized through online completion and offline examination. The comprehensive evaluation method systematically examines students' learning performance, which is conducive to mobilize learners' enthusiasm to participate in learning activities and grasp students' learning process.

3.2 Implementation Path of Flipped Classroom based on Micro-lesson

The practical operation of computer aided design courses is suitable for fragmented learning. According to the characteristics of the teaching content and some typical flipped classroom cases, a micro-lesson flipped classroom method suitable for the operation process is designed according to the three links of preparation before class, classroom learning and after class summary, as shown in Figure 2.

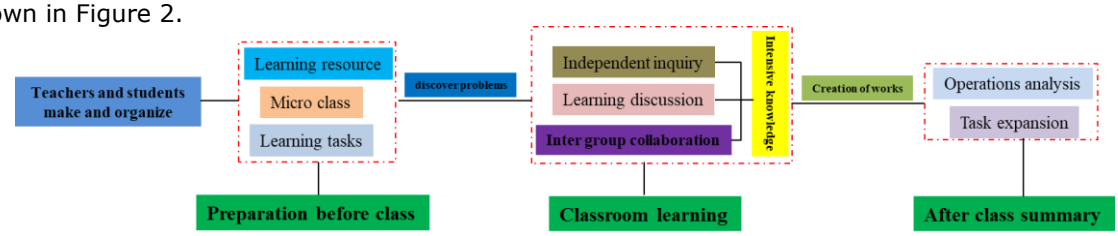

Figure 2: The flipped classroom method based on micro-lesson.

3.2.1 *Preparation before class*

Teachers sort out the course teaching units according to the teaching objectives, and further separate the content suitable for micro course teaching. After that, collect learning resources and complete the design and recording of micro courses. The video of the micro-lesson should reflect the key points of operation, technical essentials and other prompt information for students to grasp. Both teachers and students can participate in the production of micro-lesson record. The complex content is completed by professional recording personnel, and the simple content can be realized by teachers and students through screen recording software. In the pre class preparation, teachers also need to set or assign learning tasks.

3.2.2 *Classroom learning*

In classroom teaching, we should focus on solving the problem of feedback in the process of completing learning tasks. According to the content of the problem, we can organize inquiry teaching or discussion teaching; After sorting out the relevant knowledge points, according to the difficulty of the teaching content, students or independent exploration or group cooperative learning, teachers or ticket checking students practice the operation or communicate and discuss with students, and carry out appropriate individual counseling or collective explanation; Finally, complete the task, form learning works, and realize the construction and internalization of knowledge (skills).

3.2.3 *After class summary*

According to the feedback of assigned homework, teachers comment on homework, and analyze and summarize excellent works. At the same time, teachers collect learning resources related to teaching contents for students to choose, so as to consolidate and expand knowledge.

3.3 Application of Flipped Classroom in the Classroom Teaching

Firstly, under the guidance of clear teaching objectives, use multimedia tools to process the classroom teaching content, so that teachers can transform images, videos and other forms into digital teaching resources with pictures and texts while explaining knowledge points, so that students can obtain the situational experience of teaching projects and stimulate students' interest in learning. In the process of teaching design courses, many design works cannot be described in language. Through video and picture display, present the design process, so that students can not only understand the design results, but also understand the design process, that is, how to design from the initial concept to the completion of the sketch, then to the first draft and the completed draft of the design, and finally present the design works. Such an intuitive demonstration can better enable students to understand the details of design, the parts that need to be paid attention to in design, the key points in design, and further understand the thinking mode of design.

Secondly, with the development of teaching concepts, students become the core of teaching, and the use of online studying resources can obtain different learning materials, strategies and methods suitable for their characteristics. Network resources are not only an tool for the teachers to explain, but also become an important tool for students to learn.

Finally, let students improve their practical ability by directly participating in design projects. Flipped classroom can enable students to understand the specific steps and skills required to participate in the implementation of the project in advance, and can directly reproduce the real enterprise atmosphere and design process to students through video. Adjust and design the syllabus of professional practical courses, adjust the proportion of teaching hours, and adjust the theoretical content and practical content to be more suitable for the requirements of flipped classroom. Change the teaching design scheme, make full use of the combination of digital curriculum resources learning and classroom teaching, guide students to independently study the design theory, design data collection, design basic software operation and other contents for teachers' classroom examination. The organization of classroom teaching content takes students as the main body, and carries out brainstorming, design creative discussion, design project production and other contents. The assessment method of students takes the design homework completed by students as the evaluation object, and takes students' innovative design ability as the core of the evaluation. Combine students' extracurricular learning with classroom learning, and invite industry experts to evaluate students' design works.

4 ANALYSIS OF APPLICATION EXAMPLES OF FLIPPED CLASSROOM IN COMPUTER AIDED DESIGN COURSE

The implementation of flipped classroom is not only the specific practice of flipped classroom concept, but also an important part of relevant research and application promotion. Based on the analysis of the teachers, contents and students of college art and design courses, the implementation of flipped classroom teaching is embodied in three aspects: pre class preparation, classroom learning and post class summary.

The change of computer-aided design simulation value with teaching time under different flipped classroom teaching methods is shown in Figure 3. It can be seen that with the increase of teaching time, the simulation value of computer-aided design shows a gradual decreasing trend, and the pre class preparation stage decreases rapidly, followed by the classroom learning stage, and finally the post class summary stage. This shows that the students attach great importance to the after-school summary in the flipped classroom. In addition, the computer-aided design simulation values of the three stages of MOOC teaching method are lower than those of micro-lesson teaching method, but there is little difference between them, indicating that the two teaching methods can well reflect the teaching effect of flipped classroom.

Figure 4 shows the scores obtained by computer aided design in the process of different flipped classroom teaching methods. It can be seen that the scores of computer-aided design in the three learning stages are higher than 70, and the scores in the after school summary stage are the highest. Compared with MOOC teaching method, micro-lesson teaching has a higher score in the pre class preparation and after class summary stage, while the score in the classroom learning stage is slightly lower, which shows that micro-lesson teaching method can better reflect the learning situation of art and design majors, enable them to obtain knowledge, skills and emotional experience, and cultivate their inquiry ability and application ability.

Figure 5 shows the application rate of computer aided design in different flipped classroom teaching methods. It can be seen that the application rate of classroom learning stage in MOOC based flipped classroom teaching method is the highest, followed by the preparation before class and after class summary stage. The application rate of the pre class preparation stage in the flipped classroom teaching method based on micro-lesson is the highest, followed by classroom learning and after class summary.

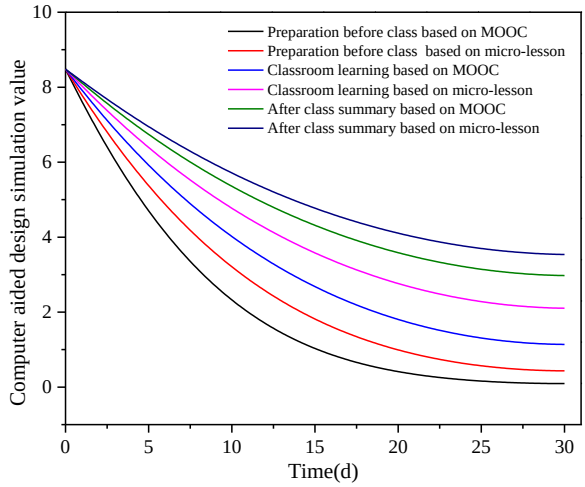

Figure 3: Changes of computer aided design simulation value with teaching time under different flipped classroom teaching methods.

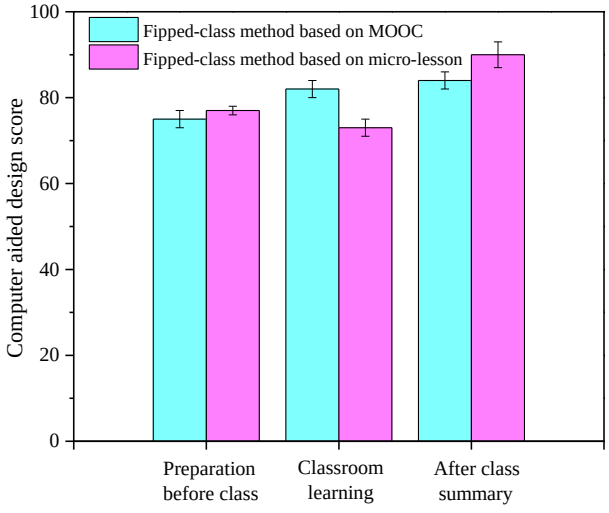

Figure 4: Computer aided design scores in different flipped classroom teaching methods.

The above results show that the flipped classroom teaching method based on MOOC focuses more on classroom learning, which is conducive to the teachers to seriously impart new knowledge in the classroom and make the students love learning. The flipped classroom teaching method based on micro-lesson pays more attention to the preparation before class. After careful preparation, students can understand the content learned in class and help students learn better.

Based on different flipped classroom teaching methods, the proportion of scores in computer-aided design is shown in Figure 6. It can be seen from this that the proportion of the post class summary stage in the MOOC based on flipped classroom teaching method is the highest, and the proportion of the scores of classroom learning is the lowest, but the proportion of the scores of the three learning stages is very close. In the flipped classroom teaching method based on micro-lesson, the score in the classroom learning stage accounts for the highest proportion, and the lowest proportion is the pre class preparation stage.

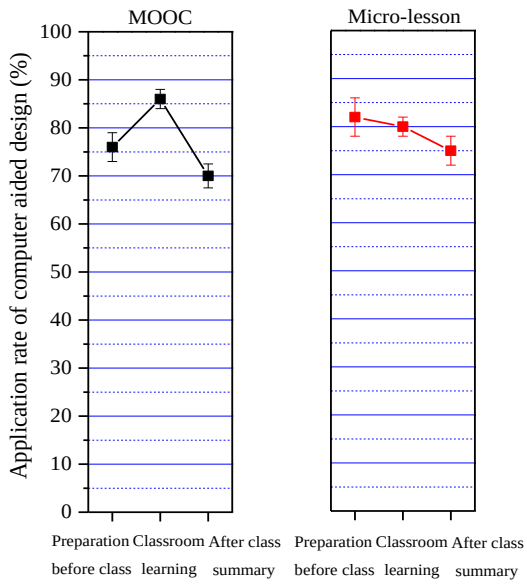

Figure 5: Application rate of computer aided design in different flipped classroom teaching methods.

Compared with the application rate of computer aided design based on different flipped classroom teaching methods (Figure 5), it can be seen that the higher the application rate of computer aided design, the lowest proportion of scores is in the learning stage, which shows that in the early application stage, students are well prepared for preview, and the corresponding proportion of scores should also be reduced, so as to promote them to learn the stage in which they have not carefully prepared, This is more conducive to the balanced development of students.

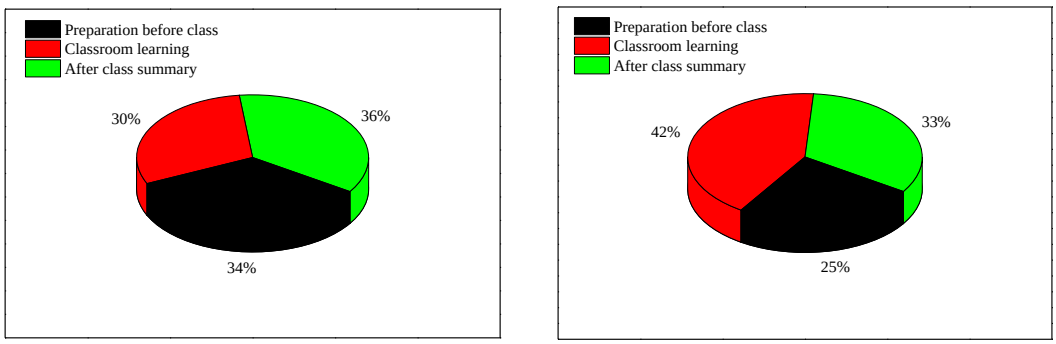

Figure 6: Proportion of scores in computer aided design in different flipped classroom teaching methods.

Figure 7 shows the discrete distribution of computer aided design in different flipped classroom teaching methods. By investigating 100 students, whose major is art and design, their discrete distribution is obtained. It can be seen that the discrete distribution of the two flipped classroom teaching methods is similar, both floating in a range, indicating that the students agree with the two flipped classroom teaching methods, which is helpful to the students' learning. By flipping the classroom, students can learn some basic teaching contents on the intelligent vocational education

platform and promote students' professional development. Through the construction of computer aided design course, the professional ability of students majoring in art and design has been greatly improved, and they focus on the cultivation of innovative design ability.

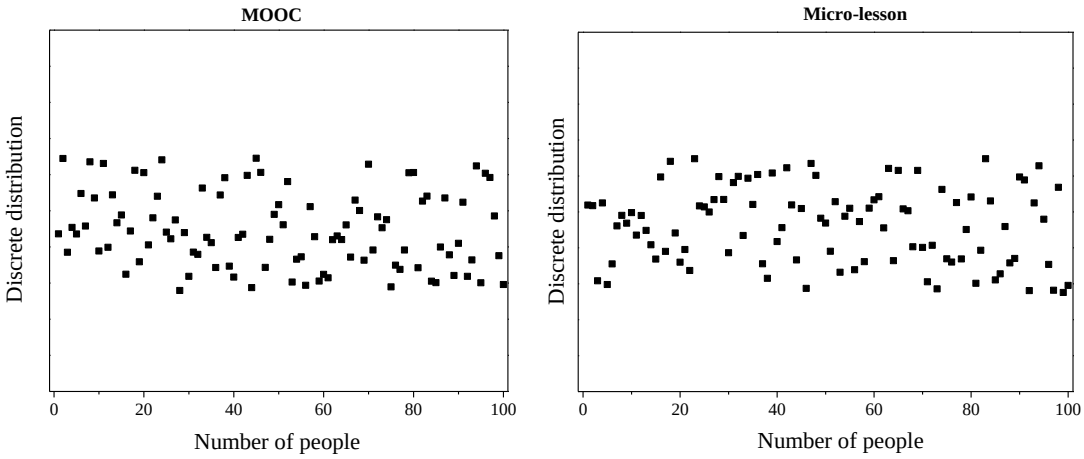

Figure 7: Discrete distribution of computer aided design in different flipped classroom teaching methods.

5 CONCLUSION

Combined with the characteristics of art design specialty, this paper designs two flipped classroom teaching methods of computer-aided design course. Based on the MOOC flipped course teaching method, teachers can make full use of the existing MOOC resources, reduce the pre class preparation slightly, and deeply excavate the fine explanation in class. Based on the flipped course teaching method of micro course, students need to make more micro courses before class, and then give full play to their subjective initiative in the classroom learning stage to carry out independent exploration and collaborative learning. In general, the two flipped classroom teaching methods are conducive to fragmented learning and internalization of knowledge, which is in line with the cognitive characteristics of art and design majors, and can be used as a reference for the teaching methods of other similar courses.

6 ACKNOWLEDGEMENT

The General Project of Humanity and Social Sciences in Universities of Henan Province 2021: Research on succession and development of imitation for black white porcelain in Henan Bacun kiln (Funding Number: 2021-ZZJH-275).

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REFERENCES

[1] Li, D.-H.; Li, H.-Y.; Li, W.; Guo, J.-J.; Zhong, L.-E.: Application of flipped classroom based on the Rain Classroom in the teaching of computer-aided landscape design, Computer Applications in Engineering Education, 28(2), 2020, 357-366. https://doi.org/10.1002/cae.22198

[2] Li, D.-H.; Jiang, B.-S.; Li, H.-Y.; Liu, X.-P.: Design of experiment course "Computer-aided landscape design" based on flipped classroom, Computer Applications in Engineering Education, 24(2), 2016, 234-240. https://doi.org/10.1002/cae.21701
[3] Chu, C.-H.; Xuan, T.-J.: Developing and evaluating a flipped corpus-aided English pronunciation teaching approach for pre-service teachers in Hong Kong, Interactive Learning Environments, 10(2), 2020, 1-14. https://doi.org/10.1080/10494820.2020.1753217
[4] Mita, Y.; Kawahara, Y.: 15-year educational experience on autonomous electronic information devices by flipped classroom and try-by-yourself methods, IET Circuits Devices & Systems, 11(4), 2017, 321-329. https://doi.org/10.1049/iet-cds.2016.0406
[5] Cotta, K.-I.; Shah, S.; Almgren, M.-M.; Macías-Moriarity, L.-Z.; Mody, V.: Effectiveness of flipped classroom instructional model in teaching pharmaceutical calculations, Currents in Pharmacy Teaching & Learning, 8(5), 2016, 646-653. https:// doi.org/10.1016/j.cptl.2016.06.011
[6] Allenbaugh, J.; Spagnoletti, C.; Berlacher, K.: Effects of a Flipped Classroom Curriculum on Inpatient Cardiology Resident Education, Journal of Graduate Medical Education, 11(2), 2019, 196-201. https://doi.org/10.4300/jgme-d-18-00543.1
[7] Asiksoy, G.; Zdamli, F.: Flipped Classroom adapted to the ARCS Model of Motivation and applied to a Physics Course, Eurasia Journal of Mathematics, Science and Technology Education, 12(6), 2016, 1589-1603. https://doi.org/10.12973/eurasia.2016.1251a
[8] Sohn, S.; Lee, Y.-M.; Jung, J.; Cha, E.-S.; Chun, B.-C.: The flipped classroom model for an undergraduate epidemiology course, Korean Journal of Medical Education, 31(2), 2019, 101-113. https://doi.org/10.3946/kjme.2019.122
[9] Whelan, A.; Leddy, J.-J.; Mindra, S.; Hughes, J.-D.; Bialy, S.-E.; Ramnanan, C.-J.: Student perceptions of independent versus facilitated small group learning approaches to compressed medical anatomy education, Anatomical Sciences Education, 9(1), 2016, 40-51. https://doi.org/10.1002/ase.1544
[10] Adams, A.-E.; Garcia, J.; Traustadottir, T.: A Quasi Experiment to Determine the Effectiveness of a "Partially Flipped" versus "Fully Flipped" Undergraduate Class in Genetics and Evolution, Cell Biology Education, 15(2), 2016, 1-11. https://doi.org/10.1187/cbe.15-07-0157
[11] Zhang, X.-M.; Yu, J.-Y.; Yang, Y.; Feng, C.-P.; Xu, S.-L.: A flipped classroom method based on a small private online course in physiology, AJP Advances in Physiology Education, 43(3), 2019, 345-349. https://doi.org/10.1152/advan.00143.2018